FUTURE OF WORK COMMISSION

Convening 2 Technological Change and its Impact on Work

October 10, 2019

Stanford Design School
Palo Alto, CA

INSTITUTE FOR THE FUTURE

ABOUT INSTITUTE FOR THE FUTURE

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SCHEDULE OF CONVENINGS

1 | **September 10–11, 2019**
Overview: The Present and Future State of Work in California
Location: Sacramento

2 | **October 10, 2019**
Technological Change and its Impact on Work
Location: Palo Alto

3 | **November 14, 2019**
Education, Skills, and Job Quality
Location: Riverside

4 | **December 12, 2019**
Low-wage Work and Economic Equity
Location: Los Angeles

5 | **January 16, 2020**
Employment and Labor Law in the New Economy
Location: San Diego

6 | **February 13, 2020**
Social Policy, Work, and Economic Security
Location: Stockton

7 | **March 12, 2020**
Investors, Capital, and the Future of Work
Location: San Francisco

8 | **April 2, 2020**
Synthesis
Location: Sacramento

TECHNOLOGICAL CHANGE AND ITS IMPACT ON WORK

Technological change is a major driver of the changing nature of work. Though the scope of California's Future of Work Commission encompasses a wide range of substantive topics, there is little question that technological change is critical to the future of work. Current developments in automation, robotics, and artificial intelligence (AI) can profoundly reshape how we perform work, how we are managed, and the job opportunities available to workers.

Automation can replace routine tasks in many settings, from manufacturing to agriculture and even white-collar work. Advances in AI could optimize and substitute for decision-making by human workers. Algorithms are increasingly used to guide production, to match workers to available jobs, and to manage work. Algorithmic management is already emerging through the use of algorithms to set work targets, supervise worker performance, and to make hiring and firing decisions. Technological change clearly brings disruptions that will shape the future of work; indeed some of those are already here today, as was discussed in the opening convening and brought to light by Eric Guillen who described feeling dehumanized while working in a warehouse under the watchful eye of algorithmic surveillance.

While there are different perspectives on the impacts of technological change, there is notable pessimism and anxiety about the expected effects on jobs. The Pew Research Center recently found that 65 percent of Americans think that robots and computers will take over many jobs now done by humans (this figure was nearly 90 percent in Japan). Most do not expect to benefit from the replacement of jobs by automation and robots. Three out of four Americans think this shift will make economic inequality worse; only one in four believe that automation will lead to new, better-paying jobs in the economy.

On the other end, some express an optimistic view that technology can usher in a better world without work and more time for leisure and more room for human creativity and compassion.

There is a wide space between the optimistic and pessimistic views: technological change is likely to displace some jobs, and it also has the potential to produce new economic and social benefits. The effects of technological change are not inevitable or predetermined. The MIT Task Force on the Work of the Future makes clear that realizing the positive potential of technological change "depends on the institutions of governance, societal investment, education, law, and public and private leadership to transform aggregate wealth into greater shared prosperity instead of rising inequality." How to accomplish this is a central challenge for this Commission.

We have experienced major technological change and structural transformations in the labor market before. Earlier waves of technological change mechanized production, facilitated mass production, and incorporated electronics and information technology into the economy. Concerns about the threat of automation are certainly not new. The 1966 report of the National Commission on Technology, Automation and Economic Progress addressed the concern that technological change "would eliminate all but a few jobs with the major portion of what we now call work being performed by machine" and insisted that the "burdens and benefits of technological economic change should be distributed fairly."

TECHNOLOGICAL CHANGE AND ITS IMPACT ON WORK

Indeed, we are already seeing these changes today—self-checkout lanes at Target, touch-screen ordering at McDonald's, and the incorporation of algorithmic management in Amazon warehouses. This suggests that the early stages of technological change may most directly impact lower-paid jobs, especially in service sectors. We have also seen the advent of such technology deployed against low-wage workers who call for better working conditions and higher pay. The perceived tension between technology and job quality is another critical challenge for this Commission.

The effects of technological change on jobs are difficult to predict. Estimates of job displacement through automation vary widely. A review of studies estimating the effects of automation concluded that "there are about as many opinions as there are experts."

The effects of technology are more complex than whether it will entirely eliminate certain jobs. Recent research suggests that automation may replace specific *tasks* (especially the routine and repetitive), not necessarily replace entire *jobs*. Beyond automation, technological change can affect many other important aspects of work: the content of work, the distribution of work across social groups, the compensation of jobs, the organization of employment relationships, and how work is controlled and managed.

We do know that the effects will be uneven. Earlier waves of technological change show us that certain workers, jobs, and communities will be more vulnerable to displacement and other adverse effects than others. There will be important differences across industries and among workers, by education level, gender, and other characteristics. We can also anticipate significant geographic variation in the impacts of technological change across places, which is especially important in a large, varied state like California. The benefits of technological change will also be uneven. Just as rising productivity over the past four decades has not significantly improved earnings for typical workers, there is no guarantee that the productivity gains of the coming wave of technological change will benefit most workers.

The impacts of technological change will ultimately depend on policies and institutions that are shaped by government and others. Attitudes about technological change and automation are quite different in countries with different social policy regimes than the anxious or pessimistic discussions that we see in the U.S. This suggests that technology itself is not necessarily the sole cause of potential negative consequences associated with technological change. Rather, the combination of technological change with policies that make individuals and families rely exclusively on their jobs for basic economic security may make the threat of job displacement through automation much more severe in the U.S. The recent MIT Work of the Future report points out that societies shape their trajectories of growth and distribution "through their educational systems, labor market regulations, collective bargaining regimes, financial markets, public investments, and tax and transfer policies." It adds that other industrialized countries with similar technologies and skills distribute economic gains more equally without sacrificing economic growth or potential for upward mobility.

ABOUT THE CONVENING:

It is fitting that this convening of the California Future of Work Commission on 'Technological Change and its Impact on Work' takes place in Silicon Valley— the epicenter of the technological transformations that are reshaping work and the economy. The convening will begin with a conversation with several leading experts on the impacts of technological change: Susan Athey (Stanford), Ken Goldberg (UC Berkeley), and Hal Varian (Google). This will be followed by a discussion about the uneven impacts of technological change in the labor market with economist Jed Kolko (Indeed). After setting this important context, the Commission will delve into specific industry cases, including manufacturing, trucking/logistics, and white-collar work. The Commission will then discuss potential responses and solutions with two experts who will share insights from their work: Dawn Gearhart (National Domestic Workers Alliance), who has spent several years organizing gig workers who access work through online platforms, and Katrine Paaby Joensen, the Consul General of Denmark and CEO of Innovation Centre Denmark.

SOME QUESTIONS TO CONSIDER:

1. How could technological change improve jobs rather than displace or devalue them?

2. What policies, programs, incentives, and institutions need to be in place in California to ensure best positive outcomes of technological change?

3. What are the potential risks of technological change to the economy and California workers?

4. How can California protect against these adverse impacts?

5. What is the role of workers in shaping solutions (i) in the workplace; (ii) at the policy level; (iii) at the point at which such technology is developed and data collected; and (iv) at the point of deployment and integration?

SELECTED RESOURCES

MIT Task Force on the Work of the Future. *The Work of the Future: Shaping Technology and Institutions*. Fall 2019.

McKinsey Global Institute. *The Future of Work in America: People and Places, Today and Tomorrow*. July 2019.

Council on Foreign Relations. The Work Ahead: Machines, Skills, and U.S. Leadership in the Twenty-First Century. 2018.

Shift: The Commission on Work, Workers, and Technology. *Report of Findings*. 2017.

DESIGN PRINCIPLES

The Commission collectively developed the following design principles to create and evaluate recommendations.

Bold: nothing should be excluded on the basis of political feasibility

Forward-Facing: let's not solve for the last war

Work-Adjacent: include work plus housing, transportation, living

Context-Sensitive: take into account implications across gender, race, age, geography

Coalition-Building: bring together multiple stakeholders

Portfolio-Based: easy/fast to hard/long-term

Scalable: achieve high impact

Agile and Iterative: can be prototyped and adapted as needed

Measurable: identify clear areas of potential impact

Actionable and Practical: grounded in real-world solutions that can be implemented

AGENDA

THURSDAY, OCTOBER 10

9:30am Arrive

10:00am **Opening / Welcome**

10:45am **Perspectives on Technological Change and the Future of Work**

Hal Varian, Chief Economist, Google

Susan Athey, The Economics of Technology Professor, Stanford Graduate School of Business

Ken Goldberg, William S. Floyd Jr. Distinguished Chair in Engineering, UC Berkeley

*Moderated by **James Manyika,** Chairman and Director, McKinsey Global Institute, and Senior Partner, McKinsey*

12:00pm **The Uneven Social Impacts of Technological Change**

Jed Kolko, Chief Economist, Indeed.com

*Moderated by **Anmol Chaddha,** Research Director, Institute for the Future*

12:45pm **Working Lunch**

Conversation with **Anne-Marie Slaughter,** CEO, New America

1:45pm **Industry Cases**

Lisa Campbell, Chief Marketing Officer and SVP, Business Strategy & Marketing, Autodesk

Steve Viscelli, Senior Fellow, Kleinman Center for Energy Policy, University of Pennsylvania

Melissa Valentine, Assistant Professor, Management Science & Engineering, Stanford University

*Moderated by **Lenny Mendonca,** Chief Economic and Business Advisor, and **Lande Ajose,** Senior Policy Advisor for Higher Education*

2:45pm Break

3:00pm **Responses / Solutions**

Katrine Paaby Joensen, Consul General and CEO, Innovation Center Denmark, Silicon Valley

Dawn Gearhart, Gig Economy Organizing Director, National Domestic Workers Alliance

*Moderated by **Julie Su,** Secretary, Labor and Workforce Development Agency*

4:00pm **Discussion / Wrap-up**

4:30pm **Public Comment**

NOTE: The Commission may not discuss or take action on any matter raised during the public comment session, except to decide whether to place the matter on the agenda of a future meeting (Government Code sections 11125, 1125.7(a)).

5:00pm Adjourn

PANELISTS

PERSPECTIVES ON TECHNOLOGICAL CHANGE & THE FUTURE OF WORK

HAL VARIAN

Chief Economist
Google
@halvarian

Hal started at Google in May 2002 as a consultant and has been involved in many aspects of the company, including auction design, econometric analysis, finance, corporate strategy and public policy. He is also an emeritus professor at the University of California, Berkeley in three departments: business, economics, and information management. He received his B.S. degree from MIT in 1969 and his MA in mathematics and Ph.D. in economics from UC Berkeley in 1973. He has also taught at MIT, Stanford, Oxford, Michigan and other universities around the world. Dr. Varian is a fellow of the Guggenheim Foundation, the Econometric Society, and the American Academy of Arts and Sciences. He was Co-Editor of the American Economic Review from 1987-1990 and holds honorary doctorates from the University of Oulu, Finland and the University of Karlsruhe, Germany. Professor Varian has published numerous papers in economic theory, industrial organization, financial economics, econometrics and information economics. He is the author of two major economics textbooks which have been translated into 22 languages. He is the co-author of a bestselling book on business strategy, *Information Rules: A Strategic Guide to the Network Economy* and wrote a monthly column for the *New York Times* from 2000 to 2007.

SUSAN ATHEY

Economics of Technology Professor
Stanford Graduate School of Business
@Susan_Athey

Susan received her bachelor's degree from Duke University, her Ph.D. from Stanford, and she holds an honorary doctorate from Duke University. She previously taught at the economics departments at MIT, Stanford and Harvard. Her current research focuses on the economics of digitization, marketplace design, and the intersection of econometrics and machine learning. She has worked on several application areas, including timber auctions, internet search, online advertising, the news media, and the application of digital technology to social impact applications. As one of the first "tech economists," she served as consulting chief economist for Microsoft Corporation for six years, and now serves on the boards of Expedia, Lending Club, Rover, Turo, and Ripple, as well as the non-profit Innovations for Poverty Action. She also serves as a long-term advisor to the British Columbia Ministry of Forests, helping architect and implement their auction-based pricing system. She is the director of the Shared Prosperity and Innovation Initiative at Stanford GSB, and associate director of the Stanford Institute for Human-Centered Artificial Intelligence.

KEN GOLDBERG

William S. Floyd Jr. Distinguished Chair in Engineering
UC Berkeley
@ken_goldberg

Ken developed the first provably complete algorithm for part feeding and the first robot on the Internet. He was awarded the National Science Foundation PECASE (Presidential Faculty Fellowship) from President Bill Clinton in 1995, elected Institute of Electrical and Electronics Engineers (IEEE) Fellow in 2005 and selected by the IEEE Robotics and Automation Society for the George Saridis Leadership Award in 2016. Ken founded UC Berkeley's Art, Technology, and Culture (ATC) public lecture series, serves on the Advisory Board of the RoboGlobal Exchange Traded Funds (ETF), and has presented 500 invited lectures worldwide. He lives in the Bay Area and is madly in love with his wife, filmmaker and Webby Awards founder Tiffany Shlain, and their two daughters.

THE UNEVEN SOCIAL IMPACTS OF TECHNOLOGICAL CHANGE

JED KOLKO

Chief Economist
Indeed Hiring Lab
@JedKolko

Previously Jed was Chief Economist and VP of Analytics at Trulia, the online real estate marketplace. He has also led research teams at the Public Policy Institute of California and at Forrester Research. Jed specializes in using large-scale proprietary and publicly available datasets to uncover insights about labor markets, the future of work, demographics, housing markets, and urban trends. He earned his B.A. in social studies and his Ph.D. in economics at Harvard University.

WORKING LUNCH

ANNE-MARIE SLAUGHTER

CEO
New America
@SlaughterAM

Anne-Marie is the CEO of New America, a think and action tank dedicated to renewing America in the Digital Age. She is also the Bert G. Kerstetter '66 University Professor Emerita of Politics and International Affairs at Princeton University. From 2009–2011, she served as director of policy planning for the United States Department of State, the first woman to hold that position. Prior to her government service, Dr. Slaughter was the Dean of Princeton's Woodrow Wilson School of Public and International Affairs from 2002–2009 and the J. Sinclair Armstrong Professor of International, Foreign, and Comparative Law at Harvard Law School from 1994-2002. Dr. Slaughter has written or edited eight books, including *The Chessboard and the Web: Strategies of Connection in a Networked World* (2017) and *Unfinished Business: Women, Men, Work, Family* (2015). In 2012 she published the article "Why Women Still Can't Have It All," in the *Atlantic,* which quickly became the most read article in the history of the magazine and spawned a renewed national debate on the continued obstacles to genuine full male-female equality. *Foreign Policy* magazine named her to their annual list of the Top 100 Global Thinkers in 2009, 2010, 2011, and 2012. She received a B.A. from Princeton, an Masters of Philosophy and Doctor of Philosophy in international relations from Oxford, and a J.D. from Harvard.

PANELISTS

INDUSTRY CASES

LISA CAMPBELL

Chief Marketing Officer
Autodesk
@LHartCamp

Lisa is responsible for business, industry, and marketing strategy for Autodesk. She is also responsible for driving brand affinity and loyalty among the current and next generation of Autodesk customers. Lisa has 25 years of software industry leadership experience with extensive knowledge in business and industry strategy in manufacturing, construction and infrastructure, digital go-to-market strategy, building brands, and business development. At both Fortune 500 companies and startups, Lisa has successfully partnered with leadership teams to transform brands, and launch new products, and business models in the marketplace.

DR. STEVE VISCELLI

Senior Fellow, Kleinman Center for Energy Policy
University of Pennsylvania

Steve is a sociologist who studies work, labor markets, and public policy related to goods movement. He is a Fox Family Pavilion Scholar, Senior Fellow at the Kleinman Center for Energy Policy, and Lecturer in the Department of Sociology at the University of Pennsylvania. Steve's first book, *The Big Rig: Trucking and the Decline of the American Dream* (UC Press, 2016), explains how deregulation of trucking and the rise of independent contracting turned truck driving from one of the best blue-collar jobs in the US into one of the toughest. His current book project, *Driverless? Self-Driving Trucks and the Future of the American Trucker,* examines the potential labor and environmental impacts of self-driving trucks and what policymakers should do about them. Steve's new research is focused on the impacts of ecommerce and platform technologies on package delivery drivers. In addition to his academic research, Steve works with truckers and a wide range of policymakers and stakeholders to make the trucking industry more efficient, safer, and a better place to work.

MELISSA VALENTINE

Assistant Professor, Management Science & Engineering
Stanford University
@stanfordmav

Melissa conducts research on how technologies change work and organizations. She conducts in-depth observational studies to develop new understanding about new forms of organizing. Her work makes contributions to understanding classic and longstanding challenges in designing groups and organizations (e.g., the role of hierarchy, how to implement change, team stability vs. flexibility) but also brings in deep knowledge of how the rise of information technology has made possible new and different team and organizational forms. Her most recent study examined how the deployment of new algorithms changed the organizational structure of a retail tech company. Prof. Valentine has won awards for both research and teaching. She and collaborators won a Best Paper Award at the CHI Conference on Human Factors in Computing Systems and the Outstanding Paper with Practical Implications award from the Organizational Behavior division of the Academy of Management. In 2019 she won the CAREER award from the National Science Foundation.

RESPONSES/SOLUTIONS

KATRINE PAABY JOENSEN

Consul General and CEO
Innovation Centre Denmark in Silicon Valley
@KatrineJoensen

Katrine is a career diplomat with more than 20 years' experience promoting Danish political and commercial interests globally. Katrine has experience with conflict resolution, security policy, development support, and economic diplomacy. Before taking up the post in Silicon Valley, Katrine developed global export and innovation strategies for the Trade Council in Copenhagen. She began her career in Bosnia-Herzegovina, and has also been posted to South Africa and Ghana where she worked to promote sustainable development. Katrine holds a M.sc. in Political Science from the University of Copenhagen, including studies at the University of Cape Town.

DAWN GEARHART

Gig Economy Organizing Director
National Domestic Workers Alliance

Dawn has spent nearly 10 years organizing, representing, and advocating for workers in the platform economy. She has shared her experiences with audiences around the world to encourage others to adopt new strategies that shift power to workers. In her latest role with the Teamsters in Seattle, she was the first to organize Uber and other drivers who passed innovative labor policies. The precedent-setting legislation offered a legal pathway for workers in a world where companies see value in avoiding traditional employment relationships. Her work leading drivers in Seattle made international news for its focus on a voice for those most impacted by big-tech. She is now based in Norway, where she's been conducting research to inform global governments and decision makers about issues and opportunities facing workers in the new economy. Dawn's role at NDWA focuses on strategic thinking regarding the future of work and its impacts. Dawn works directly with platform workers, allies, and organizers to address pressing issues regarding automation and its impact on work.

COMMISSIONERS

ROY BAHAT

Venture Capitalist
Bloomberg Beta
@roybahat

Roy Bahat invests in the future of work as a venture capitalist, with a focus on machine intelligence. Prior to his life as a VC, Bahat founded start-ups, served as a corporate executive at News Corp., and worked in government in the office of New York City mayor Michael Bloomberg. As the head of Bloomberg Beta, an investment firm with 150 million dollars under management, Bahat and his team have invested in areas like automation, data, robotics, media, productivity tools, and many others. Fast Company named Bahat one of the Most Creative People in Business and noted "Bahat is a natural innovator ... one of the most candid people you'll ever meet (check out his LinkedIn profile)." He organized "Comeback Cities," where he leads groups of venture capitalists and members of Congress on bus tours to find the untapped beds of talent and entrepreneurship in America. He also co-chaired the Shift Commission on Work, Workers, and Technology, a partnership between Bloomberg and think-tank New America to look at automation and the future of work 10 to 20 years from now.

DOUG BLOCH

Political Director
Teamsters Joint Council 7
@TeamsterDoug

Doug Bloch has been political director at Teamsters Joint Council 7 since 2010. In this capacity, he works with over 100,000 Teamsters in Northern California, the Central Valley, and Northern Nevada in a variety of industries. He was the Port of Oakland campaign director for Change to Win from 2006 to 2010 and a senior research analyst at Service Employees International Union Local 1877 from 2004 to 2006. Mr. Bloch was statewide political director at the California Association of Community Organization for Reform Now (ACORN) from 2003 to 2004 and ran several ACORN regional offices, including Seattle and Oakland, from 1999 to 2003. He was an organizer at the Non-Governmental Organization Coordinating Committee for Northeast Thailand from 1999 to 2003.

DR. SORAYA M. COLEY

President
Cal Poly Pomona
@PresColeyCPP

Dr. Soraya M. Coley, a veteran administrator with more than 20 years of experience in higher education, became the sixth president of Cal Poly Pomona in January 2015. Coley transitioned to Cal Poly Pomona from Cal State Bakersfield, where she was the provost and vice president for academic affairs from 2005 to 2014. She also served as interim vice president for university advancement in 2011-12. Her experience includes serving as Cal State Fullerton's dean of the College of Human Development and Community Service, as administrative fellow, and professor and department chair for the human services department. She was the system-wide provost and vice president for academic affairs at Alliant International University, from 2001 to 2003. Coley earned a bachelor's in sociology from Lincoln University, a master's in social planning and social research from Bryn Mawr, and a doctoral degree in social planning and policy from Bryn Mawr. She is married to Ron Coley, Lt. Col. (Ret.) USMC, who serves as the vice chancellor for business and administrative services at UC Riverside.

LLOYD DEAN

Chief Executive Officer
CommonSpirit Health
@LloydHDean

Lloyd Dean is chief executive officer of CommonSpirit Health, a newly created national health care system formed by Dignity Health and Catholic Health Initiatives. He is co-chair of the California Future Health Workforce Commission, chair of the Board of Directors for the Committee on Jobs in San Francisco, and a member of the McDonald's Board of Directors. Dean holds degrees in sociology and education from Western Michigan University and received an honorary Doctor of Humane Letters degree from the University of San Francisco. A strong advocate for health care reform, he has been actively engaged with President Obama and the White House Cabinet on healthcare issues.

JENNIFER GRANHOLM

Former Governor
State of Michigan
@JenGranholm

Jennifer Granholm served two terms as Michigan's 47th governor from 2003 to 2011, and was the Michigan Attorney General from 1998-2002. As Governor, Granholm led the state through a brutal economic downturn that resulted from the Great Recession and a meltdown in the automotive and manufacturing sectors. She worked relentlessly to diversify the state's economy, strengthen its auto industry, preserve the manufacturing sector, and add new, emerging sectors, such as clean energy, to Michigan's economic portfolio. After leaving office, Granholm served as an advisor to Pew Charitable Trusts' Clean Energy Program, where she led a national campaign for clean energy policies. She also hosted Current TV's political news analysis show "The War Room with Jennifer Granholm" and co-authored *A Governor's Story: The Fight for Jobs and America's Economic Future*, which tells how Michigan pioneered ways out of an economic storm and offers proven advice for a nation desperate to create jobs. Currently, Granholm is a contributor to CNN, a Senior Advisor to the progressive political groups Media Matters and American Bridge, is head of the sustainability practice at Ridge-Lane, and sits on numerous private sector and non-profit boards.

LANCE HASTINGS

President
California Manufacturers & Technology Association
@lance_hastings

Hastings has held several leadership roles at MillerCoors the past 15 years. He served most recently as Vice President of National Affairs for MillerCoors. Prior to that he served as Head of Regulatory & Tax Affairs for SABMiller. He also represented Miller Brewing Company and MillerCoors in Sacramento as Director of State Government Affairs, where he served on CMTA's Board of Directors. Before his long career as a manufacturing executive Hastings was the Vice President and Director of Government Relations from 1998 to 2003 at the California Grocers Association. Hastings also worked in the California State Legislature for almost a decade as a chief consultant, starting in 1989. Hastings has a Bachelors of Arts in Economics and a Minor in Government from California State University at Sacramento.

MARY KAY HENRY, CO-CHAIR

International President
Service Employees International Union (SEIU)
@MaryKayHenry

Mary Kay Henry is International President of the 2 million-member Service Employees International Union (SEIU), and her leadership is rooted in a deep-seated belief that when individuals join together they can make the impossible possible. Under her leadership, SEIU has won major victories to improve working families' lives by strengthening and uniting healthcare, property services, and public sector workers with other working people across the United States, Canada and Puerto Rico. In 2010, Mary Kay Henry became the first woman elected to lead SEIU, after more than 30 years of helping unite healthcare workers. By 2015, she was named one of the 100 most creative leaders by Fast Company magazine and was included in the top 50 visionaries reshaping American politics by Politico magazine for SEIU's innovative leadership in propelling the fight for living wages embodied in the historic movement known as the "Fight for $15." Henry believes that to better fulfill the promise of a just society America has always aspired to be, we must fight for justice on all fronts including defending the gains accomplished for access to affordable healthcare for all families under the Affordable Care Act, comprehensive immigration reform and a path to citizenship for all hardworking immigrant families, and safety and justice in all communities of color across the country.

COMMISSIONERS

CARLA JAVITS

President & CEO
Roberts Enterprise Development Fund (REDF)
@cjavitsredf

Carla Javits is President and CEO of REDF (The Roberts Enterprise Development Fund), a pioneering venture philanthropy galvanizing a national movement of social enterprises—purpose-driven, revenue-generating businesses that help people striving to overcome employment barriers get good jobs, keep those jobs, and build better lives. Through her stewardship, REDF has invested in 183 social enterprises in 26 states. These businesses have generated $755 million in revenue and employed 37,700 people—and counting. REDF's goal is to see 50,000 people employed by 2020, contributing their skills and talents to our communities and helping to build a stronger, more inclusive society.

SARU JAYARAMAN

President
ROC United & ROC Action, Director of the Food Labor Research Center
@SaruJayaraman

Saru is President of Restaurant Opportunities Center (ROC) United & ROC Action (based in Oakland, California), and co-founded ROC in New York after 9/11 together with displaced World Trade Center workers, which have organized those who work in restaurants to win workplace justice campaigns, conduct research and policy work, partner with responsible restaurants, and launch cooperatively-owned restaurants. Saru is a graduate of Yale Law School and the Harvard Kennedy School of Government. She was profiled in the *New York Times'* "Public Lives" section in 2005, named one of Crain's "40 Under 40" in 2008, was 1010 Wins' "Newsmaker of the Year" and *New York Magazine's* "Influentials" of New York City. She was listed in CNN's "Top10 Visionary Women" and recognized as a Champion of Change by the White House in 2014, and with a James Beard Foundation Leadership Award in 2015. Saru authored *Behind the Kitchen Door* (Cornell University Press, 2013), a national bestseller, and has appeared on CNN with Soledad O'Brien, Bill Moyers Journal on PBS, Melissa Harris Perry, UP with Chris Hayes on MSNBC, Real Time with Bill Maher on HBO, the Today Show, and NBC Nightly News with Brian Williams. Her most recent book *Forked: A New Standard for American Dining* (Oxford University Press) has received widespread press coverage and acclaim. **@SaruJayaraman**

TOM KALIL

Chief Innovation Officer
Schmidt Futures

Tom Kalil has been Chief Innovation Officer at Schmidt Futures since 2017. He was deputy director of the White House Office of Science and Technology Policy for President Obama from 2009 to 2017. Kalil was special assistant to the Chancellor for Science and Technology at the University of California, Berkeley from 2001 to 2008 and was chair of the Global Health Working Group for the Clinton Global Initiative in 2007 and 2008. He also served on the White House National Economic Council from 1993 to 2001 and from 2000 to 2001, was deputy assistant to President Clinton for technology and economic policy.

ASH KALRA

Assemblymember
California Assembly District 27
@Ash_Kalra

Assemblymember Ash Kalra was elected to represent the 27th California State Assembly District in 2016, and was appointed Chair of the Assembly Committee on Labor and Employment and sits on the Aging and Long Term Care, Education, Judiciary, Water, Parks, and Wildfire committees. Assemblymember Kalra has established himself as a leader on issues ranging from the environment and conservation, to criminal justice reform, health care sustainability, housing affordability, growing our transportation infrastructure, and expanding economic opportunity to all Californians. Previously, Kalra served as a San Jose City Councilmember, and as a deputy public defender in Santa Clara County. Kalra earned a Juris Doctor degree from the Georgetown University Law Center and is the first Indian-American to serve in the California Legislature.

STEPHANE KASRIEL

Chief Executive Officer
Upwork
@skasriel

Stephane Kasriel has been Chief Executive Officer of Upwork Inc. since 2015, after being Vice President of product at Upwork's predecessor company oDesk, and subsequently Senior Vice President of Product and Engineering from 2012 to 2015. He held multiple positions at PayPal from 2004 to 2010, including Managing Director for PayPal France, Global Head of Consumer Products and Global Head of Mobile Business Development. Kasriel serves as co-chair for the World Economic Forum's Council on the New Social Contract and previously served as Co-chair for the World Economic Forum's Council on Education, Gender and Work. Kasriel earned a Master of Business Administration degree from Institut Européen d'Administration des Affaires (INSEAD) and a Master of Science degree in computer science from Stanford University.

FEI-FEI LI

Co-Director and Professor
Human-Centered AI Institute, Stanford University
@drfeifei

Dr. Fei-Fei Li is the inaugural Sequoia Professor in the Computer Science Department at Stanford University, and Co-Director of Stanford's Human-Centered AI Institute. She served as the Director of Stanford's AI Lab from 2013 to 2018. During her sabbatical from Stanford from January 2017 to September 2018, she was Vice President at Google and served as Chief Scientist of AI/ML at Google Cloud. Dr. Fei-Fei Li's main research areas are in machine learning, deep learning, computer vision and cognitive and computational neuroscience. She has published nearly 200 scientific articles in top-tier journals and conferences, including *Nature,* PNAS, *Journal of Neuroscience,* CVPR, ICCV, NIPS, ECCV, ICRA, IROS, RSS, IJCV, IEEE-PAMI, *New England Journal of Medicine,* etc. Dr. Li is the inventor of ImageNet and the ImageNet Challenge, a critical large-scale dataset and benchmarking effort that has contributed to the latest developments in deep learning and AI. In addition to her technical contributions, she is a national leading voice for advocating diversity in STEM and AI. She is co-founder and chairperson of the national non-profit AI4ALL aimed at increasing inclusion and diversity in AI education.

JAMES MANYIKA, CO-CHAIR

Senior Partner
McKinsey & Company

James Manyika is Senior Partner at McKinsey and Company and Director of the McKinsey Global Institute. He was appointed by President Obama as Vice Chair of the Global Development Council at the White House (2012–present), and by US secretaries of commerce to the Digital Economy Board of Advisors (2016) and the National Innovation Advisory Board (2011). He serves on several other boards, including the Council on Foreign Relations, Aspen Institute, and John D. and Catherine T. MacArthur Foundation. He is a non-resident Senior Fellow of Brookings Institution and a Fellow of DeepMind and the Royal Society of Arts. A Rhodes Scholar, he holds a BSc in Electrical Engineering from University of Zimbabwe, and an MSc, MA and DPhil from Oxford University in Robotics, Computation.

JOHN MARSHALL

Senior Capital Markets Analyst
United Food and Commercial Workers

John Marshall is a Senior Capital Markets Analyst with the United Food and Commercial Workers' (UFCW) Capital Stewardship Program. At the UFCW, Marshall conducts financial research on public and private companies and works closely with investors and analysts on corporate governance matters. For the past two years, Marshall has been the UFCW staff liaison to the AFL-CIO's Commission on the Future of Work and Unions. Marshall graduated from the University of California at Santa Cruz with a degree in American Studies, received his MBA from the UCLA Anderson School of Management and is a holder of the Chartered Financial Analyst (CFA) designation. Prior to joining the UFCW, Marshall was Research Director for the SEIU Capital Stewardship Program. He has also held positions at Ullico, Inc., SEIU Local 250, and UNITE HERE Local 2.

COMMISSIONERS

ART PULASKI

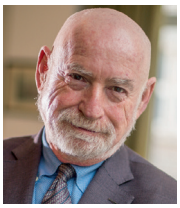
Executive Secretary-Treasurer
and Chief Officer
California Labor Federation
@ArtPulaski

Art Pulaski is the Executive Secretary-Treasurer and Chief Officer of the California Labor Federation. Since his election in 1996, Pulaski has reinvigorated grassroots activism in unions and championed support for new organizing. Under Pulaski's leadership, the California Labor Federation's achievements have included restoring daily overtime pay, raising the minimum wage, increasing benefits for injured and unemployed workers, creating collective bargaining opportunities for hundreds of thousands of public sector workers, and passing the nation's first comprehensive Paid Family Leave law. In 2010, the Federation led the successful campaign to ensure every California Democrat in Congress voted in favor of the landmark federal health care reform legislation. Pulaski has led the California labor movement in new strategies of political action and economic development. Since he took office at the California Labor Federation in 1996 the labor group has more than doubled in size.

MARIA S. SALINAS

President & CEO
Los Angeles Area Chamber of Commerce
@salinas_ms

Maria S. Salinas is the President & CEO of the Los Angeles Area Chamber of Commerce, the largest business association in Los Angeles County representing more than 1,600-member companies and serving the interests of more than 235,000 businesses across the Los Angeles region. Ms. Salinas took the helm of the organization in August of 2018 and became the first woman and Latina to lead the L.A. Area Chamber in its 130 year history. An accomplished business woman, entrepreneur, and a stalwart community leader, Ms. Salinas' business acumen and financial expertise provides her with the right experience to lead the Chamber. Ms. Salinas is a graduate of Loyola Marymount University (LMU), earning a Bachelor of Science in Accounting in 1987. She is currently Chair of the Board of Regents and member of the Board of Trustees at LMU, Board Chair of UnidosUS, and member of the founding Board of Directors of Kaiser Permanente School of Medicine. Over the years, she has served numerous esteemed civic and nonprofit organizations and has been recognized for her leadership and community service. Ms. Salinas lives in Pasadena, California, with her husband Raul, a prominent Los Angeles attorney, and their four sons.



PETER SCHWARTZ

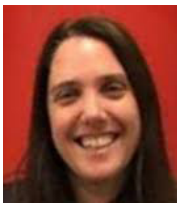
Senior Vice President of
Strategic Planning
Salesforce
@peterschwartz2

Peter Schwartz is an internationally renowned futurist and business strategist, specializing in scenario planning and working with corporations, governments, and institutions to create alternative perspectives of the future and develop robust strategies for a changing and uncertain world. As Senior Vice President of Strategic Planning for Salesforce, he manages the organization's ongoing strategic conversation. Peter leads the Salesforce Futures LAB—a collaboration between strategic thinkers at Salesforce and its customers around provocative ideas on the future of business. Prior to joining Salesforce, Peter was co-founder and chairman of Global Business Network. He is the author of several works. His first book, *The Art of the Long View,* is considered a seminal publication on scenario planning. Peter has also served as a script consultant on the films "The Minority Report," "Deep Impact," "Sneakers," and "War Games." He received a B.S. in aeronautical engineering and astronautics from Rensselaer Polytechnic Institute in New York.

HENRY STERN

State Senator
California Senate District 27
@HenrySternCA

Senator Henry Stern was elected to represent the 27th California State Senate District in 2016. He chairs the Senate Natural Resources and Water Committee and formerly chaired the Elections and Constitutional Amendments Committee. Senator Henry Stern is a sixth-generation Californian and native of this district. He is a former environmental lawyer, lecturer, senior policy advisor and civics teacher. Senator Stern has lectured at UCLA and UC Berkeley, enjoys volunteering at his local Boys & Girls Club and is a member of the Santa Monica Mountains Conservancy Advisory Committee, the Jewish Federation, the American Jewish Committee, and the Truman National Security Project. He earned a Juris Doctor degree from the University of California, Berkeley School of Law.



MARIANA VITURRO

Deputy Director
National Domestic Workers Alliance (NDWA)

Mariana Viturro is the Deputy Director at the National Domestic Workers Alliance (NDWA), the leading organization working to build power, respect, and fair labor standards for the estimated two million nannies, housekeepers, and elderly caregivers in the United States. She started organizing in the San Francisco Bay Area in 1998. Mariana has been organizing with immigrant communities and communities of color for the last 15 years. Prior to NDWA, as the Co-director of St. Peter's Housing Committee, Mariana guided a programmatic transition from service provision to organizing and then facilitated the organizational merger with a sister organization resulting in the creation of Causa Justa::Just Cause. Since March 2011, she has used her strong operational and organizing skills and a commitment to creating a culture of support and accountability to NDWA.

BETTY T. YEE

Controller
State of California
@BettyYeeforCA

State Controller Betty T. Yee was elected in 2014, following two terms on the California Board of Equalization. Reelected as Controller in 2018, Ms. Yee is the 10th woman in California history to be elected to statewide office. As the state's chief fiscal officer, Ms. Yee chairs the Franchise Tax Board and is a member of the California Public Employees' Retirement System (CalPERS) and the California State Teachers' Retirement System (CalSTRS) Boards. These two boards have a combined portfolio of more than $570 billion. Ms. Yee also serves on the Ceres Board of Directors, a nonprofit working to mobilize many of the world's largest investors to advance global sustainability and take stronger action on climate change. Ms. Yee has more than 35 years of experience in public service, specializing in state and local finance and tax policy. Ms. Yee previously served with the California Department of Finance where she led the development of the Governor's Budget, negotiations with the Legislature and key budget stakeholders, and fiscal analyses of legislation. She previously served in senior staff positions for several fiscal and policy committees in both houses of the California State Legislature. Ms. Yee received her BA in sociology from the University of California, Berkeley, and holds a master's degree in public administration.

SUPPORTING MATERIALS
SUBMITTED BY PANELISTS

21 **HAL VARIAN**
Chief Economist
Google

42 **KEN GOLDBERG**
William S. Floyd Jr. Distinguished Chair in Engineering
UC Berkeley

48 **JED KOLKO**
Chief Economist
Indeed.com

59 **STEVE VISCELLI, PHD**
Senior Fellow
University of Pennsylvania

BOTS V. TOTS

HAL VARIAN
Chief Economist
Google

Automation v Procreation

Hal Varian
June 2019

These are the author's personal views and do not necessarily reflect the views of his employer.

~~Automation v Procreation~~

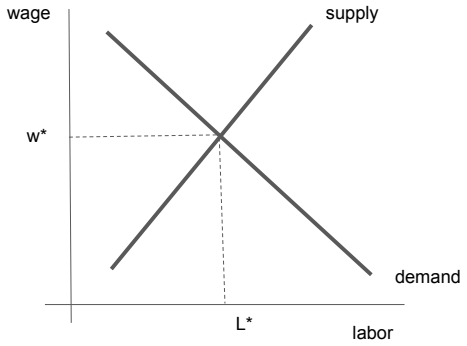
Hal Varian
August 2018

These are the author's personal opinions and do not necessarily reflect the views of his employer.

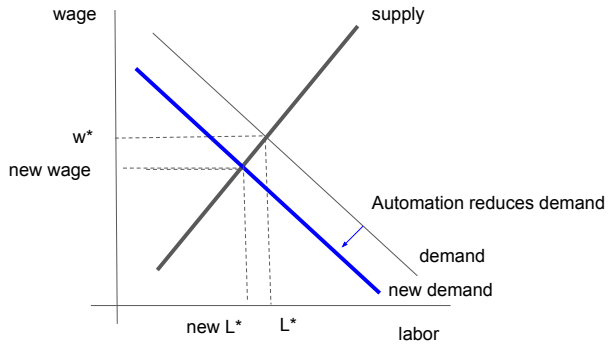
Bots v Tots

Hal Varian

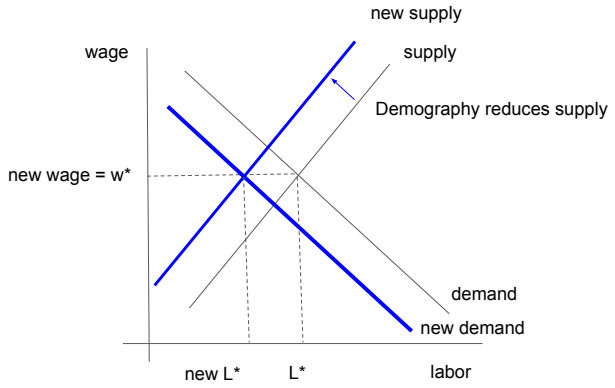
Economics of the labor market



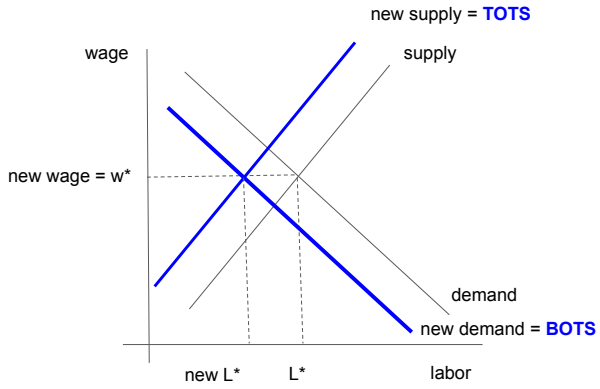
Economics of the labor market



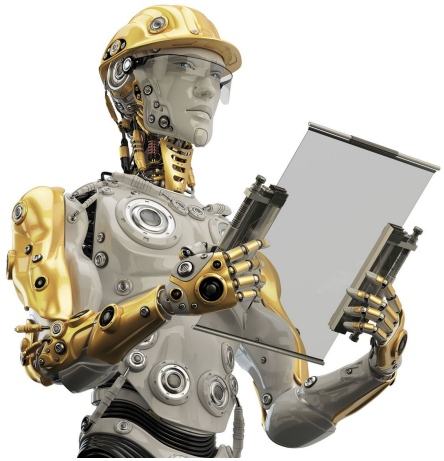
Economics of the labor market



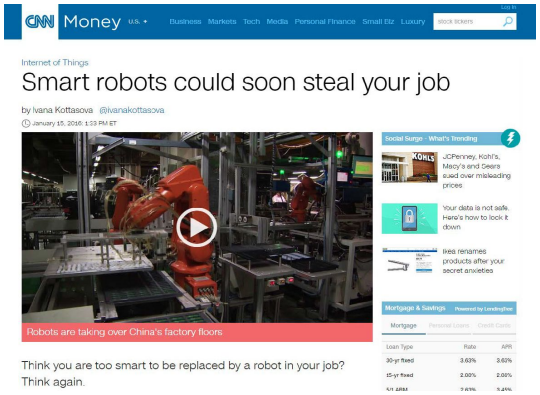
Economics of the labor market



Bots



2016: job stealing



Jason Furman

1980: job stealing

A Robot Is After Your Job

By Harley Shaiken

DETROIT — Technological innovation is widely billed as a miracle cure for the United States' economic doldrums. Its aftereffects, however, may be far from benign. The introduction of revolutionary new technologies such as robots — versatile computer-controlled mechanical arms — raise two painful possibilities: sizeable losses of jobs and a deteriorated quality of working life.

The threat of lost jobs, although also dependent on social and economic factors, is especially critical. Auto makers are already buying robots in record numbers, despite a downturn that has resulted in 250,000 indefinite layoffs. Even the faltering Chrysler Corporation has added 128 of these new "recruits" to its work force for the 1981-model year.

But the robot is only one part of a larger computerization that is affecting virtually every productive activity in society from the office to the machine shop. In fact, many white-collar occupations that promised jobs to displaced blue-collar workers in the past are themselves being automated.

In the case of robots, relatively conservative estimates predict that sales in this country will grow at a compound rate of 25 percent a year for the next decade, culminating in annual sales of $600 million and production of 17,000 robots a year by 1990. While this hardly seems threatening to a manufacturing work force of 20 million people, robots are only one of the labor-displacing technologies being introduced. Moreover, the employment effects are cumulative and have a disproportionate impact on a few key industries. Robots that begin work tomorrow will still be on the job in 1990, giving us a robot population of about 80,000. If 40 percent wind up in the auto industry (compared to 55 percent worldwide today), 32,000 robots could displace more than 100,000 auto workers. In fact, the potential loss of jobs is more serious than these figure indicate. New breakthroughs in robot technology such as "sight" and "feel" mean that each robot could displace far more workers in a decade. In addition, some industry observers feel that companies that sell computers may enter the market, resulting in a robot-population explosion in the hundreds of thousands, not tens of thousands.

The quality of working life will also change. While the first generation of robots primarily did such hazardous and hot jobs as welding and foundry work, robots are now being created for jobs where workers have the most control over the pace of work: machine loading and light assembly, among the more desirable production tasks.

...vasive to assume that enough jobs will automatically be created for the number of people displaced. Economic revitalization no longer means re-employment. And the devastating social cost of unemployment is not reckoned in the savings that technology promises.

Such a socially destructive use of technology need not be inevitable. Jobs for workers displaced and improved working conditions for those who remain ought to be a condition for the introduction of robots. Productivity gains, for example, could translate into a shorter work week at the same pay rather than into fewer jobs. Technology could be designed to enhance human skill and experience rather than make people "interchangeable" with machines. Realistically, these alternatives require worker-union participation in the design and deployment of technology.

The goal, after all, should be a technology that benefits people — not one that destroys them.

Harley Shaiken, a research fellow at the Massachusetts Institute of Technology, is completing a book on automation.

Jason Furman

1960: job stealing

Robots' Rise

They Bid for Big Jobs Both in Outer Space And in U.S. Factories

A.M.F. Designs Robot to Send To Moon; G.E. Works on One to Paint New Autos

Beetle's Hazardous Mission

By Thomas O'Toole
Staff Reporter of The Wall Street Journal

GREENWICH, Conn.—America's first astronaut to reach another planet may have long spidery arms and a bell-shaped head with a window in it.

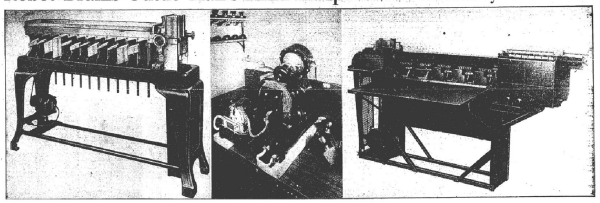
Such an inhuman-appearing space traveler is not as far-fetched as it seems. Even now the creature—a robot—is taking shape here at the Greenwich Engineering division laboratories of American Machine & Foundry Co. A.M.F. engineers believe their robot, remotely controlled from earth, would be far more useful than a human in exploring outer space—at least until rockets can be made powerful enough to be readily capable of returning home from trips to the Moon, Mars, Venus of even more distant targets.

Elsewhere around the country in laboratories and on drawing boards, increasing attention is being paid to robots, once regarded as science-fiction characters with little or no practical value. Indeed, most of the robots in use and development today bear little resemblance to the mechanical bipeds popularized by movie makers and cartoonists. But these machines, nevertheless, are true robots—automatic devices that perform human functions, or operate with seemingly human intelligence.

Jason Furman

1935: job stealing

Robot Brains Outdo Man's Mind in Speed and Accuracy of Results

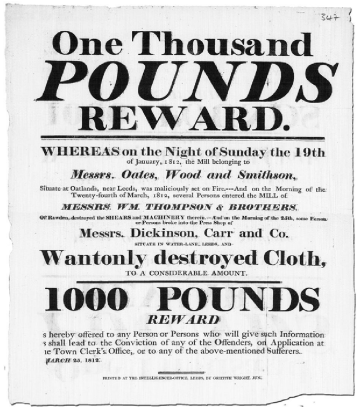


'Thinking Machines' Replace the Thinker

They Predict Tides, Pick Criminals' Fingerprints, Calculate Mathematical Problems, and Perform Amazing Tasks.

Jason Furman

1812: job stealing



One Thousand
POUNDS
REWARD.

WHEREAS on the Night of Sunday the 19th of January, 1812, the Mill belonging to

Messrs. Oates, Wood and Smithson,

Situate at Ouchinds, near Leeds, was maliciously set on Fire;—And on the Morning of the Twenty-fourth of March, 1812, several Persons entered the MILL of

MESSRS. WM. THOMPSON & BROTHERS,

Messrs. Dickinson, Carr and Co.

Wantonly destroyed Cloth,
TO A CONSIDERABLE AMOUNT.

1000 POUNDS
REWARD

is hereby offered to any Person or Persons who will give such Information shall lead to the Conviction of any of the Offenders, on Application at the Town Clerk's Office, or to any of the above-mentioned Sufferers.

MARCH 25. 1812.

Jason Furman

2017: Huh?

THE WALL STREET JOURNAL.

REVIEW & OUTLOOK
America's Growing Labor Shortage

REVIEW & OUTLOOK
Minimum Wage Reality Check

OPINION | REVIEW & OUTLOOK (U.S.)

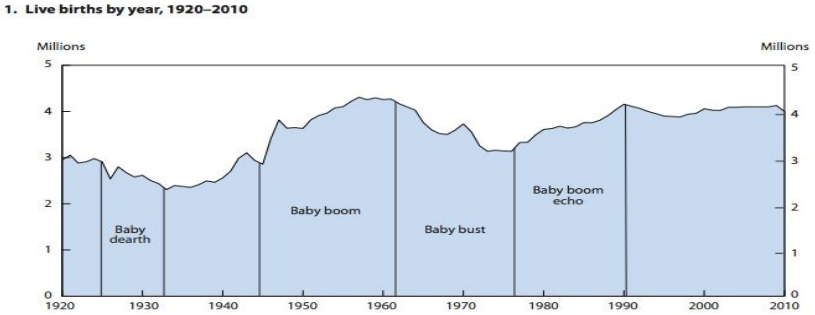
America's Growing Labor Shortage

Lack of workers in ag and construction is hurting the economy.

Construction, agriculture, truck drivers, forklift drivers, dairy farms, meat packing ...

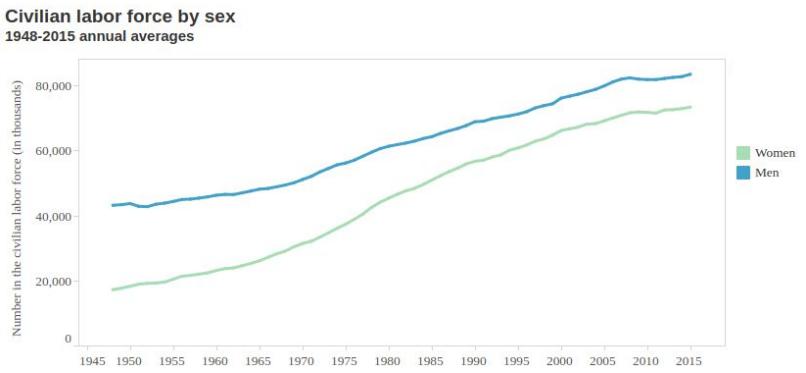
In the 20th century there were two large shocks to the labor market
...and a few small ones

Baby boomers



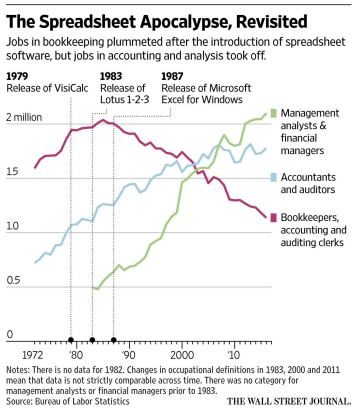
Bureau of Labor Statistics

Women entering the (paid) labor force



Dept of Labor

Spreadsheet apocalypse

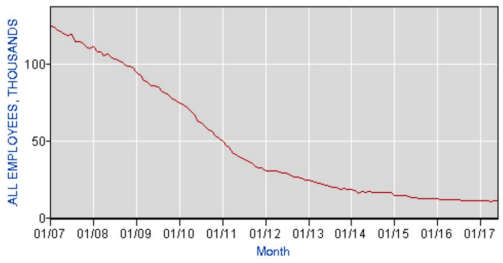


Wall Street Journal

Video rental clerks

Employment, Hours, and Earnings from the Current Employment Statistics survey (National)

Series Id: CES5553223001 (I)
Seasonally Adjusted
Series Title: All employees, thousands, video tape and disc rental, seasonally adjusted
Super Sector: Financial activities
Industry: Video tape and disc rental
NAICS Code: 53223
Data Type: ALL EMPLOYEES, THOUSANDS



Jobs and tasks

Automation, jobs and tasks

Automation doesn't generally eliminate jobs. Automation generally eliminates dull, tedious, and repetitive **tasks**.

- **Manual:** washing clothes, drying dishes, mowing lawn, digging holes, chopping wood
- **Cognitive:** making change for purchase, memorizing maps, adding columns of numbers

If you eliminate *all* the tasks associated with a job, you have eliminated a job. But this is rare.

Tasks and jobs

There were 270 detailed occupations listed in the 1950 US Census. Only 1 has been eliminated due to automation.

Quartz article based on Jim Bessen's work

Tasks or jobs?

There were 270 detailed occupations listed in the 1950 US Census. Only 1 has been eliminated due to automation.

Elevator operator

Quartz article based on Jim Bessen's work

Even elevator operators had other tasks...

- Operation
  - Safety monitor
  - Security monitor
  - Greeter
  - Provide answers to questions
  - Provide services to residents
  - Announced special prices or offers
- Many such tasks were folded into other jobs (reception, security)
- ...and don't forget those Amazon packages!
- Most jobs are more complicated than we think...

Interview Wikipedia

Groundskeeper tasks: O*NET

- Gather and remove litter.
- Use hand tools, such as shovels, rakes, pruning saws, saws, hedge or brush trimmers, or axes.
- Operate vehicles or powered equipment, such as mowers, tractors, twin-axle vehicles, snow blowers, chain-saws, electric clippers, sod cutters, or pruning saws.
- Water lawns, trees, or plants, using portable sprinkler systems, hoses, or watering cans.
- Prune or trim trees, shrubs, or hedges, using shears, pruners, or chain saws.
- Mix and spray or spread fertilizers, herbicides, or insecticides onto grass, shrubs, or trees, using hand or automatic sprayers or spreaders.
- Care for established lawns by mulching, aerating, weeding, grubbing, removing thatch, or trimming or edging around flower beds, walks, or walls.
- Follow planned landscaping designs to determine where to lay sod, sow grass, or plant flowers or foliage.

MORE

Groundskeeper tasks, continued

- Trim or pick flowers and clean flower beds.
- Attach wires from planted trees to support stakes.
- Plant seeds, bulbs, foliage, flowering plants, grass, ground covers, trees, or shrubs and apply mulch for protection, using gardening tools.
- Mow or edge lawns, using power mowers or edgers.
- Rake, mulch, and compost leaves.
- Decorate gardens with stones or plants.
- Provide proper upkeep of sidewalks, driveways, parking lots, fountains, planters, burial sites, or other grounds features.
- Shovel snow from walks, driveways, or parking lots and spread salt in those areas.
- Maintain irrigation systems, including winterizing the systems and starting them up in spring.
- Plan or cultivate lawns or gardens.
- Install rock gardens, ponds, decks, drainage systems, irrigation systems, retaining walls, fences, planters, or playground equipment.

Robots and tasks

Could we build a robotic groundskeeper?

- You could likely automate any single task with enough money and time
- But automating them all would be very challenging

Robots work best with standardized environment and repetitive tasks.

- We have been optimizing the assembly line with humans for 100 years
- It's not surprising that this environment is (relatively) easy to automate
- Half of all industrial robots are in auto plants

A heterogeneous environment is much more difficult, even when each task is relatively simple. Generally, we have seen machines that *augment* humans, not replaced them.

Ideal environment for robot gardener

Hotel housekeeper O*NET

- Carry linens, towels, toilet items, and cleaning supplies, using wheeled carts.
- Disinfect equipment and supplies, using germicides or steam-operated sterilizers.
- Clean rooms, hallways, lobbies, lounges, restrooms, corridors, elevators, stairways, locker rooms, and other work areas so that health standards are met.
- Empty wastebaskets, empty and clean ashtrays, and transport other trash and waste to disposal areas.
- Observe precautions required to protect hotel and guest property and report damage, theft, and found articles to supervisors.
- Replenish supplies, such as drinking glasses, linens, writing supplies, and bathroom items.
- Clean rugs, carpets, upholstered furniture, and draperies, using vacuum cleaners and shampooers.
- Dust and polish furniture and equipment.
- Keep storage areas and carts well-stocked, clean, and tidy.
- Wash windows, walls, ceilings, and woodwork, waxing and polishing as necessary.
- Move and arrange furniture and turn mattresses.
- Hang draperies and dust window blinds.

Ideal environment for housekeeper robot

Forbes

Orchards

Traditional orchard v modern orchard

Make the environment as homogeneous as possible (like the assembly line).

Source: Goodfruit

Easier for humans and robots

Can we replace humans with humanoid robots?

First invasion of the machines (1880s)

- Washing machines, dryers, dishwashers, vacuum cleaners, sewing machines
- None of these work like humans
- Key to eliminating routine labor is to standardize environment and eliminate routine work
- Airplanes don't fly by flapping their wings, cars don't walk, boats don't swim

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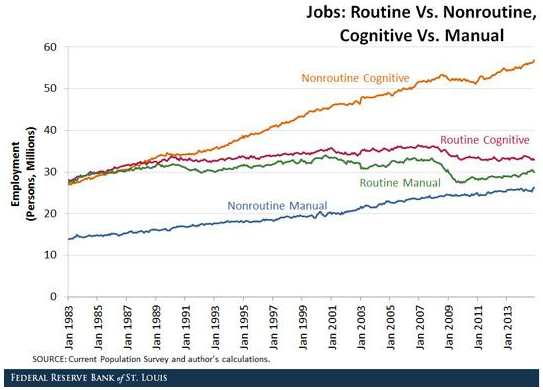
- None of these work like humans
- Key to eliminating routine labor is to standardize environment and eliminate routine work
- Airplanes don't fly by flapping their wings, cars don't walk, boats don't swim
- With a few exceptions...

Routine v Nonroutine work



Jobs Involving Routine Tasks Aren't Growing

From Henry Ford to Elon Musk

"In mass production there are no fitters." Henry Ford 1929

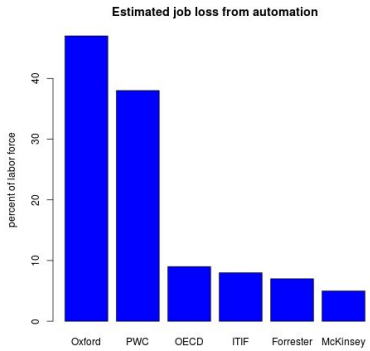
"Yes, excessive automation at Tesla was a mistake. To be precise, my mistake. **Humans are underrated.**" Elon Musk 2018

"In final assembly, robots can apply torque consistently—but they don't detect and account for threads that aren't straight, bolts that don't quite fit, fasteners that don't align or seals that have a defect. Humans are really good at this. Have you wondered why Teslas have wind-noise problems, squeaks and rattles, and bits of trim that fall off? Now you have your answer." Bernstein 2018

Heterogeneity is still a problem….

Tasks and jobs

- What tasks can be automated?
- How will tasks associated with jobs change?
- What jobs can be automated?
- What fraction does it make economic sense to automate?
- Depends what and who you ask...



Other estimates

Predicted Jobs Automation Will Create and Destroy

When	Where	Jobs Destroyed	Jobs Created	Predictor
2016	worldwide		900,000 to 1,500,000	Metra Martech
2018	US jobs	13,852,530	3,078,340	Forrester
2020	worldwide		1,000,000-2,000,000	Metra Martech
2020	worldwide	1,800,000	2,300,000	Gartner
2020	sampling of 15 countries	7,100,000	2,000,000	World Economic Forum (WEF)
2021	worldwide		1,900,000-3,500,000	The International Federation of Robotics
2021	US jobs	9,108,900		Forrester
2022	worldwide	1,000,000,000		Thomas Frey
2025	US jobs	24,186,240	13,604,760	Forrester

Predicted Jobs Automation Will Create and Destroy

When	Where	Jobs Destroyed	Jobs Created	Predictor
2025	US jobs	3,400,000		ScienceAlert
2027	US jobs	24,700,000	14,900,000	Forrester
2030	worldwide	2,000,000,000		Thomas Frey
2030	worldwide	400,000,000-800,000,000		McKinsey
2030	US jobs	58,164,320		PWC
2033	US jobs	67,876,460		Oxford University
2035	US jobs	80,000,000		Bank of England
2035	UK jobs	15,000,000		Bank of England
No Date	US jobs	13,594,320		OECD
No Date	UK jobs	13,700,000		IPPR

Technology Review

Ten largest occupations in US

Retail salesperson, cashier, food preparation, office clerk, registered nurse, customer service representative, waiter/waitress, laborer, administrative assistant, and janitor.

1. These 10 jobs account for 21% of total employment.
2. All are in services (which is 80% of private US employment.)
3. Mean income: $47,230. Registered nurse: $69,790; food preparation workers make an average of $19,110
4. Most of these *jobs* are too difficult for robots, but many of the *tasks* could be automated to a degree.

Quartz

Work week across time and space

What happens if we do become ultra productive?

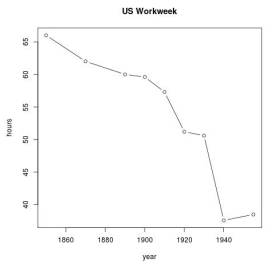
If automation increases productivity by 25%, we can accomplish in 4 days what now takes 5. How does work change?

- Work less each (day, week, lifetime)
- Consume more each (day, week, lifetime)

Workweek

Time

Year	Hours
1850	66
1870	62
1890	60.0
1900	59.6
1910	57.3
1920	51.2
1930	50.6
1940	37.6
1955	38.5



Space

Country	Hours
Belgium	35.2
Denmark	32.1
France	36.1
Germany	34.5
Italy	35.5
Mexico	45.2
Netherlands	29.1
Spain	36.5
Sweden	35.9
United Kingdom	36.5
United States	38.6

Economic History Assoc and OECD

What do people want?

What do people want?

"More jobs and less work"

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And that's exactly what technology can deliver.

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Universal Basic Income: some love it, some hate it

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Universal Basic Income: some love it, some hate it

Three day weekend: everybody loves them!

What do people want?

"More jobs and less work"

And that's exactly what technology can deliver.

Universal Basic Income: some love it some hate it

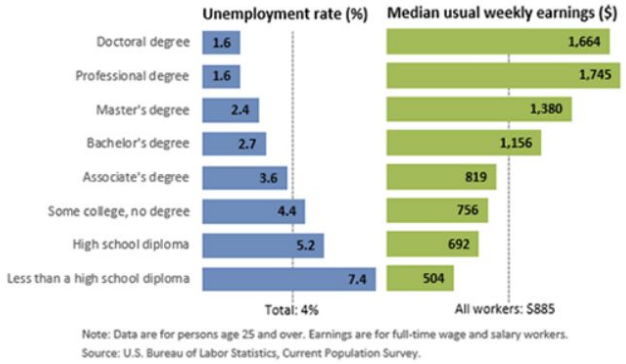
Three day weekend: everybody loves them!

So make every weekend a 3 day weekend

We just need to become 25% more productive...

But education and training will be necessary

Unemployment rates and earnings by educational attainment, 2016



Note: Data are for persons age 25 and over. Earnings are for full-time wage and salary workers.
Source: U.S. Bureau of Labor Statistics, Current Population Survey.

Bureau of Labor Statistics

Fallacy of composition for education

It's good for any individual to be more educated, but it is good for *everyone* to become more educated? Who will do the jobs that don't require much education? There will still be jobs for groundskeepers and hotel maids. However, tasks will be automated and training will be necessary.

- Routine work: machines
- Exception handling: humans.

The best way to acquire training is on the job.

- Lower opportunity cost
- More relevant
- More focused
- Higher motivation

Delivery of instruction and training

Can technology help deliver on-the-job job skills?

Not only can technology deliver this, it already does!

There are 1 billion views a day of "how to videos" on YouTube

This is unprecedented in human history.

How to videos on YouTube: cognitive

Math by subject

- Early math
- Arithmetic
- Pre-algebra
- Algebra
- Geometry
- Trigonometry
- Precalculus
- Statistics & probability
- Calculus
- Differential equations
- Linear algebra
- Math for fun and glory

CS by subject

- Intro to algorithms
- Binary search
- Asymptotic notation
- Selection sort
- Insertion sort
- Recursive algorithms
- Towers of Hanoi
- Merge sort
- Quick sort
- Graph representation
- Breadth-first search
- Further learning

Khan Academy

How to videos on You Tube: manual

- **how to** sweat copper pipe
- **how to** install a prehung door
- **how to care** for mums
- **how to** do planks
- **how to** weld cast iron
- **how to** remove a stripped bolt
- **how to** shorten blinds
- **how to** clean glass pipe
- **how to** program a garage door opener
- **how to** get a stripped screw out
- **how to** remove a stripped screw
- **how to** clean a pipe
- **how to** shingle a roof
- **how to** tig weld
- **how to** solder copper pipe
- **how to** weld aluminum
- **how to** mig weld
- **how to** balance a ceiling fan
- **how to** install a storm door

Cognitive assistance

It used to be that being a...

- ...cashier required knowing how to make change
- ...writer required knowing how to spell
- ...taxi driver meant knowing city streets
- ...a hospitality worker in an international you know a bit of foreign languages
- ...gardener, you needed to recognize plants
- ...veterinarian how to recognize dog breeds

Where there is a skills gap, you can bring the worker's skills up to the requirement, or bring the job down to workers' competencies. Cognitive assistances helps people get jobs, by reducing the tasks they need to master.

- In 1880 machines offered *manual* assistance
- In 2018 machines offer *cognitive* assistance.

Summary of bots

- Demand for labor and supply of labor are both important
- Automation commonly replaces tasks, rarely replaces jobs
- Historically this has led to more jobs and less work
- Most jobs are more complex than intellectuals recognize
- Job training is ideally provided on the job
- Technology can help deliver training as needed
- Cognitive assistance helps match skills to jobs by 1) educating workers 2) educating machines
  - Training spinners or build a spinning jenny
  - Training taxi drivers or GPS system

Tots: demography

Productivity

output/person = output/hour x hours/worker x workers/person

= productivity x employment x participation

Productivity

output/person = output/hour x hours/worker x workers/person

= productivity x employment x participation

full

Productivity

output/person = output/hour x hours/worker x workers/person

= productivity x employment x participation

full **declining**

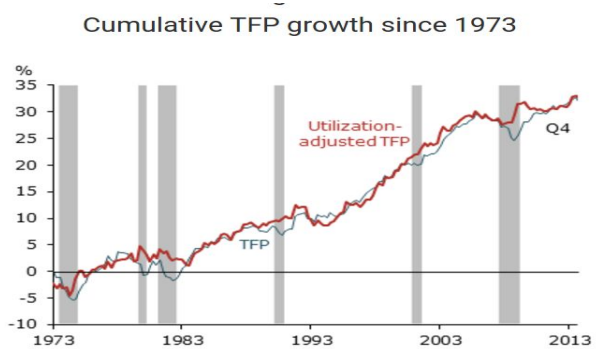
Productivity

output/person = output/hour x hours/worker x workers/person

= productivity x employment x participation

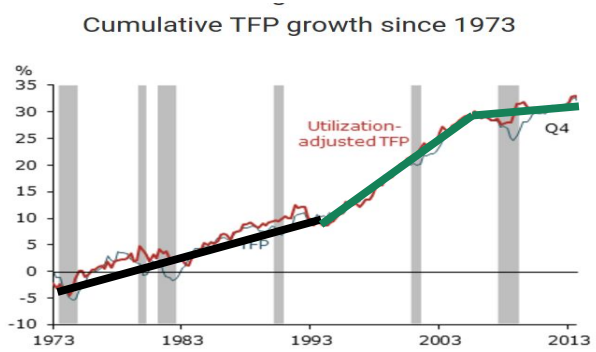
anemic **full** **declining**

Growth in productivity



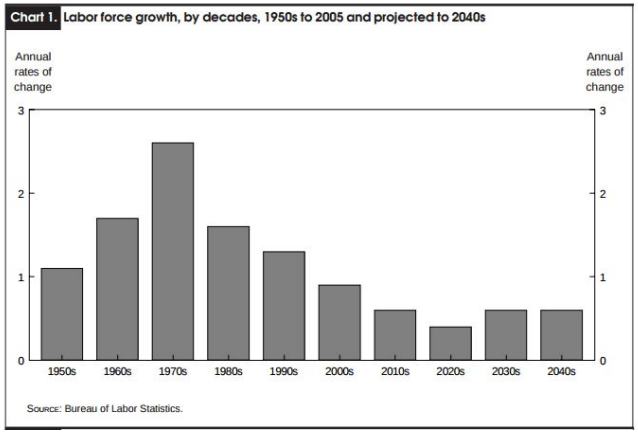
Source: Fernald and Wang, "The Recent Rise and Fall of Rapid Productivity Growth", SF Fed, Feb 2015

Growth in productivity

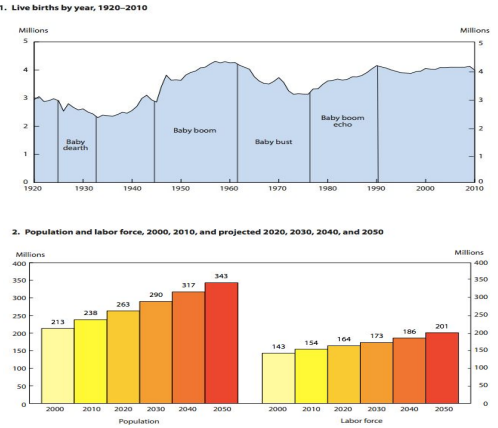


Source: Fernald and Wang, "The Recent Rise and Fall of Rapid Productivity Growth", SF Fed, Feb 2015

Growth of the labor force

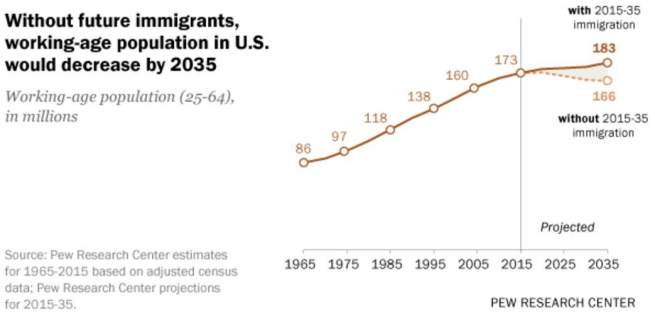


Demography is destiny

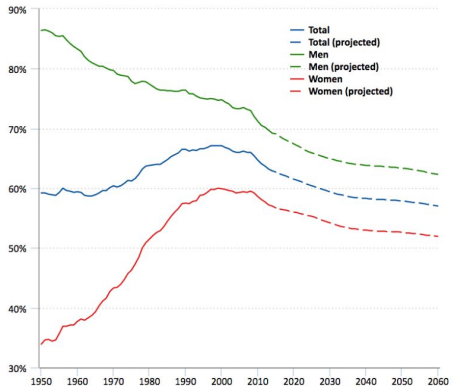


Bureau of Labor Statistics

Immigration



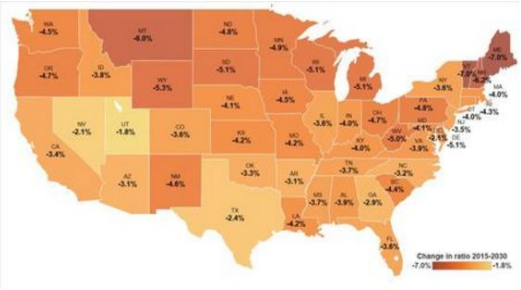
Labor force participation rates



Bureau of Labor Statistics

Where will labor shortage be worst?

Chart 1: Change in ratio of people aged 20 to 64 over total population, 2015 to 2030 *(Click to expand)*.



The Conference Board

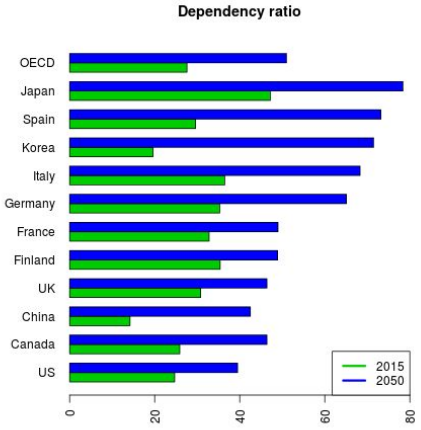
Growth in population and labor force

Decade	Population growth	Labor Force growth
2010	18.4%	7.7%
2020	10.5%	6.5%
2030	10.3%	5.5%
2040	9.3%	7.5%
2050	8.2%	8.1%

- US labor market is already beginning to tighten
- Expect a tight labor market for the next 15-25 years
- Retirees continue to consume
- Labor supply is growing more slowly than labor demand.
- Old intuitions no longer helpful
- Countervailing forces
  - 2000: 3% of 65+ working
  - 2016: 12.4% of 65+ working

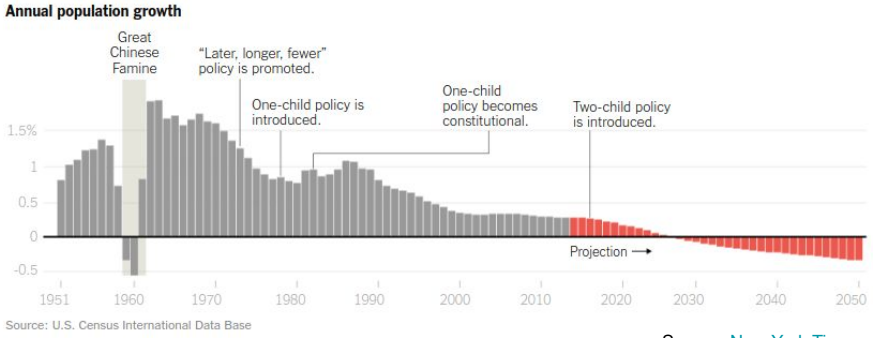
Gad Levanon, Conference Board

US is in good shape compared to many countries



OECD

China population growth



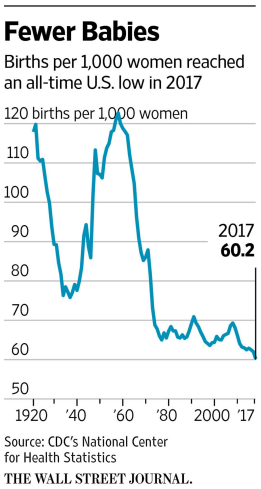
Source: New York Times

And the US birth rate is at an all-time low!

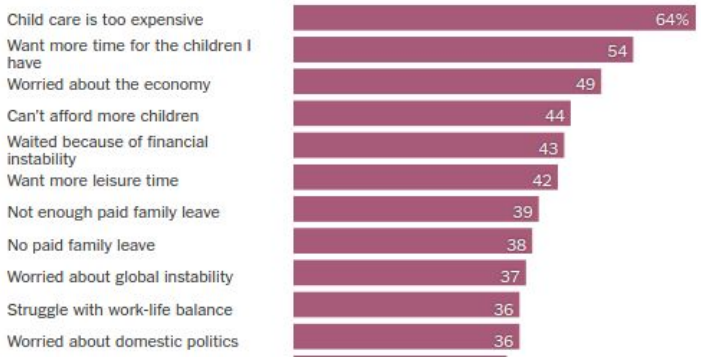
"This dearth of births could exacerbate the problems of America's aging population. Many baby boomers are in or are near retirement, leaving a smaller share of young workers to pay into Social Security and Medicare.

That is creating a funding imbalance that strains the social safety net that supports the elderly."

Source: WSJ, May 17, 2018

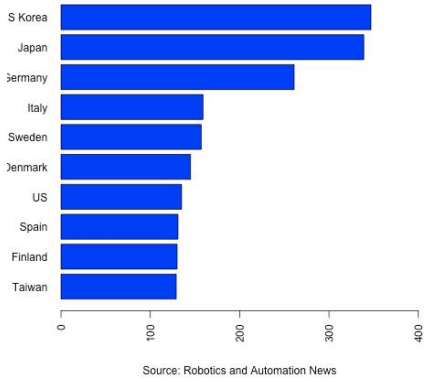


Why is US birth rate low?



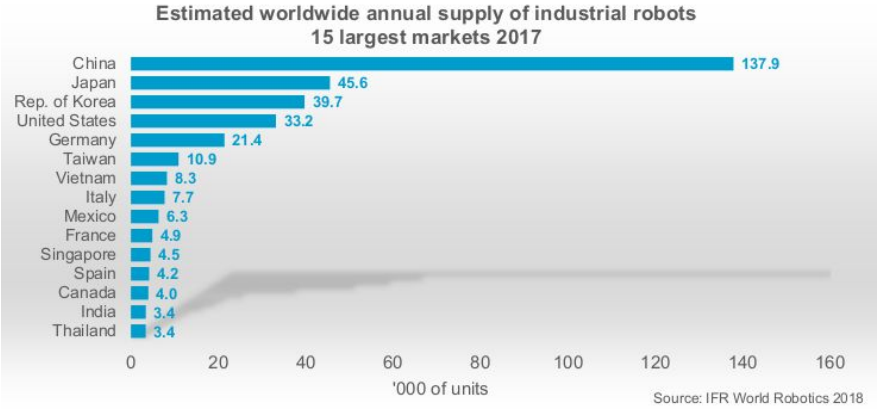
Source: New York Times, July 5, 2018

Robots per 10,000 workers



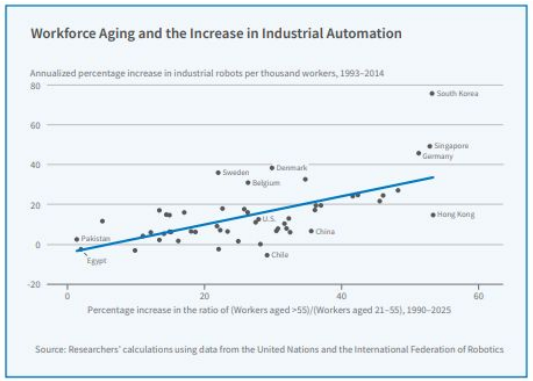
Countries with bad demographics are investing in robots. See Acemoglu and Restrepo [2017, 2018] for detailed analysis.

Supply of industrial robots



International Federation of Robotics

Workforce aging and increased industrial automation



Source: Acemoglu and Restrepo (2018)

Bots v Tots: which is bigger effect?

- Boston Consulting Group (2015) aggressive scenario + Acemoglu-Restrepo (2017) : employment/population ratio declines by 1.76% in next decade
- Bureau of Labor Statistics (2006): employment/population ratio declines by 2.7% based on demography in next decade
- Net: demographic effect is 53% larger than than the automation effect!
  - Tight labor markets
  - Rising wages
  - Increased incentive for employers to economize on labor
  - Increase incentive workers to provide more labor (part time, flexwork, delayed retirement)
- Suggestion
  - Estimated impact of automation should be compared to demographic realistic baseline, not a zero baseline
  - Both demand *and* supply matter!

As retirees age, they become more costly

Fact sheet: Aging in the United States

- People over 65 in US today: 46 million, 15 percent
- People over 65 in US in 2060: 98 million, 24 percent
- People with Alzheimer's today: 5 million
- People with Alzheimer's 2050: 14 million

Productivity growth in 2015:

- 1.3% productivity growth implies GDP will be 78% larger in 2060 than today
- Population over 65 doubles, Alzheimer's triples, and GDP only goes up by 78%
- If productivity growth were 1.6% we would could cover the doubling of the elderly

Harnassing automation for a future that works, McKinsey

THE END

COGNITIVE DIVERSITY: AI & THE FUTURE OF WORK

KEN GOLDBERG

William S. Floyd Jr. Distinguished Chair in Engineering

UC Berkeley

Executive Summary follows

Full Report: http://bit.ly/Cognitive-Diversity-Tata-Study

Cognitive Diversity: AI & The Future of Work

TATA COMMUNICATIONS

Motivation and Executive Summary

TATA COMMUNICATIONS

AI will allow us to do what it is that we are uniquely meant to do: to focus on high-level thinking, strategy and paving the way for innovation.

–Tony Blair, Executive Chair of the Institute for Global Change and Former UK Prime Minister

Motivation and Executive Summary

The new role of the human being is not to produce; it is to create.

—Reinaldo Pamponet, Founder, Itsnoon

This study began in the summer of 2016 with a series of discussions between Vinod Kumar, CEO of Tata Communications, and Ken Goldberg, professor of engineering at the University of California, Berkeley, about how perceived and potential innovations in artificial intelligence and cloud communications will affect business practices, jobs and worker morale.

Although 5G networking is on a clear road map, the evolution and impact of AI is less certain, due in part to widespread claims of an impending "Singularity" when AI and robots might surpass humans and "steal" a substantial fraction of jobs.

Goldberg's critique of the Singularity as distracting and counterproductive motivated him to propose an alternative concept, "Multiplicity," where groups of machines and humans collaborate to innovate and solve problems. Machine learning theory has established the importance of statistical diversity in algorithms, parameters and data sets.

In *The Diversity Bonus*, Scott E. Page highlights the importance of cognitive diversity—differences in how humans perceive, interpret, reason and solve—in human groups. The more diverse the participants, he argues, the more opportunities to discover insights and novel approaches. Accordingly, the goal of this study is to explore inclusive and constructive future roles for AI that could have a positive impact on work and morale, under the hypothesis:

AI has the potential to enhance collective intelligence and intellectual diversity, allowing human workers to do more diverse thinking, become more efficient, and undertake more creative, fulfilling labour.

Tata Communications, operating at the forefront of a pivotal moment in the evolution of society—the so-called "Fourth Industrial Revolution"—helps customers make sense of and navigate the vast potential offered by emerging and disruptive technologies such as the internet of things (IoT), artificial intelligence (AI), big data, mobility and cloud computing. It is also uniquely positioned to help its customers embrace these new opportunities starting to make their presence felt including edge computing, 5G, blockchain and more—enabling its customers' digital future, now.

The study, conducted by Tata Communications and Prof. Goldberg,[1] began with a literature survey and was influenced

[1] Produced in conjunction with Gershoni Creative (San Francisco, California).

Of our respondents

81%

indicated that demographic diversity in the workplace is important or very important

90%

believe that cognitive diversity is important for management

by discussions at UC Berkeley with Profs. John Zysman, Laura Tyson, Costas Spanos and Shankar Sastry of the WITS[2] group. The study includes a 2018 survey of 120 global business executives who were current or prospective clients of Tata Communications; 15 in-depth interviews with leaders from both emerging and developed markets across the US, Europe, South America, Asia, India and the Middle East, including Tony Blair, executive chair of the Institute for Global Change and former UK prime minister; and two discussion forums with 23 internationally renowned experts from the fields of artificial intelligence, machine learning, design, art, government, politics, ethics, entrepreneurship, behavioural economics, journalism, engineering and human resources.

The data suggests that most business leaders (93%) are actively tracking advances in AI and that small and large organizations may benefit most from AI. The data also reveals similar attitudes toward AI in both emerging and developed markets and a strong correlation between leaders who value cognitive diversity and leaders who have a positive outlook on the impact of AI.

The study revealed many specific ways AI could benefit organizations in the future, in particular the potential for AI to: enhance customer experience and engagement; support human workers by automating tedious subtasks and emphasizing the importance of intuition, empathy, and other uniquely human skills; provide new justification to expand diversity in organizations and teams; increase employment by increasing the quality and demand for goods and services, especially amid changes in demographics and immigration policies; and motivate continuing education and lifelong learning. Four key points from the study are:

1. The structure of work will change and require greater agility and flexibility.
2. AI has the potential to help individuals become more agile, curious and nimble.
3. AI has the potential to enhance human collaboration.
4. AI has the potential to enhance cognitive diversity within groups.

One unique outcome from the study is a vision for a future system that could provide an ongoing “AI-based devil’s advocate” consistent with the theme of Multiplicity, where AI supports humans by providing a novel cognitive perspective. Such an AI system would surface contrarian perspectives for leaders and groups to counter: feelings of intimidation among junior workers, confirmation bias and groupthink. An “AI-based devil’s advocate” might use natural language processing and machine learning to analyze emails and meeting transcripts, learning to be sensitive to keywords and trends in order to generate periodic reminders about the big picture (“Elephant in the Room”) and alerts that challenge unanimous and potentially false assumptions (“Emperor Has No Clothes”).

[2] Work in an era of Intelligent Tools and Systems (WITS). University of California, Berkeley. http://wits.berkeley.edu

The study also suggests that leaders actively develop "AI strategies" that begin to explore the potential upsides of AI for customers and workers. The best way for leaders and workers to prepare for AI is to expand training and education programs (a "Multiplicity Movement," see page 13) that emphasize uniquely human skills: creativity, curiosity, imagination, empathy, human communication, diversity and innovation.

There is no doubt that AI and related technologies are evolving rapidly. In contrast to conventional wisdom and newspaper headlines warning of widespread loss of jobs and threats to humanity, this study provides a much needed inclusive and positive vision for the future.

The important question is not, "When will machines surpass human intelligence?" but instead, "How can humans work together with machines in new ways?"

Vinod Kumar

Ken Goldberg

5 QUESTIONS WE SHOULD BE ASKING ABOUT AUTOMATION AND JOBS

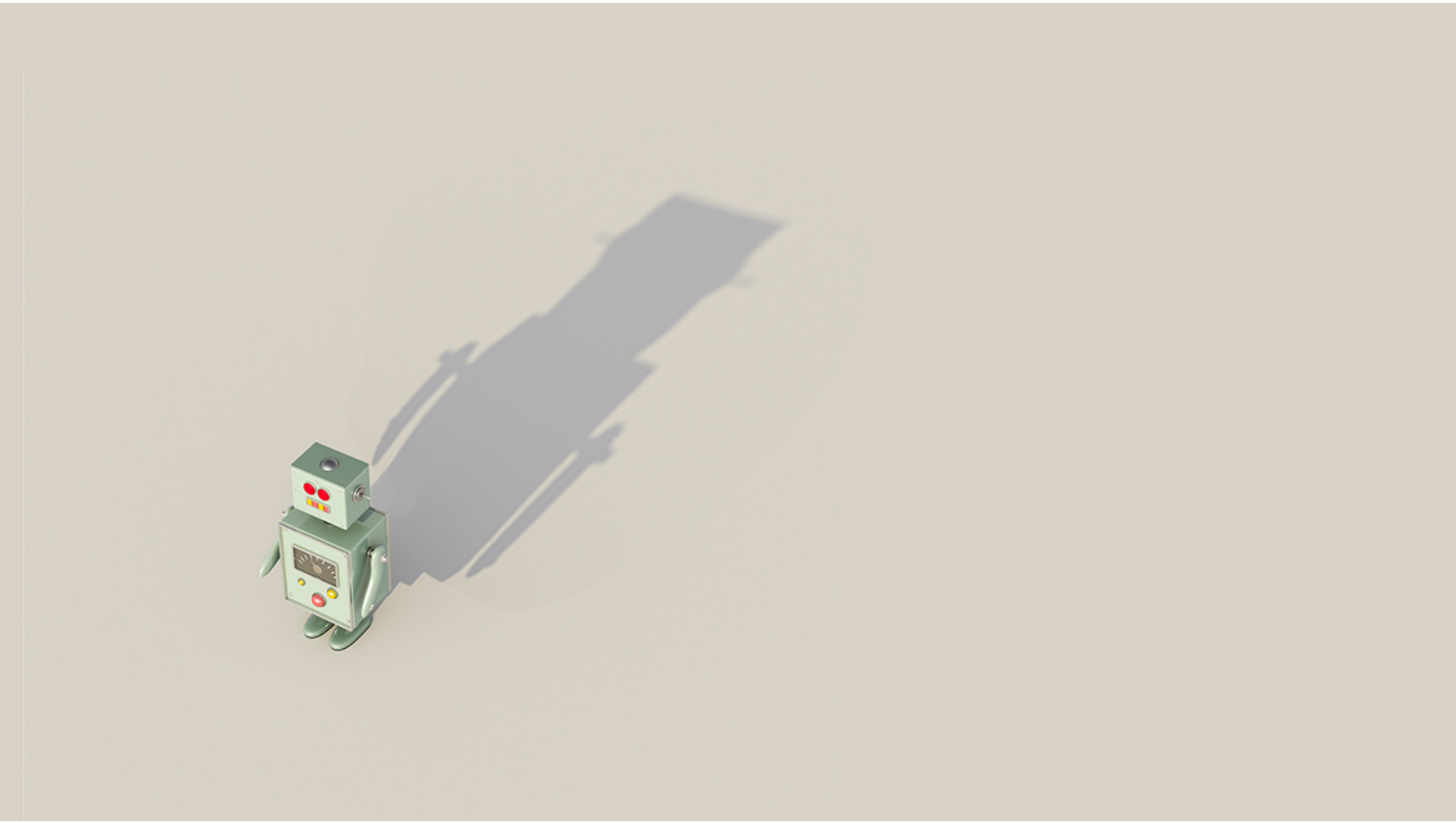
JED KOLKO
Chief Economist
Indeed.com

ECONOMY

5 Questions We Should Be Asking About Automation and Jobs

by Jed Kolko

DECEMBER 19, 2018



WESTEND61/GETTY IMAGES

We simply don't know for sure whether automation, algorithms, and AI will ultimately create more jobs than they destroy. Opinions are all over the map. One widely cited study predicted 47% of jobs will be automated, and technological change has in fact contributed to declining employment in recent years. Some are already preparing for a world without work.

But automation has been going on for centuries, and jobs still exist: that's because automation replaces some kinds of human labor while boosting demand for others. Furthermore, job upheaval today is relatively modest. The mix of jobs in the economy is changing more slowly in recent decades than in the 1940s and 1950s, for instance (see the chart below). Today, economists worry that the labor market isn't dynamic enough: numerous measures of fluidity and dynamism, like migration and job turnover, have been declining for decades.

The Mix of Jobs in the U.S. Economy Changed the Fastest in the 1940s and '50s

Note: Data analysis measures the rate of change by decade except for 1890, when no data was available.
Source: U.S. Census Bureau
HBR

But this uncertainty should not blind or distract us from other pressing questions about automation that we're sure to face regardless of whether automation adds to or subtracts from the total number of jobs. Here are five important, overlooked questions about automation and jobs:

Will workers whose jobs are automated be able to transition to new jobs? The pain from automation arises not only from how many jobs are eliminated, but also from whether workers in automated jobs can transition to other work. On Indeed's site we have data on how some workers in threatened occupations are seeking new opportunities, such as retail workers looking at customer service and sales-rep roles. But transitions may be harder than in the past. Job churn has slowed in recent decades, as firms both hire and fire less than they used to, and because people move less than before. The labor market may be changing less today than in the 1940s and 1950s, but today's slower employment growth and lower mobility could make transitions more drawn-out and painful.

Who will bear the burden of automation? Regardless of how many jobs are eliminated by automation, the pain will be uneven. The less-educated are far more likely to work in "routine" jobs, which are more susceptible to automation, than workers with a college or graduate degree. Men are

more likely to work in routine jobs than women are. And the geographic divide is stark: just one-third of jobs in metro Washington DC and San Jose CA are routine, versus half or more in much of inland California and many smaller southern and Midwestern metros. These regional differences line up with the partisan divide: counties that voted more strongly for President Trump in 2016 have a higher share of routine jobs and therefore are more likely to be affected.

How will automation affect the supply of labor? Automation might affect labor supply, not only labor demand. Just as past technological innovations, like washing machines and kitchen appliances, reduced the time needed to do household work and contributed to the entry of women into paid employment, future technological advances related to automation might also shift how much people are willing and able to work. For instance, autonomous vehicles might turn commuting into productive work time. Or, autonomous vehicles could chauffeur kids to school and activities, freeing up parents to work more hours. Alternatively, automation could boost productivity and lower consumer prices, possibly reducing labor supply since people will need to work less to afford the same items. It's far from clear which of these effects will win out.

How will automation affect wages, and how will wages affect automation? The pace of automation depends on prices, not just technological feasibility. Just because a robot or algorithm can perform a task as competently as a human doesn't mean that human will be replaced. Automation depends on the cost of the technology relative to the cost of human labor. In today's tight labor market, for instance, rising wages and worker shortages might encourage automation and boost productivity. At the same time, automation that replaces workers in some sectors could push them into the labor supply for other sectors, potentially depressing wages, slowing productivity, and aggravating inequality. Again, it's not clear which force will be stronger.

How will automation change job searching? Artificial intelligence has the potential to predict better matches between job seekers and open positions. Automated screenings and tests can potentially remove human biases that disadvantage certain candidates. However, algorithms might also reinforce human prejudices if the algorithms are trained on biased datasets. Plus, algorithms might be differentially applied to certain groups: one expert warns of a future where "the privileged … are processed more by people, the masses by machines." Finally, people might be skittish about

automated hiring. A recent survey found people less enthusiastic about algorithms evaluating job candidates than about driverless cars or robot elder care-givers, which could slow down their adoption

We don't need to wait to discover whether automation creates more jobs than it destroys to start answering these questions and acting on the answers. Making job transitions easier, focusing on those most at risk of job loss, and thinking about labor supply, wages, and job search are all essential for navigating these new technologies – whether or not automation ultimately adds to or subtracts from overall employment.

Jed Kolko is the chief economist at Indeed, the world's largest online jobs site.

This article is about ECONOMY

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3 COMMENTS

Imani Mehta 9 months ago

Will this increase situations like the opioid crisis as displaced workers (truck drivers, etc.) go to jobs that are even more high-risk and labor-intensive?

Reply 0 0

WHO'S AFRAID OF AUTOMATION?

JED KOLKO
Chief Economist
Indeed.com

Demographics, State of the Labor Market

Who's Afraid of Automation?

Tweet

January 10, 2019

by Jed Kolko @JedKolko

People are worried that robots will take our jobs. Some 60% of American adults think robots, automation, and artificial intelligence will put many jobs at risk, even though expert predictions about job losses are all over the map. These fears are a rare example of bipartisan agreement about the labor market—concerns cross demographic and geographic lines, according to a September 2018 Indeed survey of 2000 American adults.

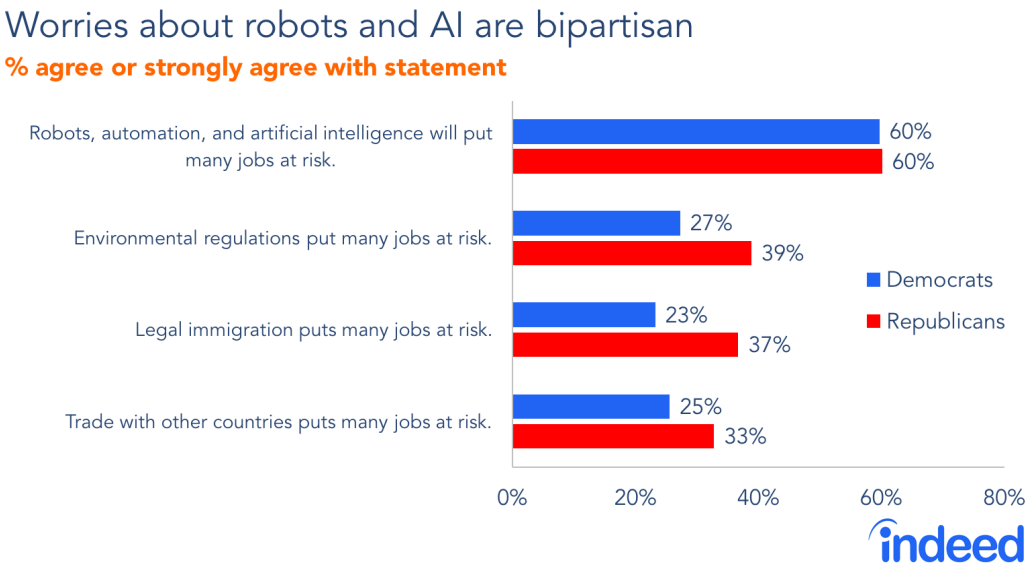
People who say they are pessimistic about America's economic future tend to be more concerned about automation. So are people with less education—and rightly so since their jobs are more at risk. At the same time though, young working-age adults and women are worried about automation even though they're less vulnerable than other groups.

Support for many labor market policies runs hotter for people more concerned about automation. Surprisingly, the policy that automation worriers lean toward most strongly is restricting legal immigration—even though today's immigrants often work in professional and technical occupations that aren't especially at risk from automation. Other policies, like worker training or a universal basic income, might help those affected by automation more directly.

Automation worries are widespread

Three out of five adults who responded to our survey think robots, automation, and artificial intelligence will put many jobs at risk. These concerns are far more widespread than worries about other factors—only half as many adults think environmental regulations, legal immigration, or trade hurts jobs.

Furthermore, worries about automation cross partisan lines. Among both Democrats and Republicans, 60% think these technologies will put many jobs at risk. In contrast, Republicans are more concerned than Democrats that environmental regulations, legal immigration, and trade will hurt jobs.



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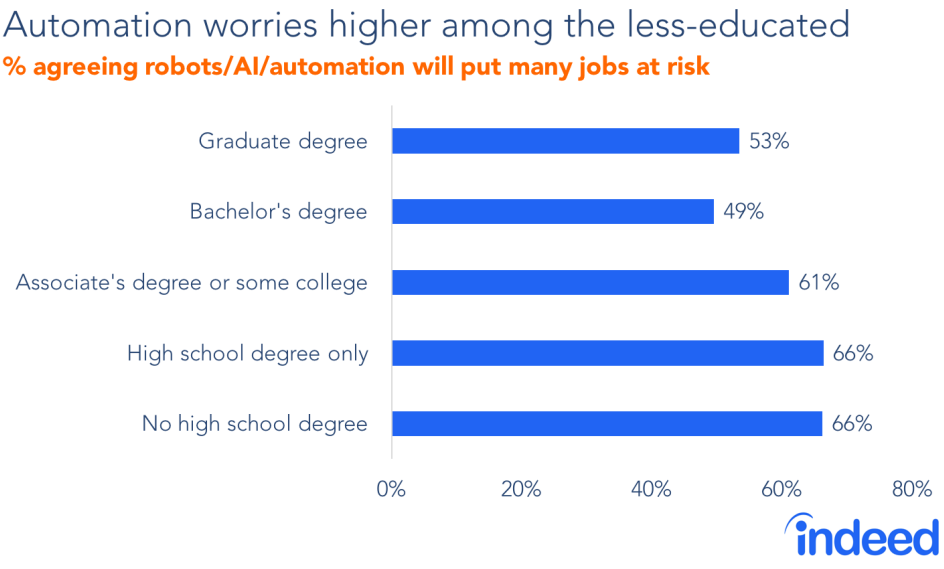
Still, automation worries some people more than others. Two-thirds of people with a high-school degree or less agree that these technologies will threaten many jobs, compared with half of those with at least a bachelor's degree. Younger prime-working-age adults, 25 to 44, are more concerned than 18 to 24 year-olds and older adults. Women are more concerned than men, as are people who are more pessimistic about national economic conditions today. But as we'll see in the next section, those most worried about automation aren't always those most at risk.



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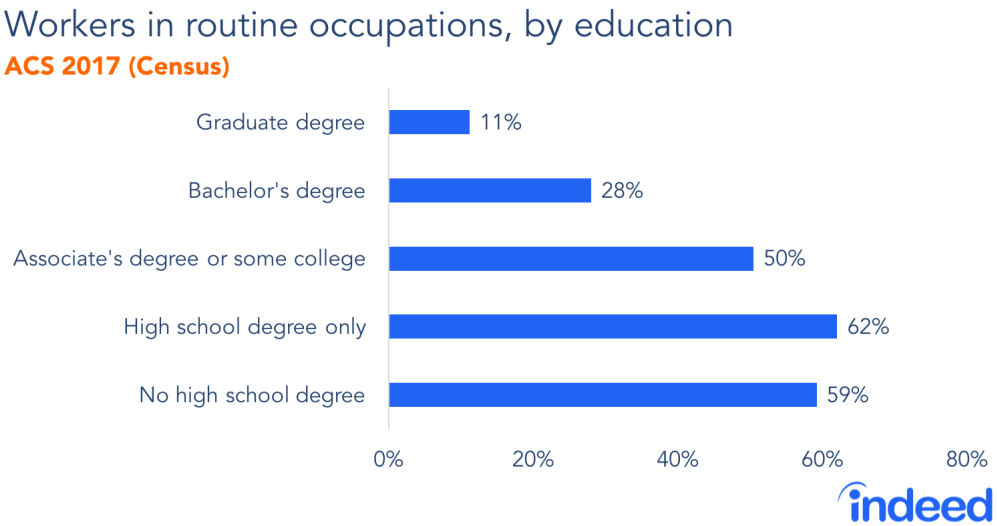
Even people not personally at risk are worried about automation

Although worries about automation are widespread, the pain is likely to be more concentrated. The types of jobs potentially most at risk from automation and AI are "routine"—expressed as a set of rules and therefore potentially replaced by algorithms. These include manufacturing and other goods-producing jobs, as well as sales and clerical roles. Professional, technical, and personal-service jobs are less vulnerable.

According to Census data, 62% of people with only a high-school degree work in routine jobs, versus just 28% of those with a bachelor's and 11% of graduate-degree holders. The education gaps in whose jobs are at risk are much wider than the gaps in how worried people are about automation.



Tweet

On other dimensions, the people who appear to be most at risk aren't the most worried. Although women are more concerned that automation will put many jobs at risk, they are less likely to hold routine jobs than men are —37% compared with 51% of male workers. Similarly, young adults 25 to 44 are the most worried about automation, even though they are less likely to work in routine jobs than 18 to 24 year-olds and those 45 or older.

Location also matters. Although there's little geographic pattern in who is worried about automation, jobs are more at risk in some places than others. Less than 35% of jobs are routine in metro San Jose and Washington DC, and college towns like Boulder, CO and Ithaca, NY. But more than 60% of jobs are routine in manufacturing centers like Dalton, GA and Elkhart, IN, and the oil boomtown of Odessa, TX. Places with a lower share of routine jobs have higher levels of education, and their residents are more confident about local economic conditions. They also are more likely to vote Democratic. So, even though worries about automation cross political and geographic lines, the pain would be likely to hit some people and places much harder than others.

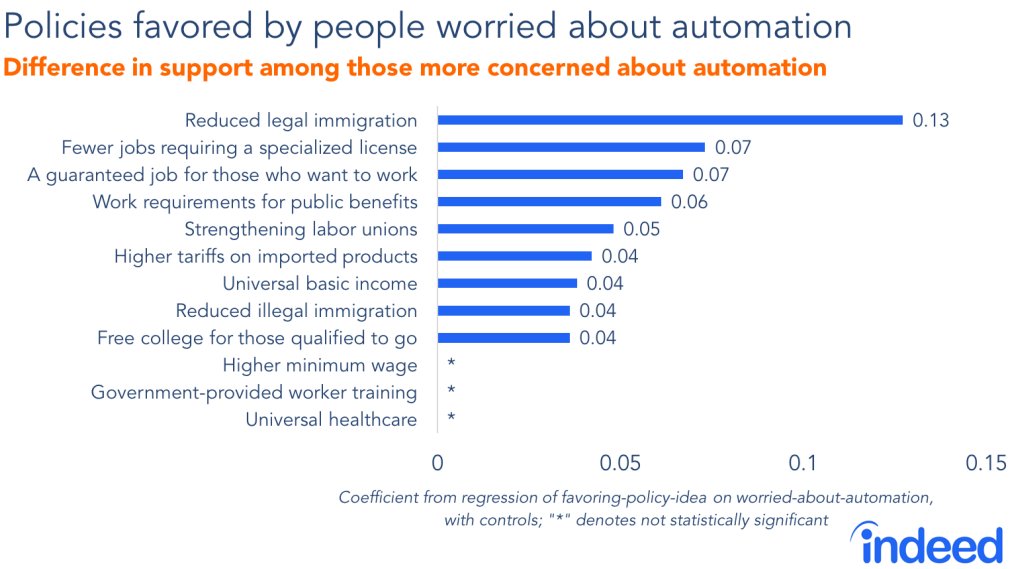
Automation concerns could lead to policy demands

There is no consensus among experts about how automation will affect the labor market. Some studies agree with the 60% of adults who think automation will hurt jobs, while other studies side with the optimistic 40%. But if automation does end up putting lots of people out of work, there'll be pressure on the government to do

something.

What labor market policies are popular among people who think automation will hurt jobs? People more concerned about automation tend to favor reducing legal immigration—perhaps in the hope they won't have to compete as hard for the dwindling number of jobs that survive automation. That's the policy most strongly associated with agreeing that automation will put many jobs at risk, after adjusting for demographics, partisanship, and other attitudes. Reducing specialized occupational licensing and instituting a jobs guarantee are also more popular policy ideas among people more concerned about automation's effect on jobs.

Notably, people worried about automation are no more likely to support government-provided worker training—even though experts argue workers will need retraining as automation transforms the labor market. And, universal basic income—a favorite policy of some tech leaders who are building the technologies that will speed automation—has only modestly higher support among people more worried about automation than those who aren't worried.



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There remain so many unanswered—and unanswerable—questions about robots, automation, and artificial intelligence. It's possible they will put tons of people out of jobs and force us to rethink the entire role of work. Or they might create new occupations we can scarcely imagine today, boost productivity, and make us all wealthier. Today, Americans lean toward pessimism. Anxiety is widespread about how automation will affect jobs. Even those who aren't themselves at risk of losing their jobs are worried. If their fears come true, political pressure to protect at-risk workers might build.

Methodology

This blog post is based on an online survey of 2,000 US adults age 18+ conducted September 19-23, 2018, for Indeed by Decipher/FocusVision. Weights were applied in order to match respondent distributions across age, educational attainment, race/ethnicity, and sex with the 2018 Current Population Survey's Annual Social and Economic Supplement.

Throughout this analysis, Democrats and Republicans include both people who identified with that political party, as well as independents and others who lean toward that party. Some questions follow the language used by the Pew Research Center. However, our results should not be compared with Pew Research Center results for trending purposes.

The prevalence of routine jobs is based on the US Census Bureau's 2017 American Community Survey.

The propensity of people to worry about automation is based on a regression of the 4-point scale response to agreement or disagreement with "robots, automation, and artificial intelligence will put many jobs at risk" on political leaning, attitudes about personal financial situation and national economic conditions, age, education, sex, and race/ethnicity.

The relationships between automation worries and specific labor policies are based on separate regressions of a 3-point scale response to whether each policy is a good idea on the 4-point scale response to the question whether robots, automation, and AI will put many jobs at risk. Controls were included for political leaning, attitudes about personal financial situation and national economic conditions, and several additional attitudinal statements about the labor market.

Jed Kolko

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DRIVERLESS? AUTONOMOUS TRUCKS AND THE FUTURE OF THE AMERICAN TRUCK

STEVE VISCELLI, PHD
Senior Fellow
University of Pennsylvania

Executive Summary follows

Full Report: http://driverlessreport.org/

DRIVERLESS?

Autonomous Trucks and the Future of the American Trucker

Steve Viscelli

September 2018

A report from the
UC Berkeley Center for Labor Research and Education
and Working Partnerships USA

UC BERKELEY LABOR CENTER

WORKING PARTNERSHIPS USA

Executive Summary

Will autonomous trucks mean the end of the road for truck drivers? The $740-billion-a-year U.S. trucking industry is widely expected to be an early adopter of self-driving technology, with numerous tech companies and major truck makers racing to build autonomous trucks. This trend has led to dozens of reports and news articles suggesting that automation could effectively eliminate the truck-driving profession.

By forecasting and assessing multiple scenarios for how self-driving trucks could actually be adopted, this report projects that the real story will be more nuanced but no less concerning. Autonomous trucks could replace as many as 294,000 long-distance drivers, including some of the best jobs in the industry. Many other freight-moving jobs will be created in their place, perhaps even more than will be lost, but these new jobs will be local driving and last-mile delivery jobs that—absent proactive public policy—will likely be misclassified independent contractors and have lower wages and poor working conditions.

Throughout this transformation, public policy will play a fundamental role in determining whether we have a safe, efficient trucking sector with good jobs or whether automation will exacerbate the problems that already pervade some segments of the industry. Trucking is an extremely competitive sector in which workers often end up absorbing the costs of transitions and inefficiencies. Strong policy leadership is needed to ensure that the benefits of innovation in the industry are shared broadly between technology companies, trucking companies, drivers, and communities.

The findings below are based on in-depth industry research and extensive interviews with the full range of stakeholders: computer scientists and engineers, Silicon Valley tech companies, venture capitalists, trucking manufacturers, trucking firms, truck drivers, labor advocates and unions, academic experts, and others.

294,000 or 2.1 million?
The need for scenario-forecasting analysis

Prior studies and news stories have suggested that nearly all of the roughly 2.1 million heavy-duty truck drivers in the United States could lose their jobs to automation. However, that number includes many industry segments that are unlikely to be automated in the near future, such as local pickup and delivery and carriers using specialized equipment. This report finds that the jobs most at risk of displacement are long-distance driving jobs with few specialized tasks, representing about 294,000 drivers.

1. Today, wages and working conditions in trucking vary widely by industry segment

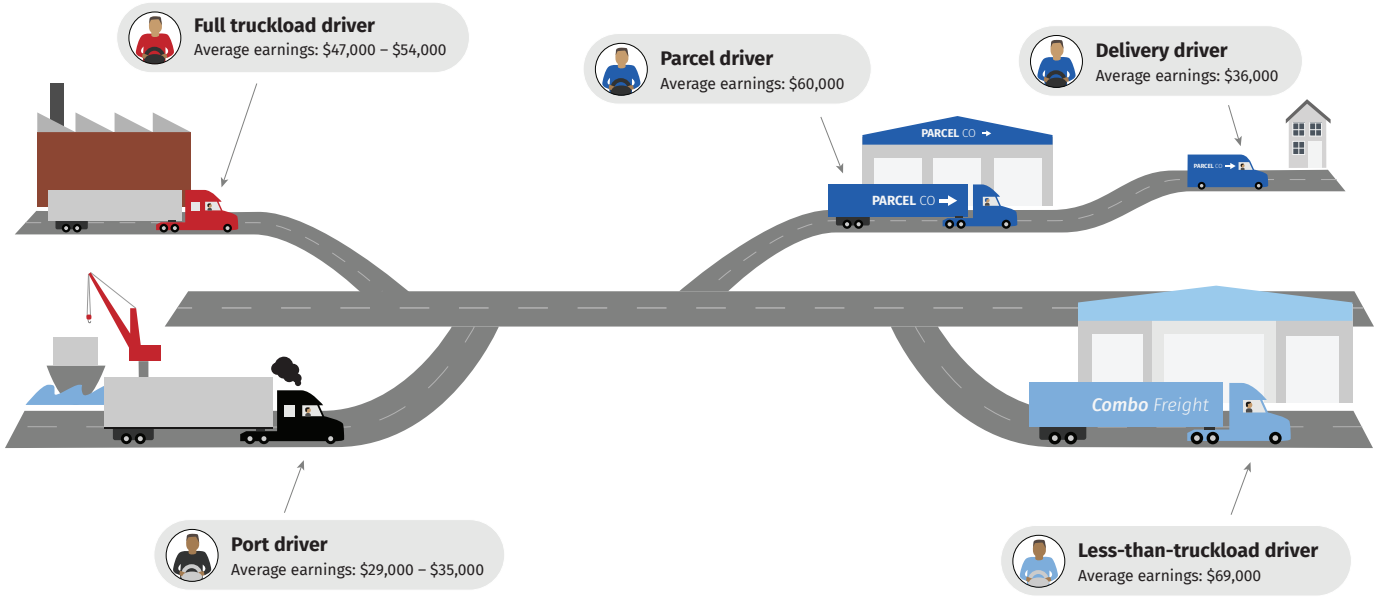
While truck driving is often portrayed as one of the few remaining middle-class jobs that doesn't require a college degree, Figure 1 shows that the quality of trucking jobs varies significantly across different segments of the industry, which can be split into long-distance and local driving.

Long-distance drivers move goods from factories to distribution centers or retail stores or between distribution centers. Many are working at "for hire" trucking firms, and an important distinction here is whether they are driving a full truckload for a single customer or if their load is a combination of freight from different customers (known as "less-than-truckload").

Drivers for less-than-truckload firms and parcel companies such as UPS typically have higher wages, better benefits, and stable careers (unionization rates are high). By contrast, full truckload companies tend to pay lower wages, churn through workers new to the industry, and often misclassify their workers as independent contractors (unionization rates are low). Unfortunately, these practices set the competitive standard in key parts of the industry.

Local driving jobs, particularly those driving light-duty trucks, pay significantly less than long-distance jobs. The large majority are local delivery drivers who perform a wide range of assignments, delivering anything from express packages to flowers. They take home salaries that can be half of what long-distance drivers make. The other major category of local driving jobs are at the ports, where drivers work long hours for low wages. When port drivers are contractors rather than employees, they can work the equivalent of two full-time jobs and earn less than minimum wage.

FIGURE 1: Current configuration of truck-driving jobs



2. Without policy intervention, automation will likely eliminate high- and mid-wage trucking jobs, while creating low-quality driving jobs

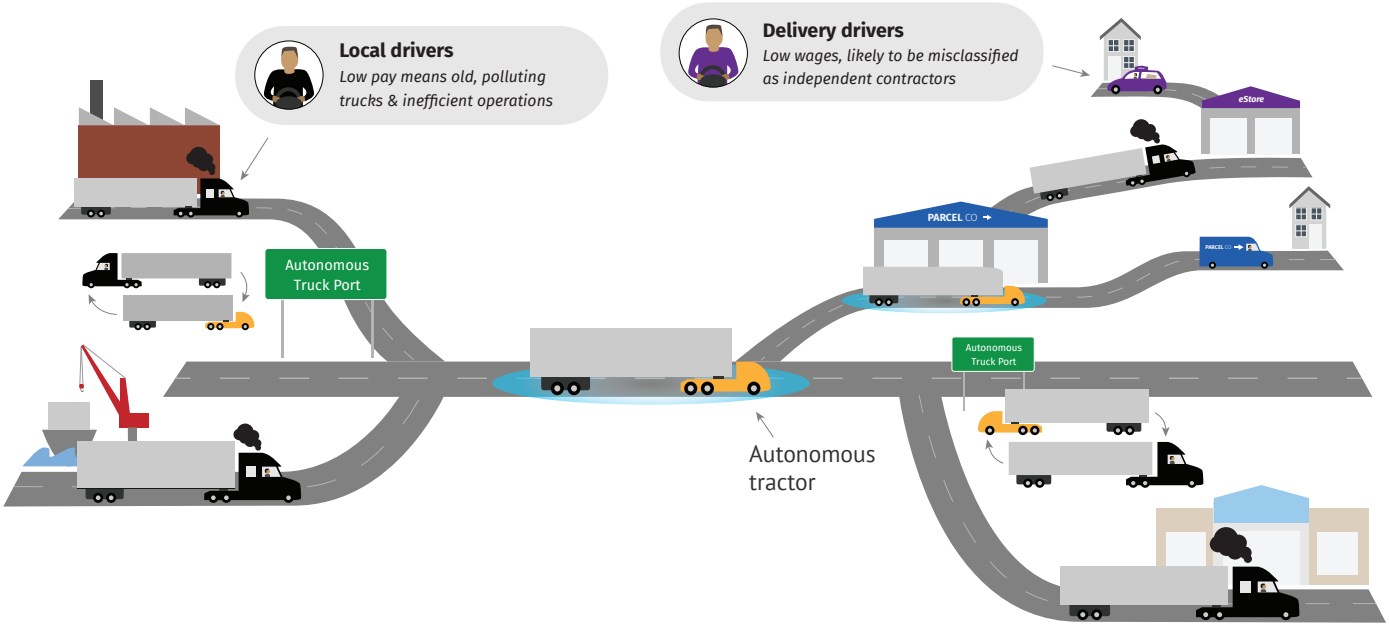
Based on an analysis of a range of potential scenarios for the adoption of self-driving technology (see *Potential Adoption Scenarios, page iv*), here are the four ways that automation is most likely to change trucking:

Autonomous trucks are best suited to long-distance highway driving, while humans will still be needed to navigate local streets and handle non-driving tasks.

Many industry experts and developers expect that self-driving trucks will soon be able to drive autonomously on the highway, but that it will take far longer (perhaps several decades) before driverless trucks will be able to routinely navigate local streets packed with cars, pedestrians, cyclists, road work, and other unexpected challenges. Humans will also be needed to handle the many non-driving tasks—coupling tractors and trailers, fueling, inspections, paperwork, communicating with customers, loading and unloading, etc.—that drivers currently perform.

Therefore, the most likely scenario for widespread adoption involves local human drivers bringing trailers from factories or warehouses to "autonomous truck ports" (ATPs) located on the outskirts of cities next to major interstate exits. Here, they will swap the trailers over to autonomous tractors for long stretches of highway driving. At the other end, the process will happen in reverse: a human driver will pick up the trailer at an ATP and take it to the final destination (see Figure 2).

FIGURE 2: Most likely automation scenario, absent policy intervention



Potential Adoption Scenarios

This study is based on an analysis of six potential scenarios for how self-driving technology could be used in the trucking industry. The scenarios are the result of interviews with engineers, developers, trucking firms, and drivers, along with reviews of industry trade literature.

- **Human–human platooning:** A series of human-driven trucks would be electronically linked, with the lead truck controlling speed and braking in the following truck(s). This approach would let the trucks travel much closer together on the highway, improving aerodynamics and fuel efficiency. Each truck would still have a human driver to maintain the lane and navigate local streets.
- **Human–drone platooning:** Similar to the human–human platoon, except that a single human driver would lead a platoon of autonomous drone trucks on the highway. The human driver would be available to operate the lead truck, manage unexpected situations, or make repairs and ensure safety if a truck broke down mid-route. As in the exit-to-exit scenario below, local drivers would bring loads to an autonomous truck port (ATP) near the highway, where they would swap trailers with the drone trucks for the highway platoon.
- **Highway automation + drone operation:** Human operators would remotely control trucks on local streets and in complicated situations, and then trucks would drive autonomously on the highway. This approach would rely on highly trained dock staff to handle tasks currently performed by drivers, such as inspection and coupling.
- **Autopilot:** Similar to autopilot in airplanes, a human would handle loading and local driving, then sleep in the back of the truck while the computer drove on the highway.
- **Highway exit-to-exit automation:** Human drivers would take care of non-driving tasks and navigate complicated local streets, then swap trailers with self-driving trucks at an ATP next to the highway. The autonomous truck would handle the long-distance freeway driving, then hand off the load at an ATP near the destination.
- **Facility-to-facility automation:** In situations where warehouses and shipping facilities are located near major interstates, autonomous trucks may be able to handle industrial roads (where there are few pedestrians and complex intersections) and drive directly from origin to destination.

Absent significant changes in the policy or economic context, this report concludes that highway exit-to-exit automation is the most likely scenario to be widely adopted in the future. However, human-led platoons represent a model that has fewer technological challenges, a strong economic case, and better jobs for long-distance drivers.

Automation could replace most non-specialized long-distance drivers—about 83,000 of the best trucking jobs and 211,000 jobs with moderate wages but high turnover rates and poor working conditions.

As shown in Table 1 (page v), the most likely automation scenario evaluated in this report could result in the loss of an estimated 294,000 trucking jobs. Specifically, self-driving trucks will be best suited for use in industry segments with long stretches of highway driving, minimal need for drivers to perform other tasks, and large firms with the capital to buy (and expertise to integrate) new technologies.

Two parts of the long-distance industry best fit this bill:

TABLE 1: Truck driving jobs and potential impact of autonomous trucks

Key segments of the trucking industry	Average annual wage	Number of drivers	Turnover	Independent contractors	Unionization rates	Potential impact of autonomous trucks
LONG DISTANCE DRIVING						
Full truckload	$46,641–$53,690	211,000	High	Common	Low	Significant job loss
Less-than-truckload	$69,208	51,000	Low	Uncommon	High	Significant job loss
Parcel	$59,660	32,000	Low	Uncommon	High	Significant job loss
LOCAL DRIVING						
Ports	$28,783 (contractors) $35,000 (employees)	75,000	Low	Predominant	Low	Uncertain
Pickup and delivery	$35,610	877,670	Varies	Mixed, potential to shift towards contractors	Varies	Strong job growth
POTENTIAL NEW SEGMENT (PROJECTED)						
Autonomous truck ports	?	100,000+	?	?	?	Strong job growth

Notes: See Section 4 for sources on wages and employment.

Truckload

Truckload drivers typically work for large trucking companies, hauling full trailers over long distances directly from one customer location to another. These drivers rarely perform work such as loading and unloading or caring for special kinds of freight. These characteristics make their jobs more likely to be automated. An estimated 211,000 long-distance jobs in this segment are at risk of displacement from autonomous trucks. As described above, working conditions in this segment are arduous, and turnover is high. Wages are lower than in the unionized segment of trucking and private, in-house fleets, but higher than local delivery driving, the lowest-wage segment of the industry.

Less-than-truckload and parcel

In parcel and less-than-truckload operations, shipments from different customers are combined together at trucking company terminals, driven to another facility near the destination, and then

sent out for delivery. The long-distance drivers who haul these combined shipments on the highway rarely do much more than driving, which makes their jobs also vulnerable to automation. Up to 51,000 less-than-truckload drivers are at risk of displacement by autonomous trucks, plus another 32,000 parcel drivers. These are some of the best jobs in the industry, and drivers earn some of the highest incomes in trucking, in part because of high unionization rates. Because these drivers are able to make a career out of trucking, they tend to be older than the average driver and much older than the average U.S. worker.

Over the next several decades, e-commerce growth and lower freight costs could create many new driving jobs, perhaps more than will be lost to automation. Without policy intervention, however, these new jobs will likely have low wages and poor working conditions.

The combination of automation decreasing the cost of moving freight by truck and consumers ordering more goods online and expecting rapid delivery will likely increase the need for local drivers to:

- Move loads to and from autonomous truck ports;
- Shuttle goods from large centralized warehouses outside cities to smaller local depots—the approach being adopted by firms such as Amazon to enable rapid last-mile delivery;
- Deliver packages and other goods to customers' doors.

However, without proactive public policy, these new driving jobs are likely to be far worse than the jobs that are lost. Drivers bringing loads to ATPs are likely to face conditions similar to those currently experienced by port drivers, such as low pay, long periods of unpaid waiting, and independent contractor misclassification. The port driving sector is rife with stories of drivers putting in 16-hour days but losing money after paying off truck loans, company charges, and other fees. And if local drivers can only afford old and inefficient trucks, more communities are likely to suffer from the high pollution and asthma rates common in neighborhoods near ports.

Delivery drivers, meanwhile, typically take home less than half the pay of better-paid long-distance drivers. Retailers seem increasingly likely to subcontract to small firms with low pay or to adopt the Amazon Flex model of treating delivery drivers as independent contractors who do not receive benefits, must use their own vehicles, and lack the right to organize for higher wages and better working conditions.

Splitting trucking into local human driving and autonomous highway driving is likely to foster the "digitization" of freight matching, with the potential for intense downward pressure on driver earnings.

Currently, long-distance trucking firms rely on complex systems to match drivers with a series of loads, seeking to minimize miles driven without freight, while complying with limits on how

long drivers can be behind the wheel. Splitting trips between autonomous trucks that can almost constantly be on the highway and local human drivers who go home each night vastly simplifies this load-matching problem. This approach is likely to lead to the "digitization" of freight, with app-based marketplaces where local drivers can select from available loads.

Digitization could significantly reduce the number of miles driven without freight, saving the trucking industry billions each year. However, the destructive competition of a digitized load-matching system could put intense downward pressure on local drivers' earnings. To a significant degree, the impact of this approach on drivers will depend on public policy and job-quality standards.

3. Proactive industry and public policy action will be needed if automation is to deliver broad economic, environmental, and social benefits

The way we move goods is going to change dramatically in the coming decades, but how new technologies make their way onto our roads—who benefits, who may be left behind, the impact on our environment—will be shaped by the response of governments, businesses, and workers across the industry. Effective public policy can ensure that trucking evolves into a productive, high-road industry. Policymakers, collaborating with workers and industry leaders, have an opportunity to tackle some of our biggest challenges: creating good, family-supporting jobs, improving road safety, and reducing traffic congestion and carbon emissions. The following three main pillars should drive that collaboration.

Develop an industry-wide approach to worker advancement and stability

Policymakers should create a Trucking Innovation and Jobs Council, bringing together diverse stakeholders across the sector—workers, employers, technologists, and policymakers—to support a 21st-century trucking workforce. The Council would develop and implement an action plan for how industry stakeholders would fund, design, and carry out policies and programs to accomplish two goals: (1) the development of good career pathways and training/job-matching programs for incumbent, dislocated, and future workers; and (2) the creation of safety-net programs to support transitions within and out of the industry, including work-sharing initiatives, supplemental and flexible unemployment insurance, and retirement packages.

Ensure strong labor standards and worker protections

Policymakers should establish a framework of strong labor standards that can shape the impact of autonomous trucks, ensuring high-quality trucking jobs now and into the future. Specific policies include addressing independent contractor misclassification and wage theft; expanding early warning systems in the case of layoffs; and exploring new ways to establish good jobs in the industry and strengthen workers' right to organize. Some of these policies have long been needed;

the goal is to enact them now so that low-wage business models do not become the norm in the industry's growth segments.

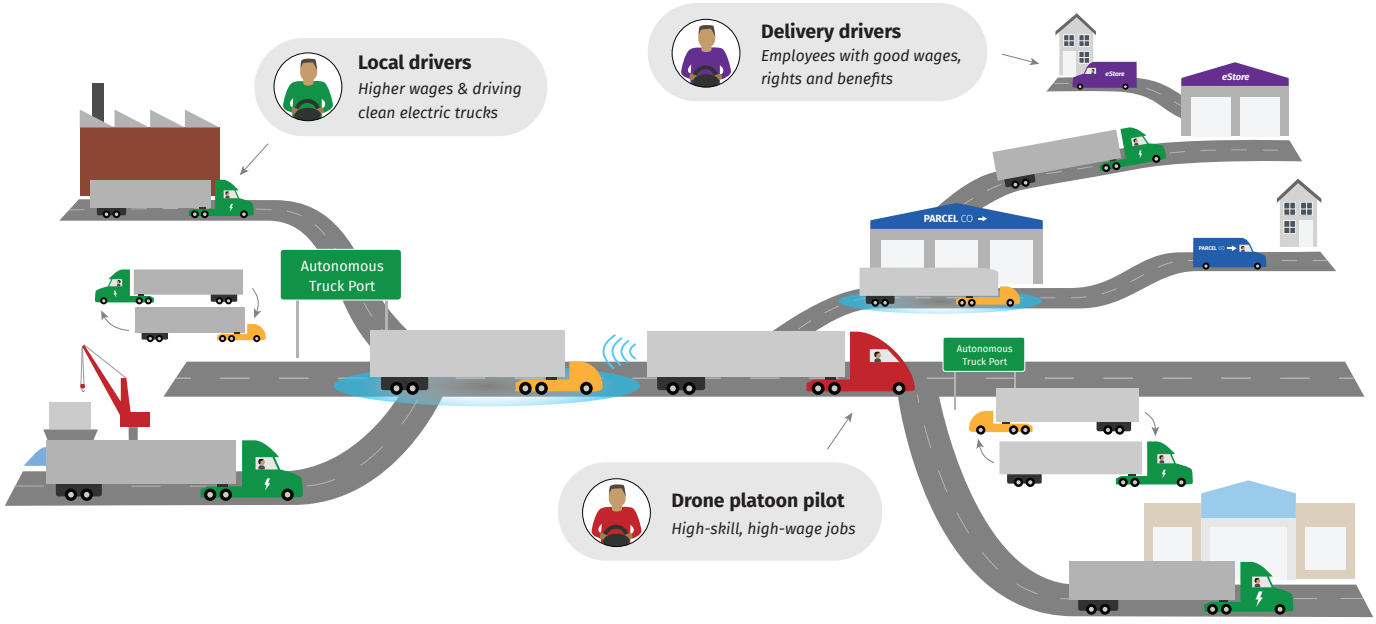
Promote innovation that achieves social, economic, and environmental goals

In order to ensure the best social, economic, and environmental outcomes for drivers, local communities, and our transportation infrastructure, policymakers need to play an active role in regulating the industry and the development of new technology. Examples of specific policies include engaging stakeholders to develop a shared innovation agenda and leveraging public research funding to implement it; allowing state and local governments to experiment with new policy responses; and ensuring that public dollars and policies do not subsidize the displacement of workers.

* * *

What might an alternative, shared innovation agenda look like for the adoption of autonomous trucks? This report identifies an adoption scenario with good outcomes for workers, job quality, and public health and safety: human-led platooning, coupled with clean and electric trucks. Figure 3 illustrates this scenario, where drivers lead platoons of autonomous trucks on highways and have the experience and knowledge to deal with equipment problems, poor weather, and rapidly changing road conditions like accidents, construction, traffic, and erratic drivers. This model would yield many of the best environmental benefits of automation through increased fuel economy and the use of clean trucks for the growing segment of local driving. The policy menu outlined above would also raise labor standards and help train and support workers through the transition. The result would be a robust, sustainable 21st-century trucking industry that broadly shares the benefits of innovation among technology companies, trucking companies, drivers, and communities.

FIGURE 3: Alternative automation scenario, with policy intervention

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