Robots for the Long Haul

There are 1.8 million heavy truck and tractor-trailer drivers in the United States. Will self-driving trucks soon mean the end of many of those jobs?

BY DAVID A. PRICE

In October 2016, a tractor-trailer loaded with about 52,000 cans of beer traveled 120 miles on I-25 from Fort Collins, Colo., to Colorado Springs.

That, in itself, was unremarkable. What made the trip historic is that there was no one in the driver's seat: A driver sat in the back of the cab while an automated system did the work. An on-board computer collected information on the truck's surroundings from video cameras, laser-based sensors, and radar, then used it to make decisions about steering, acceleration, and braking.

The beverage run was a demonstration of a self-driving truck system under development by San Francisco, Calif.-based Otto, founded in January 2016 by a team that included engineers involved with Google's self-driving car efforts and with Google Maps. The firm was acquired at the advanced age of eight months by Uber for a reported $680 million. Otto is one of a number of companies, both startups and established manufacturers, working on self-driving trucks; the projects are generally focused on automating long hauls on highways, with human drivers — at least for some time to come — riding along to take the wheel on local streets.

The promise: safer highways, as the systems can't get drowsy and, in theory, won't make mistakes; less fuel consumption, since the autonomous trucks can be programmed to keep to efficient speeds; and, depending on whom you talk to, perhaps lower labor costs — much lower. With the software in control from highway on-ramp to off-ramp, companies say, drivers will be able to take their required rest breaks in the sleeper berths of the cabs, allowing for close to 24/7 utilization of the trucks and fewer truck drivers. That, in turn, means cheaper transportation.

But it's a development that may repay close attention by policymakers and labor-market economists. Long-haul truck driving is among a dwindling number of jobs that pay a middle-class wage without requiring a college degree. According to the Bureau of Labor Statistics (BLS), some 1.8 million people, most of them driving long hauls, earn a living as drivers of heavy trucks and tractor-trailers, with a median income of more than $41,000.

It sounds like a lot of jobs, and it is. A 2015 study by researchers at the Philadelphia Fed, the Cleveland Fed, and the Atlanta Fed ranked the U.S. economy's "opportunity occupations," meaning the occupations paying at least the national median wage (adjusted for local price differences) and available to workers without a bachelor's degree. Looking at the nation's 100 largest metropolitan statistical areas, they found that 27.4 percent of employment was in opportunity occupations in 2014 — and in terms of the number of jobs in opportunity occupations, heavy and tractor-trailer truck driving ranked fifth. (Registered nurse jobs ranked first.) Overall, heavy and tractor-trailer truck driving made up one in eight jobs in opportunity occupations.

Should we be concerned?

An Industry Rolling Out

The impetus for the development of self-driving vehicles, both cars and trucks, came from the U.S. military after the turn of the millennium. The Defense Advanced Research Projects Agency, or DARPA, sponsored a "grand challenge" in 2004, offering a $1 million prize for the autonomous vehicle that was first to complete a course across 142 miles of desert from Barstow, Calif., to Primm, Nev. (In past decades, DARPA had provided seed money for the development of other technologies with military potential, including 3D computer graphics and a precursor of the Internet.) Fifteen vehicles started, but none finished; the most successful vehicle made it only 7.5 miles.

Progress came quickly, however: Another challenge the following year saw five vehicles out of 195 entrants finish a 132-mile course in Nevada. And in 2007, a third challenge set in a simulated environment of urban traffic yielded six finishers out of 11 contestants.

A decade later, while self-driving cars may get more of the headlines, self-driving trucks are the sought-after grail of development teams at around a half-dozen companies. In addition to Otto, the company behind the Colorado demonstration, Daimler's Freightliner division is developing and testing a self-driving semi truck, named Inspiration, that is licensed to operate on the roads of Nevada. PACCAR, maker of Kenworth, Peterbilt, and other truck lines, has announced a partnership with chip maker NVIDIA to develop self-driving trucks and has reported testing its first on a closed course. Two other Bay Area startups, Embark and Starsky Robotics, are road-testing self-driving semis. The latter firm plans to station truck drivers in a central location to supervise 10 to 30 trucks each and have them drive the trucks during the local portions of trips by remote control.

And large self-driving trucks from Caterpillar and Komatsu are being used at mine sites to haul mining loads. The latest generation of the Komatsu machine is headless — that is, it doesn't have a cab for a driver. Volvo Trucks

A semi truck outfitted for self-driving by Starsky Robotics operates in autonomous mode during a highway trip in February 2017.

is testing a self-driving truck in an underground mine in Sweden, where it operates in tunnels more than 4,000 feet below the surface.

Apart from the ones toiling at the mines, the self-driving trucks under development are designed to run autonomously on the highway portion of a long haul because highway driving is easier to automate.

"Highway driving is a lot simpler than driving around San Francisco," says Stefan Seltz-Axmacher, CEO and co-founder of Starsky Robotics. "Humans aren't great at doing repetitive tasks for long periods of time. Robots are really good at sustained boring tasks."

Attractions of Self-Driving Trucks

Behind these efforts is a bet that self-driving trucks will bring major cost savings. One category of potential savings is avoiding accidents; in 2015 alone, according to the National Highway Traffic Safety Administration, accidents involving large trucks killed 4,067 people and injured an estimated 116,000. Of the fatal crashes involving large trucks, 27 percent occurred on an interstate, where self-driving trucks could be expected to make a difference. Beyond the costs associated with lost lives and injuries, trucking companies and their insurers bear costs from vehicle damage, cargo delays, and more.

Still, it's not yet clear how much better self-driving trucks will do than their human counterparts: A Federal Motor Carrier Safety Administration study in 2008 found that in crashes between a truck and a car, the car or its driver was the cause 56 percent of the time, not the truck driver. And in 27 percent of car-truck accidents — whether attributed to the car or the truck — there were brake problems in the truck, a maintenance issue rather than a driver issue. Regardless of the exact amount of improvement, though, developers of the trucks see accident prevention as a major selling point.

Another is fuel savings. The American Transportation Research Institute found in a 2016 report that fuel costs in recent years have made up 30 percent to 40 percent of a motor carrier's operational costs on average, the largest line item — higher, even, than the loan or lease payments on the truck itself. Thus, even a modest 10 percent increase in fuel economy from more energy-efficient driving would translate into a significant payoff.

Then there are the drivers. Few believe that long-haul truck drivers will be replaced entirely; for the time being, and perhaps for a long time, they'll be needed to handle local roads and to deal with things like weigh stations, refueling, breakdowns, tire blowouts, and loading and unloading. But if the developers of self-driving trucks can make the trucks autonomous on the highways, and overcome the regulatory obstacles, the savings in salaries, benefits, and recruiting costs could be high. Morgan Stanley research estimated in 2013 that adoption of self-driving trucks could yield a two-thirds reduction in the number of drivers. Even if the shift leads companies to demand more technical skills in the remaining driver positions, leading to a 50 percent wage increase, Morgan Stanley estimated that the net result is still an elimination of around half of total labor costs, for a savings of roughly $70 billion industry-wide. The assumption of a wage increase, moreover, may be generous since the reduction in their actual driving time during a trip could push wages down.

The American Trucking Associations, a trade association of trucking companies and other truck fleet operators, has expressed skepticism about the technology's potential to displace drivers. "It's important technology," says Bob Costello, the organization's chief economist, "but we just don't think it gets rid of the driver anytime soon or even allows the driver to go back and sleep."

In Costello's view, self-driving trucks will make truckers' jobs a bit easier rather than replace them.

"Autonomous technology should make the highways safer for all vehicles," he says. "But aircraft have been autonomous in many ways for a long time, and you still have pilots in the cockpit. We think that is very much true for the foreseeable future for trucking."

But some proponents predict that automation will eliminate the need for truckers in the cab during the highway portions of trips sooner rather than later. "I think it's going to happen very rapidly," says Seltz-Axmacher. "The sight of a truck driving autonomously on an interstate will not be extraordinary in five years. It will be within that."

The Demise of White Line Fever?

The onset of self-driving trucks, if they live up to the labor-saving claims, presents a new instance of a question that has periodically confronted economists and policymakers for centuries: What, if anything, should the government do when equipment is displacing — or seems likely to displace — large numbers of workers? For the

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most part, the consensus answer historically has been: Do nothing to stand in the way of adoption of new labor-saving technology, because the displaced labor will find its way to more productive uses.

Yet some historical concerns about automation seem to have been partly vindicated. Tim Taylor, managing editor of the *Journal of Economic Perspectives,* has noted that while forecasts of rising unemployment have not come true, forecasts of increasing income inequality have to an extent. Since the 1980s, the U.S. economy has seen a pattern in which high-education, high-wage jobs and low-wage, low-education jobs have grown, while the share of employment in the middle — the routine jobs that have been the most susceptible to automation, such as production workers and clerical workers — has gone down, a trend known as "job polarization" or "hollowing out."

And in the short term, such changes mean painful adjustments for the displaced jobholders, notes Harvard University labor economist Richard Freeman.

"If you've been doing truck driving for 10 or 15 years, it's going to be harder for you to make investments in new kinds of skills," he says. "Traditionally, when people get laid off — the evidence is mainly for factory-type people — they take roughly a 20 percent cut in wages to find another job, they're not getting as good a job, and it can take six months to a year. So there is a big cost."

Another factor, Freeman says, is that self-driving trucks are just a part of a much larger movement toward robotics and other automation. "One of the things about the current technology is that the other jobs that you might have said people would go to are also being impacted."

Economists and others have put forward a number of proposals to reduce the effects of job loss from technological change, offshoring, and other structural forces. Beyond state unemployment insurance programs, these have included retraining and a universal basic income (that is, a guaranteed income paid by the government to all citizens regardless of need). In a paper published by the Brookings Institution in 2005, three researchers who were then with Brookings — Lael Brainard (now on the Fed's Board of Governors), Robert Litan, and Nicholas Warren — argued for a federal wage insurance program for all long-tenured workers who are permanently displaced; the workers would receive a wage subsidy for two years after landing a new job.

But there are optimistic scenarios for truck drivers. One is that truck driving jobs might follow the path of bank teller jobs after the introduction of automated teller machines (ATMs). During the period from 1980 to 2010, the number of bank tellers in the United States actually increased slightly even as ATMs proliferated, according to James Bessen of the Boston University School of Law. ATMs reduced the cost of bank branches, but banks did not simply pocket those savings. "Banks responded by opening more branches to compete for greater market share," Bessen wrote in a 2015 article in *Finance & Development*. "Bank branches in urban areas increased 43 percent. Fewer tellers were required for each branch, but more branches meant that teller jobs did not disappear."

Could the same happen in trucking? Michael Watson, a supply chain consultant and co-author of the 2012 book *Supply Chain Network Design*, says that self-driving trucks may change the economics of supply chains in ways that could mitigate — but probably not fully offset — the job losses. By reducing the cost of transportation, self-driving trucks might lead manufacturers to build more warehouses so they can give customers faster deliveries.

"A large manufacturer may have only two to five warehouses in the United States," Watson says. "One of the reasons is that it's expensive to store inventory in these facilities. And it's expensive to ship products to the warehouses. But if the transportation costs get cheaper with self-driving trucks, I can have a lot of little warehouses around the country and provide better service."

That, in turn, creates jobs in local delivery. Moreover, Watson says, many of the new short-haul jobs would likely be higher-value-added jobs, interacting with customers and collecting intelligence. According to the BLS, today's delivery drivers and driver/sales workers have a lower median income of $28,000, though that could change depending on how the role evolves.

"The analogy is companies like Coca-Cola and Pepsi that make deliveries into the grocery store," he suggests. "When the drivers make a delivery, they're stocking the shelves, making sure their shelves look right. They're also gathering competitive information. So when Coke goes in, they're looking at what Pepsi's doing and passing that information back. More companies will be able to do that when the economics of trucking change."

Self-driving trucks, Watson says, will be only the starting point for changes in the industry.

"Amazon's not going to just take the reduced transportation costs and call it a day," he contends. "They're going to use this to change service in a whole new way. Other companies will do the same." **EF**

Readings

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