



RESEARCH AGENDA

PREPARING FOR THE WORK OF THE FUTURE

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ABSTRACT

Breakthroughs in artificial intelligence and robotics are rapidly changing the terms of comparative advantage between humans and machines in the workplace, with potentially profound implications for labor market operation and for the opportunities available to human workers of different skill and education levels. This overview paper discusses four areas where research is needed to identify strategies for managing these changes in ways that benefit workers, firms, and the broader economy: (1) skills training, (2) postsecondary education, (3) alternative work arrangements and the “gig economy,” and (4) management practices. In each area, we highlight key findings from recent studies and discuss opportunities for further innovative experimentation to evaluate program and policy options, pilot novel interventions, and help workers, firms, and governments prepare for the “Work of the Future.”

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1. INTRODUCTION

Advances in artificial intelligence (AI) and dexterous, adaptive robotics are rapidly shifting the terms of comparative advantage between humans and machines in performing different tasks—with potentially profound implications for future labor markets and for the earnings opportunities available to human workers of different skill and education levels (Brynjolfsson and McAfee 2014; Autor 2015; Acemoglu and Restrepo 2018a). Uncertainty about how these technology-induced changes will play out is prompting anxiety and anticipation alike, and has become an area of active research and debate.¹ From a policy perspective, implications for the career prospects of workers without postsecondary education, and for broader trends in income inequality and labor market polarization, have emerged as topics of particular concern (see text box “Technology’s Polarizing Effect on Labor Markets: Recent Trends and Implications for Less-Educated Workers”). J-PAL North America’s Work of the Future Initiative was launched to support rigorous research that helps answer the question: How can workers, employers, governments, nongovernmental organizations, and educational institutions prepare for, and perhaps mitigate, technology’s disruptive effects while also maximizing technology’s potential to promote economic growth, expand economic opportunity, and complement human skills in ways that make for rewarding, high-quality jobs? This overview paper highlights key findings from research to date on these issues and identifies specific questions, topics, and research opportunities that could extend current understanding and help guide future workforce policies and investment.

¹ See Graetz and Michaels (2018); Acemoglu and Restrepo (2017, 2018b); Autor and Salomons (2018); Nakamura and Zeira (2018) for a small subset of recent perspectives on this topic.

The research agenda we outline is organized into four broad areas of inquiry. The first two concern worker training and post-secondary education, respectively, which are widely viewed as critical to equip current and future workers with the skills to thrive in an economy where automation, AI, and other new machine technologies have the potential to replace humans in a growing set of tasks. A third topic area is the “gig economy” and the emergence of nontraditional work arrangements, in many cases enabled by new technology. Though already the subject of numerous studies, further research could help answer open questions about the role of technology in the gig economy, the labor supply preferences of gig economy workers, the skills demanded of these workers, and—importantly—effective policy options for improving economic security for people in nontraditional work arrangements. The fourth and last topic area focuses on opportunities to boost firm productivity and benefit workers through improved general management practices, better workplace design, and thoughtful attention to machine–human interactions.

In each of these four broad areas, further research and creative experimentation are needed to answer open questions, formulate more effective policy responses, and direct future investment in technology and human capital alike. Throughout this paper, we highlight opportunities for using randomized control trials (RCTs) to build out the knowledge base; in some cases, we also offer a small sample of existing experiments and describe specific experiments that seem especially promising. Of course, additional questions and experiments, beyond those identified here, may offer fruitful and important lines of inquiry—thus, we hope this paper, far from bounding the scope of future J-PAL activity on these issues, serves as a starting point to stimulate further thinking and innovative research designs.

The disruptive and highly uneven effects of technological progress on labor markets and earnings opportunities for workers of different skill levels have been well documented (Acemoglu and Autor, 2011; Acemoglu and Restrepo, 2018c). As computers and robotics have displaced human labor in a growing number of middle-skilled, routine tasks, labor markets in industrialized economies have become increasingly polarized, with employment concentrated in high-education, high-wage professional, technical, and managerial occupations, on the one hand, and low-education, low-wage occupations—such as service and manual jobs—on the other (Autor et al., 2006, 2008; Goos and Manning, 2007; Autor, 2013; Michaels et al., 2014; Goos et al., 2014). The data suggest that this hollowing out of middle-skill work began in earnest in the decade from 1980 to 1990, accelerated thereafter, and grew most rapidly between 2000 and 2015. These shifts have differentially affected workers of different skill levels, greatly benefiting individuals with at least some college education, whose skills are strongly complemented by technology, while simultaneously shifting many non-college educated workers (i.e., those with high school or lower education), who might previously have been able to obtain middle-skill jobs in manufacturing/production or clerical/administrative occupations, into low-wage work. The overall result has been a striking divergence in real wages by education: even as the number of more-educated workers has increased (relative to the number of less-educated workers), their earnings have risen sharply while those of less educated workers have declined (Autor, 2019).

In recent work, Autor et al. (2019) document that the polarization of jobs and earnings in the United States over the last four decades has had an important geographical dimension. Specifically, the technology-induced loss of middle-skill jobs, which used to be concentrated in urban areas (typically in the form of production and manufacturing jobs for men and office or clerical work for women), has driven growing numbers of non-college adults who live in cities and metropolitan areas into traditionally low-education, low-wage jobs in service occupations (e.g., food service, cleaning, security, recreation, health aides), transportation, and manual labor. These workers face stagnant or declining earnings prospects, even in cities with thriving economies and excellent job opportunities for highly educated workers. A key consequence of these trends has been the unwinding of the historically robust urban wage premium that, until circa 1970, used to accrue to workers of all skill levels in densely populated areas. Over the last four decades, however, the urban wage premium for non-college workers has declined precipitously (Baum-Snow et al., 2018; Autor, 2019), even as the urban wage premium for college workers has risen sharply (Diamond, 2016).



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Overall, the hollowing-out of earnings opportunities for less educated workers, particularly in urban areas, has exacerbated occupational and income segregation, likely knocking out additional rungs in the ladder of opportunity for these less-educated adults and their children. These findings beg the question: Where is the land of opportunity for low-wage workers? Using an approach pioneered by Lin (2011), Autor and Salomons (2019) study the composition of emerging job opportunities using changes in Census Bureau occupational titles. They propose three broad categories with different skill requirements and likely earnings prospects: (1) “frontier jobs,” which involve the production and use of new technologies—these jobs tend to be relatively highly paid and disproportionately held by college-educated men; (2) “wealth jobs,” which typically involve providing labor-intensive, in-person services to affluent consumers—these jobs are not usually technically demanding and typically offer wages close to the mean of the local wage distribution; and (3) “last mile jobs,” which involve carrying out nearly-automated tasks that require a residual set of human abilities—these jobs typically require no specialized skills and pay below-average wages. In other words, available evidence seems to suggest that the work of (at least) the near future is likely to be as strongly polarized as the work of the present in terms of skill requirements and wage levels. This work adds urgency to the overarching policy challenge that animates J-PAL North America’s Work of the Future research agenda: How to navigate the technological developments that will shape future job markets and develop the skills and other supports that will allow workers of all education levels, but most urgently non-college educated workers, to thrive.

2. SKILLS TRAINING

Technological change has always shaped labor markets by shifting demand for different tasks and human skills. Just as past advances caused jobs in agriculture to decline while increasing demand for factory workers, the next wave of advances in robotics and AI can be expected to cause large employment declines in certain occupations (motor vehicle operators, for example), while simultaneously creating demand for new tasks that potentially require different skill sets (such as monitoring and maintaining semi-autonomous machines). Investment in training to provide workers with new skills is an obvious and common policy response to counter these displacement effects. Understanding what can be achieved through such investments and which training models are most effective at helping workers boost their long-term employment and earnings prospects is therefore an important area for further research.

2.1. Understanding the Efficacy of Different Training Models and Delivery Mechanisms

A large number and variety of training or “active labor market programs” (ALMPs) have been implemented in the United States and other developed and developing countries. Studies of these programs have come to mixed conclusions about their efficacy.

Two careful meta-analytic studies of the vast literature on ALMPs by Card et al. (2010, 2017) find modestly positive average effects of these programs writ large. Although impacts average close to zero in the short run, results tend to become more positive two to three years after completion of the program. The time profile of impacts varies by type of program, with larger average gains for programs that emphasize human capital accumulation. Job search assistance programs that emphasize “work first” tend to have similar impacts in the short and long run, whereas training and private sector employment programs have larger average effects in the medium and longer term. Public sector employment subsidies tend to have small or even negative average impacts across all time horizons. The average impact of ALMPs varies across groups. Job search assistance programs appear to be relatively more successful for disadvantaged participants, whereas training and private sector employment subsidies tend to have larger average effects for the long-term unemployed. Brown and Freund (2019) review ALMPs outside the United States. They find modestly positive average effects for job placement services, training programs, and wage subsidies. By contrast, public work programs and direct job creation are reported to be ineffective. These aggregate conclusions, by their nature, sum over outcome measures for a plethora of heterogeneous programs and thus may mask differences in overall efficacy, or efficacy for specific subpopulations or in specific circumstances (e.g., during periods of economic recession versus expansion).

Given these modest benefits, many economists and policy makers have come to view investments in traditional training programs with some skepticism. For example, a recent World Bank report estimates that only 30 percent of youth employment programs are successful, and many of those have limited positive effects (Kluve et al., 2016). Other approaches to skills training, however, may show more promise. For example, apprenticeships typically combine paid on-the-job training with classroom instruction to prepare workers for high-skill careers. Workers benefit from apprenticeships by receiving a skills-based education that prepares them for good-paying jobs, while employers benefit by recruiting and retaining a skilled workforce. An example of an apprenticeship program in the United States that is widely considered to be successful is the Georgia Youth Apprenticeship Program, which benefits from a collaboration between state government, high schools, postsecondary schools, businesses, and worksite supervisors (Lerman, 2014). Evidence on the general efficacy of apprenticeship programs, however, is relatively thin. Reviewing a program that provides subsidies to third-party employers who provide jobs to eligible disadvantaged workers, Dutta-Gupta et al (2016) finds clear benefits in terms of higher earnings and employment and concludes that the subsidies are socially cost-effective.

Early evidence from experiments with apprentice-like sectoral employment programs is perhaps even more promising. As with apprenticeships, these programs emphasize on-the-job training, but they do not require the creation of formal or registered apprenticeship positions. Typically, sectoral training programs include some upfront screening (e.g., minimum literacy and math skills and showing up on time for intake sessions); soft-skills training; three to eight months of occupational/industry training, often with an industry partner and/or community college or nonprofit intermediary; job placement; and follow-up services. The text box “Summary of Recent Research on Sectoral Employment Programs” summarizes findings from recent studies of several programs of this type. Based on the fact that researchers have found short-to-medium-run impacts on earnings of around 20 percent or more in eight of the eleven program evaluations discussed in the box,² there is accumulating evidence that sectoral approaches may be more effective than older training models, such as the Job Training Partnership Act (JTPA) and the Comprehensive Employment and Training Act (CETA). These older programs employed a more general, “one size fits all” approach to training that may be less effective in an economy that demands more specialized skills (Fadulu, 2018).

2 The eleven evaluations cover ten sectoral training programs: three programs in the P/PV sectoral employment study (Wisconsin Regional Training Partnership, Jewish Vocational Service-Boston, and Per Scholas); four programs in the MDRC WorkAdvance study (Per Scholas, St. Nicks Alliance, Madison Strategies Group, and Towards Employment); Project QUEST; Year Up, YouthBuild, and National Guard Youth ChalleNGe. Of note, the Per Scholas program is evaluated twice with similar results for different cohorts eight years apart.



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As Bertrand et al. (2019) note, high school vocational education has a controversial history in the United States, largely due to a perceived trade-off between teaching readily deployable occupational skills versus shunting mostly disadvantaged students away from the educational and career flexibility afforded by general academic courses. This longstanding debate receives new evidence in Bertrand et al.'s (2019) study of the Norway's "Reform 94" policy. This policy integrated more and better general education into the Norwegian vocational education track, offered vocational students a pathway to college through a supplementary semester of academic courses, and sought to improve the quality of the vocational track through greater access to apprenticeships. Bertrand et al. identify the impacts of the reform through a difference-in-discontinuity research design, comparing students born just before and after the reform's birthdate eligibility cutoff to students born around the same cutoff in placebo years.

Bertrand et al. (2019) find that the high-quality vocational training offered by Reform 94 drew marginal boys out of a 'college track' in Norway and into skilled blue-collar jobs where they ultimately experienced higher adult earnings. Comparing treated and untreated cohorts of students, the paper is able to infer that essentially none of the marginal boys who were diverted from college-track to vocational-track high school programs by Reform 94 would otherwise have completed college. Thus, the tradeoff between 'college diversion' and 'vocational investment' was essentially absent for young Norwegian men. The results were less encouraging for Norwegian women, however. Reform 94 induced more women to enter the vocational track, increased their high school graduation rates, and ultimately raised the fraction of women who were college-eligible. Despite this, it had no effect on college completion or adult earnings. A proximate explanation appears to be that young women entering the vocational track almost exclusively pursued training in lower-paying service-based fields. These findings underscore the potential of well-designed vocational education programs to foster entry of young adults into skilled blue-collar occupations without inadvertently diverting disadvantaged students from pursuing higher education. At the same time, they highlight the critical importance of appropriate sectoral targeting, especially vis-à-vis traditionally gendered non-college jobs. Vocational education that guides young women or young men towards occupations with limited potential for skills acquisition and earnings growth over the career is unlikely to be worthwhile.



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A labor market that is continually evolving in response to technological change is likely to create continuing and growing demand for training and “re-skilling” programs. Against this backdrop further research is needed to better understand which types of programs and specific interventions or program elements are likely to be effective for different populations and industry settings, and to explore how existing models that have demonstrated effectiveness might be successfully scaled up. Recent work by Davis et al. (2017) offers a potentially useful framework for evaluating the performance of sectoral training programs at scale. Scale-up challenges likewise apply to expanding the apprenticeship model. Lerman (2014) identifies multiple barriers to building apprenticeship systems in the United States, including lack of information, employer perceptions that apprenticeships will bring in unions, the failure to track unregistered apprenticeships, and the limited budget of existing apprenticeship programs, which tend to be focused in the construction sector. Finally, research is needed to evaluate the effectiveness of even newer training models that have emerged in recent years, such as the Pathways in Technology Early College High School (PTEC) program, which was launched by IBM in Brooklyn, and Pacific Gas and Electric’s PowerPathways skill development program, which partners with local community colleges in California (Holzer, 2011).

2.2. Complements to Skills Training

An important question for new research is whether other employment supports or services can complement the benefits achieved through skills training. Evaluations of programs that combine multiple types of interventions suggest that such supports may be as or more important than the training component in some cases. For example, McConnell et al. (2016) and Fortson et al. (2017) examined a program that provided intensive services and training to a randomly selected group of unemployed workers. Participants are randomly assigned to receive customized entrepreneurial or on-the-job training, adult basic education, and/or intensive services, including a staff assessment, job search assistance, and career counseling. Data from a follow-up survey indicate that these intensive services increased participants’ earnings by about \$7,133, or 20 percent, over the full thirty months after job seekers were enrolled in the study. By contrast, providing training funded under the federal Workforce Investment Act of 1998 (WIA) did not increase earnings or improve employment-related outcomes in the thirty months after random assignment relative to providing only core and intensive services.

A recent non-experimental study by Hyman (2018) examined worker-level earnings and re-employment responses to Trade Adjustment Assistance (TAA), a large social insurance program that couples retraining incentives with extended unemployment insurance for displaced workers. The author exploits the quasi-random assignment of TAA cases to investigators of varying approval leniencies. Using employer–employee matched Census Bureau data, Hyman found that TAA-approved workers had approximately \$50,000 greater cumulative earnings ten years out, as a result of both higher incomes and greater labor force participation. In the most disrupted regions, workers who participated in TAA were more likely to switch industries and move to labor markets with better opportunities.

Liquidity constraints are another factor that shapes some individuals’ training and re-skilling decisions. Both the meta-analyses by Card et al. (2010, 2017) and a recent report by the Council of Economic Advisers (2018) emphasize that skill-based interventions may have a high rate of return, but they take longer to pay off and have higher up-front costs. Thus, individuals who cannot afford to stop working for an extended period of time may have difficulty taking advantage of productive training opportunities. Future research could explore the role of liquidity constraints and identify related interventions as a potentially important complement to training and re-skilling programs.³

3 For example, Minnesota recently introduced bipartisan legislation to allow people to use tax advantaged savings accounts to pay for educational expenses like skills training, apprenticeships, & professional development. (Klobuchar, 2019).

Other types of interventions focus on disseminating information about and helping individuals navigate the patchwork of skill training and job support services available to them. The state of Missouri, for example, has pioneered a program to provide laid-off workers with job vacancy information tailored to their individual skill sets and likely geographic mobility (Council of Economic Advisers, 2018). The information comes from a software analytics company, Burning Glass Technologies, which maintains an extensive labor market database, and is provided by the state's Dislocated Worker Program as soon as the state receives notice of a plant closing or mass layoff (Dislocated Worker Program).

In another recent quasi-experimental paper, Barr and Turner (2018) study a program in which unemployment insurance (UI) recipients were sent a letter to encourage them to enroll in postsecondary education programs. The letter provided information on eligibility for federal financial aid (through the Pell Grant program) that UI recipients may not have been aware of. The program led to a large increase in postsecondary enrollment among UI recipients within six months of receiving the letter but its ultimate earnings effects are uncertain. This is an unfortunate limitation, since earnings estimates would be informative about the extent to which UI recipients might have been making a “mistake” due to a lack of full information about their higher education financing options.

Other types of informational interventions target the demand side of the labor market by helping to disclose worker abilities to potential employers. Pallais (2014) conducts an experiment in which independent contractors are randomly hired and given either detailed or coarse public evaluations on an online platform. Being hired and being the subject of a detailed evaluation were found to substantially improve a worker's subsequent employment outcomes, especially for workers with previous jobs. Follow-up experiments are needed to explore how subsidies for hiring young workers and public access to employment test results might affect entry-level labor markets.

Programs that actively assist displaced workers by connecting them with relevant training and support services and/or by matching them with suitable new job opportunities represent another promising area for future research. More broadly, the difficulty of navigating fragmented support systems creates opportunities for intermediaries—or “connectors”—to help individuals access these systems. A number of recent experiments, which connect individuals to benefits and information, provide a potentially useful template for this kind of work (Finkelstein and Notowidigdo, 2019; Guyton et al., 2017; Bettinger et al., 2012). Whether the challenge is filling out financial aid applications, signing up for social insurance programs, or taking advantage of job training opportunities, many eligible people appear to be leaving benefits on the table. Measuring the potential to realize private and social returns by improving individual navigation processes could be

the subject of an informative experiment. The specific form of related interventions—simple information, application assistance, counseling, and/or mentoring—could also be part of the experimental design, both to compare cost-effectiveness across different types of interventions and to evaluate which interventions are complements and which are substitutes. Babcock et al. (2012) provide useful guidance on designing complementary interventions to target related behavioral issues (such as providing mentoring to combat procrastination and de-bias worker expectations as part of job search assistance programs).

Of course, different populations of workers are likely to benefit from different types of interventions. Training strategies and job supports tailored to older displaced workers, for example, may not be as effective for younger people who are just entering the workforce, and vice versa. Similarly, labor market conditions and skill demands are likely to vary across regions and industries. Even within a given training program, different participants are likely to realize different levels of benefit. Thus, new research to explore treatment effect heterogeneity can uncover information about which parts of the population are most likely to benefit from different types of training.

Such research could also inform future efforts to improve program efficacy through better targeting, both in terms of designing programs to serve particular populations and in terms of refining outreach and enrollment efforts. New machine learning methods may make it possible to target individuals who are most likely to benefit from a particular program, thereby increasing overall effectiveness (Nichols and Zeckhauser, 1982). The limitations and potential unintended consequences of such “targeting” or “profiling” systems, however, must also be understood. For example, Black et al. (2003) studied a profiling system for UI recipients where marginal recipients were randomly selected to receive re-employment services. Black et al. (2003) found that the system, which was designed to recommend individuals for training who were most at risk for long-term unemployment, instead caused individuals to exit unemployment; the authors concluded that the “threat” of mandatory training may have been more effective than the training itself in this context. Additionally, the underlying economic logic of targeting and profiling is subtle and may be sensitive to behavioral biases (such as lack of information or inattention) that may cause individuals to make mistakes when deciding whether to enroll in beneficial programs (Finkelstein and Notowidigdo, 2019).

2.3. Broader Impacts of Skill Training Programs

More research is needed to understand the nature and extent of training program effects, for individuals and the broader labor market. To date, experiments aimed at assessing the efficacy of training programs have tended to focus on outcomes for the individuals who enroll. This could overstate or understate the aggregate impact if training has spillover effects for individuals who are not directly targeted by the program. Such effects could be positive, if, for example, individuals learn about training programs from their friends, family, or coworkers and decide to enroll themselves. In this case, traditional experiments would understate the aggregate gains from training.

On the other hand, training programs that make it easier for one individual to find a job could make it harder for an “untreated” individual to find a job. This is likelier to be an issue in labor markets where jobs are rationed, either for institutional reasons or because macroeconomic conditions are poor. In these cases, the employment and earnings gains from successful programs could come at the expense of crowding out job seekers who do not obtain training. Randomization executed at the site level (rather than at the individual level) can allow researchers to study spillovers through mechanisms such as peer communication, which may be especially important for information or counseling-type interventions. Crépon et al. (2013) report results from such a “cluster” randomization, which was carried out in France to study the spillover effects of job placement assistance. Their paper provides a useful template for studying spillover effects in other contexts. Together with high-quality evidence from other experimental and quasi-experimental papers in a range of settings (Lalive et al., 2015; Gautier et al., forthcoming), these findings raise the possibility that spillover effects could be a general feature of training and re-skilling programs. Research into these effects should therefore remain a priority of future experimental work on training programs; Rothstein and Von Wachter (2016) provide useful guidelines for designing, implementing, and interpreting the results of such experiments.

More work is also needed to evaluate the long-term effects of training programs in terms of later earnings, employment, and career advancement outcomes, potentially through follow-up studies. Short-term positive effects do not guarantee sustainable wage growth or lasting advancement to high-quality employment. For example, Thrush (2018) reports that the labor market impacts of Job Corps, a national job training program, fade over time. Job Corps training offers no discernible long-term benefits, as many program graduates are employed in the same low-wage jobs that they could have gotten without the program. Whether training programs set workers on a positive career trajectory thus requires further examination.

These questions are especially important in light of the large literature in labor economics that documents the lasting consequences of job displacement. Farber (2017) finds that many displaced workers (particularly older individuals) struggle to return to work and experience large reductions in earnings for many years. More recent work has tried to unpack the reasons why different people experience such different earnings trajectories following job displacement (Lachowska et al. (2018) pay particular attention to the role of employers, or firms). A promising avenue for experimentation could target programs that specifically focus on displaced workers who are currently trying to find new jobs. Another could target programs that augment traditional job search strategies with new technology. Examples of technology-based interventions could include building a recommendation algorithm that would allow job seekers to identify existing vacancies or appropriate labor markets for their skills and using machine learning methods to provide relevant, individualized information to jobseekers about their labor market prospects, including expected time to find employment.

Outside the United States, Andersen and Svarer (2007) and Andersen (2015) discuss the success of the Danish “flexicurity” model in coping with the recession of 2008–2009. In this model, unemployment insurance, social assistance, and active labor market policies were linked to create an incentive structure that did not rely on general benefit reductions. The authors find that gross job flows in Denmark remained high, periods of unemployment for most workers were short and there was no evident increase in long-term unemployment during the period in question. The authors suggest that Denmark’s active labor market policies and favorable fiscal situation account for the success of this model.

Lastly, private returns to training programs are typically measured using income or earnings. But assessments of the efficacy of such programs could encompass a wider range of dimensions. People draw value from feeling that they are worthy of being invested in, and this may create positive spillovers in improved health, reduced medical expenses, or reduced crime rates (Davis and Heller, 2017; Modestino, 2017). Such spillover effects are currently understudied, but they are an important part of measuring the full social returns to training programs.

Maguire et al. (2010) implement experiments to evaluate three training programs—the Wisconsin Regional Training Partnership, Jewish Vocational Service–Boston, and Per Scholas in New York—that provide training targeted to specific sectors (construction, manufacturing, and health care in the case of the Wisconsin program; medical billing and accounting in the case of the Boston program; and computer-related technologies in the case of the New York program). All of these programs offered training and provided industry-recognized certifications to successful participants; in addition, they all focused on individuals who were low-income, unemployed, or otherwise disadvantaged (including refugees, immigrants, or welfare recipients). Self-reported survey data indicate that participants in these sector-focused programs earned about \$4,500 more than control group members over the 24-month study period. Training program participants were more likely to work, and to hold jobs with higher wages and benefits.

Hendra et al. (2016) and Schaberg (2017) use experiments to evaluate the WorkAdvance program, which offers sector-based training and job support services in information technology, environmental remediation, transportation, manufacturing, and health care. Eligible individuals included unemployed or low-wage working adults. These individuals were randomly assigned to either a control group, or to a treatment group that received occupational skills training sufficient to earn industry-recognized certifications as well as pre-employment and career readiness services, job development and placement services, and retention and advancement services. Based on data from follow-up surveys, the WorkAdvance program appeared to increase earnings by about \$2,313 on average, or 13 percent, in the third year after program completion. WorkAdvance also increased the likelihood of obtaining a credential in the targeted sector by between 25 and 46 percentage points across sites.

Elliott and Roder (2017) report results from an RCT of the QUEST project, which provides financial, academic, and other support to help individuals complete occupational training programs at community colleges, pass certification exams, and obtain jobs in the health care sector. QUEST services include financial assistance, remedial instruction, counseling, weekly meetings that focus on life skills, and job placement assistance. The authors find that QUEST has a large, sustained impact on participants' earnings, with the treatment group earning \$2,286 more than the control group, on average, three years after participating in the study and \$5,080 more than the control group, on average, six years after participating. Individuals who receive QUEST services are employed for a longer period, have greater financial stability, are more likely to obtain a health-care certificate or license, and are less likely to earn a college degree compared to individuals who do not receive QUEST services.

Fein and Hamadyk (2018) use experiments to evaluate the Year Up program, which is designed to serve urban young adults (ages 18–24). The randomly selected treatment group received six months of full-time training in the IT and financial services sectors, followed by six-month internships at major firms. The study finds that Year Up increased average quarterly earnings by \$1,895, or 53 percent, in the sixth and seventh quarters after random assignment. Efforts to co-enroll participants at local colleges as part of the Year Up program increased college enrollment during the first follow-up year. As Year Up graduates worked in the second year, college enrollment in the treatment group fell to below that of the control group.

Miller et al. (2016) and Miller et al. (2018) report on an RCT of the YouthBuild program, which provides vocational training, educational services, counseling, and leadership development opportunities to low-income young people (ages 16–24) who do not complete high school. The authors find that YouthBuild increases the rate at which participants earn high school equivalency credentials and leads to a small increase in wages and earnings at thirty months.

Millenky et al. (2011) report on an RCT of the National Guard Youth ChalleNGe program, which targets young people who have dropped out of high school and provides general and vocational education in a quasi-military environment. The authors find that program participants were more likely to obtain a GED certificate or high school diploma, earn college credits, and be employed three years after they entered the study.

Notably, each of these sector-based programs targets a specific population. For example, Year Up targets young adults with high school equivalencies and basic reading and math skills, while YouthBuild targets young adults without those skills and provides work experience and basic education (Bloom and Miller, 2018). The National Guard Youth ChalleNGe and YouthBuild programs work with more disadvantaged populations than other sectoral employment programs that screen participants on basic skills (e.g., eighth-grade level English and math). This suggests caution in extrapolating to broader populations, and points to some open questions for future research: Can sectoral employment programs be as effective with less stringent screening? Is it possible to develop new models that combine the features of programs that do not screen applicants (e.g., National Guard Youth ChalleNGe, YouthBuild, Job Corps) with those of programs that do screen applicants and appear to generate larger earning impacts (e.g., Year Up)?

3. POST-SECONDARY EDUCATION

Among the most widely noted and consequential labor market impacts of technology change in recent decades has been a dramatic increase in the returns to post-secondary education, as reflected in the college wage premium. For example, Zimmerman (2014) estimates the marginal admission to a representative university yields earnings gains of 22 percent between eight and fourteen years after high school completion. Increasing educational attainment and reducing barriers that may prevent individuals from pursuing post-secondary education is thus an obvious strategy for anticipating and preparing for the work of the future. Among other challenges, this means addressing the financial obstacles, information barriers, and problems of low high school achievement and poor academic preparation that currently discourage many prospective students (Holzer and Baum, 2017). We begin this discussion by focusing on traditional post-secondary education—i.e., college—before turning to non-traditional models for boosting educational attainment, such as through online learning platforms.

3.1. Traditional Post-Secondary Education

Traditional forms of post-secondary education include colleges and universities, community colleges, and certificate and vocational programs. Important research questions in this area focus on the efficacy of different strategies for boosting college attendance and completion rates among high school graduates. For example, Carrell and Sacerdote (2017) use an experiment to examine the impacts of mentoring, information, and financial incentives on college-going rates for high school seniors in New Hampshire. The authors find that providing information from the admission offices of local community colleges or cash bonuses for completing college applications are not effective in increasing college-going rates. By contrast, being matched with mentors, who visited students every week until their college applications were completed and filed, increased college-going rates by 15 percent for women. Mentoring effects were much smaller for men. The treatment effect does not derive from simple behavioral mistakes, student disorganization, or a lack of easily obtained information. Instead the mentoring program appears to substitute for the potentially expensive and often missing ingredient of skilled parental or teacher time and encouragement.

Exploring the role of financial barriers, Angrist et al. (2016) use an experiment to examine the effect of a scholarship program for students attending Nebraska public colleges. Students in the randomly selected treatment group received grants sufficient to cover the full cost of tuition and fees; a randomly selected subset of this group also participated in learning community programs. The authors find that access to the scholarship boosts college enrollment and persistence, especially for groups with historically low college attendance, including nonwhite students, first-generation college-goers, and students with low high school GPAs. Many students who receive the scholarship shift from attending two-year colleges to attending four-year colleges; as a consequence, rates of completion for an associate's degree actually decline among scholarship recipients compared to the control group. In fact, despite substantial gains in four-year college enrollment, award winners from the first study cohort are slightly less likely to graduate on time than students in the control group who did not receive the scholarship.

Addressing a different set of barriers to post-secondary attainment, Evans et al. (2017) use an experiment to examine the effects of a case management program on community college completion rates in Texas. The authors find that the program, which includes a comprehensive set of interventions, including referrals, mentoring, coaching, and access to emergency financial assistance (EFA), significantly increases persistence and degree completion, especially for female students. However, there are no differences in outcomes between students that receive only EFA and the control group, which suggests that other forms of support are more important than financial support.

Similar results emerge from an experimental evaluation of the Accelerated Study in Associate Programs (ASAP) initiative developed by the City University of New York (CUNY). ASAP's supports include enrollment requirements, financial resources, structured pathways to support academic momentum, and advising, tutoring, and career development services. Scrivener et al. (2015) and Weiss et al. (forthcoming) evaluate the benefits of this program for CUNY students using random assignment and find that it increases the graduation rate of participants by 18 percentage points, which is almost double the rate of 22 percent in the control group over three years. After six years, degree completion rates of ASAP students remain 10 percentage points above control group members, indicating that ASAP did not merely accelerate degree completion but increased it in absolute terms. ASAP was subsequently implemented at three community colleges in Ohio. Sommo et al. (2018) report that 19 percent of ASAP participants in the Ohio colleges earned a degree or credential compared with 8 percent of the control group two years after random assignment to the program.

Thus, studies to date seem to suggest that mentoring and similar types of support—in contrast to financial assistance or information programs alone—are the most effective interventions for increasing post-secondary program enrollment and completion. Further research, potentially including additional follow-up studies, is needed to examine the long-term effects of these interventions in terms of labor market performance, career development, and credit outcomes years after graduation. Similar to the research questions discussed in the previous section on skills training, further attempts could be made to identify the populations that benefit most from different types of mentoring interventions and financial or informational supports. Further research is also needed on the role of institutions in responding to changing labor market demands and on other strategies, such as adding “guided pathways” to higher education starting in secondary schools, and providing targeted training to smooth the transition from post-secondary education into employment.

Lastly, research is needed to explore the potential for community colleges to play a larger role in workforce training. For many students, community college is a more affordable choice for higher education than four-year college enrollment. Average annual in-state undergraduate tuition at two-year public institutions (community colleges) in the United States was \$3,038 in the 2015–2016 academic year. The equivalent figure for four-year public institutions was \$8,778 (National Center for Education Statistics, 2017). This cost differential helps account for the fact that community colleges educate approximately one-third of all undergraduate students in the United States today (National Center for Education Statistics, 2017). A variety of interventions to help students complete community college have been shown to be successful in existing studies (Evans et al., 2017; Scrivener et al., 2015; Elliott and Roder, 2017), although the question remains whether these models can be adapted and replicated on a larger scale. Another promising avenue for experimentation involves connecting community colleges with employers to design skill development programs within post-secondary institutions that are directly responsive to market demands. An example of this approach is the PowerPathways program in California (Holzer, 2011).



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3.2. Alternative Models for Delivering Post-Secondary Education

Online coursework has been heralded as a potentially transformative technology for expanding access to higher education because it lowers the cost of delivery and removes capacity constraints. One out of three students now takes at least one course online during their college career, a share that has increased threefold from 2002-2011 (Allen and Seaman, 2013). Although online education is increasingly prevalent, relatively little is known about its overall impacts and efficacy, in terms of learning outcomes, compared to traditional educational models. More broadly, an important set of research questions focuses on how new technologies could augment and potentially transform traditional education models.

Escueta et al. (2017) offer a comprehensive review of the literature on existing education technologies, concluding that although computer-assisted learning can be effective in helping students learn, providing students with access to technology yields largely mixed results for learning outcomes. When it comes to academic achievement, computer distribution and internet subsidy programs generally did not improve grades and test scores at the K-12 level. At the post-secondary level, the impacts are not encouraging still. According to this review, students who take fully online courses may experience negative learning outcomes compared to students who take in-person courses, but the effects of blended learning are generally on par with those of fully in-person courses.

Bettinger et al. (2017) focus on the effects of online learning at the college level in terms of student achievement and progress toward degree completion using data from a large for-profit university, where each course is offered both online and in-person, and each student enrolls in either an online section or an in-person section. Exploiting changes in course offerings from term to term and the distance individual students must travel to attend in-person courses as instruments for taking online courses, the authors find that, compared to in-person courses, taking online courses reduced grades by one-third of a standard deviation, reduced grades in future courses by one-eighth of a standard deviation, and reduced the probability of remaining enrolled a year later by more than ten percentage points.

Even if online courses—sometimes called massive online open courses (MOOCs)—are less effective than in-person courses in terms of learning outcomes, online platforms could still offer benefits by increasing access to higher education, especially for disadvantaged students. Goodman et al. (2019) examine this issue in the context of the Georgia Institute of Technology's online master of science degree program in computer science (OMSCS), which decides admissions using an arbitrary GPA threshold that is unknown to program applicants. Using a regression discontinuity design to compare enrollment outcomes for applicants just above and below the GPA threshold, the authors find that there is nearly no overlap between the applicant pools for the online program and the in-person program; moreover, demand for the online option is driven by mid-career individuals. Applicants who fall just short of the admission threshold are no more likely to enroll elsewhere than those who just meet the threshold; the applicants who fall just short also spend less time, on average, pursuing non-degree training compared to the time required to complete the degree.



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The mixed evidence on online learning, both in terms of efficacy and access, suggests several fruitful directions for new research. A first, obvious question focuses on which educational technology models are likely to produce maximum benefits in terms of learning gains and other outcomes. Oreopoulos et al. (2018) find with an experiment that combining text message coaching with an online preparatory module has positive impacts on nonacademic outcomes, even though it produces no meaningful effects on course grades and credit accumulation. Would online courses combined with other services, such as guidance on time management or supervision of technology use improve learning outcomes? And in what areas are technology-enabled behavioral interventions, such as large-scale text message campaigns, likely to be most effective?

RCTs can also be used to study the longer-run effects of online education on labor market outcomes. For example, researchers could investigate how skills gained from online training compare with the skills gained through in-person training, and whether these skills are similarly rewarded in the labor market. Audit studies can be used to explore whether employers discriminate between online and in-person degrees, following the template of recent resume audit studies that compare labor market outcomes for degree holders from for-profit versus non-profit universities (Deming et al., 2016; Darolia et al., 2015).

Finally, we see demand for research to identify opportunities for cost-effective online technology to complement more costly education delivery models. One possible direction for future experiments is to target online learning opportunities to specific populations that might otherwise have limited access to post-secondary training or education (e.g., displaced workers, gig economy workers who cannot access employer-provided training, and low-income students). New research could also explore the efficacy of technology-facilitated consulting or coaching to inform prospective students about education financing options and skill demands in their local labor market. These interventions would be similar to the coaching and information interventions that are already in use in traditional education settings.

More broadly, opportunities exist for further experimentation with innovative education models that integrate information, technology, counseling, and mentoring.⁴ Such experimentation could complement other ed tech research with the aim of helping online education platforms continue evolving to serve a broader range of students, including disadvantaged students or students who may be less motivated than the students who are already taking advantage of MOOCs.

4 For example, Vermont uses an online app “FRESH EBT” to coach SNAP recipients budgeting their benefits. (Rosenberg, 2019).

4. ALTERNATIVE WORK ARRANGEMENTS AND THE “GIG ECONOMY”

A third area for new research on the work of the future focuses on the role of technology in bringing about alternative work arrangements and on the labor market impacts—and related policy challenges—associated with the so-called gig economy. The most recent effort to estimate the size of this sector finds that roughly 10 percent of U.S. workers were participating in an alternative work arrangement in 2017, with modest growth (1–2 percent) in the share of workers in these arrangements between 2005 and 2015 (Katz and Krueger, 2019).

From a workforce perspective, the emergence of temporary, contract, on-call, and free-lance work, and its potential to replace a sizable share of traditional direct-hire employment, has been a mixed blessing. On the one hand, the substantial flexibility and low barriers to entry that characterize many jobs in the gig economy have created new earnings opportunities for individuals who, for a variety of reasons, might have difficulty committing to full-time employment or lack the skills to obtain more stable and better-paid jobs. On the other hand, gig economy jobs offer far less stability and financial security, and they generally fall outside the web of benefits and worker protections that exists for many direct-hire employees. According to one estimate, as many as 40 percent of hourly workers in the United States do not know what their next week’s hours and pay will be (Rowan, 2019). Thus an important focus for research in this area centers on the need for an updated set of social safety net and workplace regulations that is better adapted to the variety of employment arrangements that characterizes today’s labor market. A further challenge is to explore new models of representation for nontraditional workers and to identify—and provide, potentially using nontraditional education models—the kinds of training and entrepreneurial know-how that will help workers succeed and thrive in the gig economy.

Historically, independent workers were relatively skilled: they tended to include engineers, computer programmers, and “independent businessmen.” Workers in the gig economy, however, are often less educated than the average worker and they earn considerably less than do regular employees with similar characteristics and in similar occupations (Katz and Krueger, 2016). The labor market for these workers recalls the old “hiring halls” discussed in Autor (2008), with a technological platform serving as the market-maker or matchmaker and functioning to commoditize a set of relatively undifferentiated labor services. Given this setup, the findings in Hall et al. (2017) are unsurprising: with a large reservoir of workers able to supply basic labor services, the gig economy job market is characterized by a very elastic labor supply curve, leading to limited wage growth, even as the market expands and demand for this type of labor increases.

In fact, jobs in today’s gig economy more closely resemble jobs in the temporary help supply (THS) sector of the recent past (e.g., home health aides, child care workers) and they come with many of the same drawbacks. For example, although THS jobs were once viewed as offering a potential pathway to full-time, stable paid employment, Autor and Houseman (2010) found that job placements in this sector did not improve—and may have diminished—workers’ subsequent earnings and employment outcomes. Comparable results for gig economy workers would be concerning, particularly if young people who enter this segment of the labor market misperceive their longer-term earnings prospects.

Research could focus on a set of related questions: What is really new about current non-traditional work arrangements compared to the “temp jobs” of the recent past? What skill sets do gig workers need and what kinds of training do they receive on and off the job? What level of economic security do these jobs provide for the average worker? What changes in the social safety net are needed if this sector continues to grow? What is the role of government regulation in protecting gig economy workers and promoting productivity? And what role can technology play in improving the outlook for gig workers by, for example, making it possible to organize new, online markets for short-term labor that provide greater earnings stability and opportunities for advancement?

One salient feature of gig work that has already drawn considerable study is its flexibility. Flexibility is also an important source of similarity between the temporary help sector and the gig economy, in that both types of workers often work uneven schedules with no regular hours. However, this apparent similarity masks a subtle difference. Temp employment generally *demand*s flexibility from workers, with “just-in-time” scheduling as an extreme example. For example, DePillis (2015) reports that many employers in the retail sector inform workers of their next shifts in tiny increments and often at the last minute. By contrast, the gig economy often allows workers to *supply* flexibility on their own terms—a feature that may be highly valued by some workers.

Mas and Pallais (2017) estimate worker valuations over alternative work arrangements from a field experiment involving applicants for work in a national call center. The authors elicit preferences by building a discrete choice experiment using two work arrangements and a randomly varied wage difference between the two options. Work arrangements include a traditional work arrangement, flexible scheduling, working from home, and an irregular schedule. The authors find that most workers are not willing to pay for scheduling flexibility, though a tail of workers with high valuations allows for sizable compensating differentials. The average worker is willing to give up 20 percent of wages to avoid a schedule set by an employer on short notice, and 8 percent for the option to work from home.

Chen et al. (2017) document the ways in which Uber drivers utilize flexibility and estimate the driver surplus generated by this flexibility. Using high-frequency data on hourly earnings, the authors estimate how drivers' reservation wages vary from hour to hour. They compute expected surplus from the Uber labor arrangement as well as expected surplus from alternative arrangements that afford drivers with less flexibility. The results indicate that Uber drivers benefit significantly from real-time flexibility, earning more than twice the surplus they would in less flexible arrangements. If required to supply labor inflexibly at prevailing wages, drivers would also reduce the hours they supply by more than two-thirds.

Mas and Pallais (forthcoming) estimate the marginal value of non-work time (MVT) in the same spirit as Mas and Pallais (2017). The authors elicit preferences by building a discrete choice experiment, which asks applicants (in a national process to staff a call center and fill data entry positions) to choose among randomized wage-hour bundles. Mas and Pallais find that estimated MVT is increasing in hours worked: Individual labor supply is highly elastic at low hours and more inelastic at higher hours. For unemployed applicants, their preferred estimate of the average opportunity cost of a full-time job due to lost leisure and household production is 60 percent of after-tax marginal product; it is 72 percent when the fixed costs of employment and child care are included.

These papers focus on estimating worker preferences over different alternative work arrangements; future experiments could explore patterns of self-selection among workers based on their valuations of workplace flexibility. Additionally, many gig economy platforms likely collect a great deal of data about their workers even when they are not working for pay. For example, Uber monitors driver behavior even when the drivers are not collecting a fare (but are using the app), which may allow researchers to learn more about the “non-work time” that sits between paid work and leisure. This may allow researchers to develop a sharper understanding of how gig economy workers make labor supply decisions.

Findings from other studies that have used data from Uber and other gig employers to test long-standing concepts and questions in economics, such as inter-temporal influences on labor supply, the gender earnings gap, welfare impacts under different worker compensation schemes, and the incidence of labor shocks on worker wages, are summarized in the text box “Additional Findings in Gig Economy.” To date, however, there has been less research aimed at understanding the longer-term impacts of gig employment for workers and at identifying strategies to address the potential limitations of this work in terms of workers' financial security and opportunities for advancement. Where innovative policies have been introduced to extend job protections and benefits to gig workers, experimental research is needed to assess their efficacy. Economists have already started to think about

these issues—for example, Harris and Krueger (2015) have developed an initial framework for redesigning unemployment insurance, workers' compensation, and mandatory benefits like health insurance to cover gig economy workers.

The emergence of the gig economy also highlights a need to test alternative models of worker representation. Gig workers typically have little individual bargaining power to negotiate contracts with either intermediaries or their ultimate customers. And their relationships with intermediaries or customers are not dependent, deep, extensive, or long-lasting enough for intermediaries or customers to assume responsibility for worker benefits or protections (Harris and Krueger, 2015). Alternative approaches to worker representation could look to models such as the membership-based American Association of Retired Persons (which offers group-rate health insurance plans to individuals 50 and older), Working Today (which offers representation for independent workers), and the National Domestic Worker Alliance (which offers benefits and training to domestic workers). Another type of organization, the “work council,” may also offer a useful model. These organizations, which already exist in Germany, Netherlands, Spain, Poland, Sweden, Italy, France, and Belgium, are distinct from trade unions, but (like unions) they negotiate employment terms and conditions with employers (Rogers and Streeck 1995; Streeck and Vitols 1995).

Other types of interventions could help gig workers build economic security and navigate the resources and policies that are already available to them. For example, the U.S. tax code provides mechanisms for self-employed workers to save for retirement as a replacement for traditional employer-provided pensions (O'Shea, 2019). Counseling programs could help workers take full advantage of these and other existing tax benefits, credits, and deductions (Uber or Lyft drivers, for example, may find it difficult to calculate tax deductions for mileage and depreciation). Counseling and information assistance could help gig workers in other areas too, such as with savings and retirement planning and with training in entrepreneurship or other useful skill sets that would improve their long-term earnings potential.

We conclude this section by noting that the gig economy captures a broad range of services.⁵ Thus far, many of the gig economy jobs that have been studied by economists are jobs that involve relatively undifferentiated services. As the gig economy and the technology platforms it relies on continue to evolve, however, there may be greater scope for differentiation in products and services in ways that deliver better economic returns and improve the quality of gig work.

5 For example, on-demand local movers ([Dolly.com](https://www.dolly.com)), short-term apartment rentals ([Airbnb.com](https://www.airbnb.com)) or on-demand, in-home massages ([Zeel.com](https://www.zeel.com)).

In addition to studying alternative work arrangements and workplace flexibility, economists have conducted a number of innovative experiments, in many cases using the Uber driving platform, to study inter-temporal labor supply, the gender earnings gap, and the incidence of labor demand shocks on worker wages.

Angrist et al. (2017) analyze welfare differences for Uber drivers under two compensation arrangements: drivers pay either a portion of their fare to the Uber platform or a fixed payment to Uber independent of their fare. The authors conduct an experiment that offered random samples of Uber drivers in Boston a virtual lease that eliminates or reduces the Uber fee. The authors estimate that the inter-temporal substitution elasticity (ISE) for the Uber wage effect on Uber hours is around 1.2. They identify a “lease aversion” phenomenon in the finding that many drivers who would have benefitted from leasing failed to opt in. The study suggests ISE and lease aversion are the key parameters to access compensation schemes where the right to work can be purchased at either a flat rate or a rate proportional to earnings. Interestingly the ISE estimated for Uber drivers is similar to what Fehr and Goette (2007) found in an experiment involving bicycle messengers.

Cook et al. (2018) examine the gender earnings gap in a gig context where the penalty for job flexibility is small. Focusing on Uber drivers in the Chicago metropolitan area, the authors measure the contribution of different factors to the gender earnings gap by treating each factor as an omitted variable in the relationship between earnings and gender and measuring the bias that would result if the factor were excluded. The authors document a roughly 7 percent gender gap in driver earnings that can be entirely attributed to three factors: experience on the platform, preferences in terms of where to work, and preferences for driving speed. The authors do not find that men and women are differentially affected by a taste for specific hours, a return to within-week work intensity, or customer discrimination.

Hall et al. (2017) examine the effects of city-specific UberX base fare changes on supply-side outcomes with a city-week panel using a differences-in-differences framework to analyze effects on drivers’ hourly earnings. The comparison groups include UberX drivers in other cities and UberBlack drivers in the same city. A between-city synthetic control analysis is used to examine effects on market quantities, such as total rides taken. The authors find that, when the base fare increases, drivers’ hourly earnings rates rise immediately, but then begin to decline and eventually return to the pre-change level in about eight weeks. Drivers spend a smaller fraction of their working hours transporting passengers when fares are higher. A fare increase reduces wait times and the quantity of trips taken but it has no discernible effect on the number of active drivers.



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These papers are examples of researchers studying traditional economics topics using data from the gig economy. The work of Angrist et al. (2017), for example, complements similar, earlier work on labor supply elasticity for bicycle messengers, stadium vendors, and (pre-Uber) taxi cab drivers (Fehr and Goette, 2007; Oettinger, 1999; Camerer et al., 1997; Farber, 2005; Farber, 2008), though the exceptional richness of the Uber data and the explicit randomization of incentives distinguishes this paper from much of that earlier work. Because barriers to entry in many low-wage service occupations are limited, it is possible that increases in demand rarely translate into meaningful wage increases because the very elastic labor supply into the sector keeps wages from rising. This naturally raises concerns about economic security and economic opportunity for gig workers and also serves as a useful reminder that classic economic concepts can still be useful in understanding these newer work arrangements, just as Shapiro and Varian (1999) showed that classic economic concepts worked fairly well to describe the network economy at the dawn of the Internet Age.



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5. MANAGEMENT PRACTICES

Management practices have an important role to play in enabling firms to adopt and use new technology in ways that complement human workers and enhance productivity. In fact, management itself can be studied as a “technology”—one that has potentially large effects on a firm’s overall performance and on the quality of jobs and the nature of the workplace environment it offers employees (Bloom et al., 2017b). In this conceptualization, firms’ ability to keep improving their management practices is an important factor in their competitive success; in fact, Bloom et al. (2017b) estimate that variation in management practices can account for as much as one-third of overall variation in total factor productivity (TFP)—both across countries and across firms within countries.

This section focuses on research topics in the broad area of management practices. Specific subtopics within this area include general management practices, human resources management (i.e., recruiting, hiring, and retention decisions), workplace design, and the management of human–technology interactions. Many firms and industries could realize substantial productivity gains by implementing improvements in all of these areas. Identifying and testing these opportunities, however, may not be straightforward, especially in settings where technology is evolving rapidly.

The literature on these topics includes several examples of researchers working closely with firms to carry out innovative RCTs. These experiments are often directly useful for the firms involved and can help elucidate more general management lessons.

5.1. General Management Practices

One of the most fascinating pieces of evidence that “management matters” comes from Bloom et al. (2013), which reports results from a management field experiment involving multi-plant textile firms in India. In this experiment, free consulting on management practices was provided to randomly chosen treatment plants in an effort to estimate productivity effects using an RCT. The plants that received consulting and adopted new management practices realized a 17 percent increase in productivity in the first year by improving quality and efficiency and reducing inventory. Within three years, the intervention led to the opening of more production plants. The authors speculate that informational barriers largely account for plants’ failure to implement these productivity-enhancing practices prior to the experiment. In this context, competition did not drive less efficient plants out of the market because the inability to delegate decision-making away from firm owners impeded the growth of more efficient plants, thereby reducing reallocation between plants.

In a follow-up paper, Bloom et al. (2018a) study the persistence of management practices adopted as a result of this field experiment. They find that while treatment plants eventually dropped roughly half the management practices adopted as part of the original experiment, a large and significant gap in practices remained between these plants and the untreated control plants. And while few management practices had spread across firms in the study, many practices had spread within firms, from the treatment plants to the control plants. Managerial turnover and time constraints on the part of plant directors were the two most cited reasons for dropping management practices introduced as part of the experiment.

These findings suggest that further experimentation across a range of industries could be very useful to improve current understanding of opportunities for improved management practices and to devise strategies for overcoming barriers to the adoption of such practices.

5.2. Hiring, Recruiting, and Retention Practices

Rapid growth in the field of data science is already affecting human resources practices at many firms. For example, advances in machine learning techniques have allowed some human resource (HR) managers to rely on machine predictions—rather than human judgment—to make hiring and firing decisions. Two recent papers provide some early evidence on the performance of these hiring and recruiting technologies in the field.

Hoffman et al. (2017) examine the impact of job testing technology on the quality of hires using a unique personnel dataset from fifteen firms that employ low-wage workers with the same type of skills. Previously, HR managers used their own judgment to hire new workers. After testing was introduced, HR managers had access to a test score for each applicant and were encouraged, but not required, to make hiring decisions according to these scores. Exploiting the staggered introduction of job testing across sample locations, the difference-in-difference results suggested that use of the test improved hiring decisions; people who were hired against test recommendations did not perform as well, whereas hires with good scores had substantially longer tenures than workers who were hired without testing. These results suggest that when managers overrule test recommendations it is often because they are biased or mistaken, not because they have superior private information.

Horton (2017) finds more modest effects from an experimental intervention in which employers received algorithmically generated recommendations about which workers to recruit for job openings on the oDesk platform. Employers in the control group could wait for workers to apply, or search for candidates and invite them to apply. Employers in the treatment group received these additional recommendations. Horton finds that employers acted on these recommendations but the algorithm identified candidates who were similar to the workers that would have been recruited even without this information. Recommendations increased the overall fill rate in technical job openings by 20 percent but had no detectable effect on non-technical job openings. There was little crowd-out effect because the baseline vacancy rate for these jobs was low enough that market expansion effects dominated.

These two papers highlight the potential for new technology to augment traditional human resource strategies. More research is needed to evaluate this potential, including firm-level experiments to test different strategies and technologies. Experimental research could also examine retention practices at the firm level, especially in the service sector where high rates of employee turnover are common. This is often interpreted as a sign that many service jobs are not “good jobs,” since in standard job search models, job tenure is a direct proxy for job quality (Jovanovic, 1979). Such research might point to strategies for improving retention and would likely be of interest to policymakers as well as employers, particularly if these strategies lead to improved job quality and also enhance workers’ longer-term earnings trajectory.

5.3. Workplace Design

Firms can also use new technology to implement innovative workplace designs. A much-discussed example is the trend toward allowing employees to work from home, which takes advantage of widespread access to high-speed Internet.⁶ This type of “alternative work arrangement” has obvious benefits for workers,⁷ but its overall impact on firm (or team) productivity is less well understood.

A study by Bloom et al. (2014) examines the impact of working from home on worker performance by randomly assigning a set of call center employees at the Chinese travel agency Ctrip to work either from home or in the office for nine months. After this period, Ctrip allowed the employees to reselect between working at home or at the office. The authors find that in the first experimental period, working at home led to a 13 percent performance improvement, of which nine percent came from working more minutes per shift, due to fewer breaks and sick days, and four percent came from completing more calls per minute, possibly because of a quieter and more convenient work environment. Given the option to reselect between home and office, more than half the workers in the experiment switched, which led to a larger productivity gain of 22 percent.⁸

More research is needed to explore whether these results are generalizable beyond the particular firm and type of work studied by Bloom et al. (2014), but evidence of productivity gains documented in their paper suggests that other firms could benefit from experimenting with work-from-home arrangements.

6 For example, Bloom et al. (2014) discusses the benefit of working from home; Gordon (2018) discusses tips to set a schedule when working from home.

7 For example, Hervey (2018) points out working from home gives worker more agency.

8 Ironically, holding performance constant, the promotion rate of those working at home fell, suggesting that improved management practices are required to reap the benefits of home-work arrangements over the longer term.



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5.4. Managing Machine–Human Interactions

RCTs could help firms develop new strategies for optimizing the interaction of humans and machines in the workplace. Opportunities to deploy technology in ways that complement human workers (as opposed to simply replacing human workers) are of particular interest. Making the most of these opportunities requires a nuanced understanding of the comparative advantages that humans and technology offer in different settings. For example, software has been developed to assist doctors in making diagnoses and selecting treatment plans,⁹ but these are complex tasks that require rigorous evaluation along a number of dimensions. Getting doctors to trust an expert software system is not straightforward, and establishing guidelines for when human discretion should override software recommendations—if at all—remains an open question in health care.

Moreover, even when the productivity-enhancing benefits of a management practice or technology innovation are clear, widespread adoption does not always follow (Bloom et al., 2018a). Performance-improving practices have been shown to diffuse slowly in some sectors, including the U.S. healthcare system (Sacarny, 2018). These examples raise the possibility that even sophisticated firms could benefit from information or consulting interventions that would help them select and implement an optimal set of technology choices and management practices. Staged roll-outs or experiments across firms or employee teams may be useful for isolating the specific impacts of a new technology and for learning what works.

Finally, an important issue in the realm of machine–human interactions concerns the unintended loss of human expertise or experience when workers become distanced from a highly specialized task as a result of increased reliance on automated controls. Mindell (2015) discusses an airplane crash that was caused by pure pilot error. In that particular incident, recovery would have been possible using old techniques, but many pilots have been trained in an environment where machines do most of the work, and thus may have difficulty implementing emergency solutions without recourse to automated systems. Beane (2018) reports that medical students are increasingly taught to master robotic surgical techniques at the expense of generalist training. Beane faults the rise of surgical robots for clogging the traditional apprenticeship pipeline. Similarly vivid examples may exist in other professions. As machines play a larger role in many complex and high-stakes tasks, there is a need for further experimentation to learn how best to aid humans in their tasks without distancing them from the underlying processes and considerations involved. Opportunities to redesign workplace practices or training curricula in ways that avoid or minimize the negative consequences of “automation dependency” present an exciting area for new research and experimentation.

⁹ For example, the University of Texas MD Anderson Cancer Center uses “APOLLO” computer program to analyze generic data and provide doctors with treatments suggestions (Park, 2017).



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6. CONCLUSION

A vigorous debate is underway about the nature and magnitude of the challenges and opportunities that incumbent workers and new labor market entrants will face as they seek employment, career ladders, and economic security in an increasingly automated, robotized, machine-intelligent, and rapidly evolving work environment. There is little question, however, that public anxiety about the future of work has reached a fever pitch (Akst, 2013) when innumerable articles appear on a regular basis to foretell the demise of employment due to one incipient technological innovation or another. Fortunately, one does not need to take a strong stand on the reliability of these prognostications to recognize that there is abundant opportunity for ambitious, ingenious, and rigorous experimentation to build an evidence base to assist workers, firms, and governments prepare for the “Work of the Future.”

The four areas on which our overview has focused—skills training, post-secondary education, alternative work arrangements (i.e., the “gig economy”), and improved management practices—are subjects that are ripe for further exploration, whether the workplace changes drastically, as some predict, or merely continues to gradually evolve. In either case, prioritizing cost-effective, well-targeted human capital investments in incumbent workers and future labor market entrants, building modern labor market institutions that support evolving employment arrangements, and augmenting management practices to boost productivity and complement labor, are worthy—indeed, urgent—objectives for forward-looking social science and public policy. We are profoundly optimistic about the potential for deploying innovative

experiments to evaluate program and policy options and pilot novel interventions that will build the knowledge base for maximizing the public and private benefits and mitigating the adverse impacts that necessarily accompany any consequential change in the operation of labor markets or the demands for skills.

While some might argue that “experimenting on the future” is inherently futile since we do not know what the future will hold, we believe to the contrary that an overriding lesson of the last two decades of randomized controlled trials in social science research is that no question is “too big” to defy the tools of frontier social science wielded by creative and methodologically rigorous researchers. And we are similarly convinced that the technological advances that are the proximate impetus for this research agenda are also untapped tools for improving experimentation, augmenting skills acquisition, assisting workers to share in the gains from technological innovations, and enabling firms to realize the potential of these innovations to boost productivity and augment labor. Recognizing that the agenda described here will almost surely prove circumscribed and narrow relative to the proposals we expect to receive from J-PAL affiliates for the Work of the Future Initiative, we are deeply excited to review and learn from these proposals.

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ABOUT J-PAL

The Abdul Latif Jameel Poverty Action Lab (J-PAL) is a global research center working to reduce poverty by ensuring that policy is informed by scientific evidence. Anchored by a network of 171 affiliated professors at universities around the world, J-PAL conducts randomized impact evaluations to answer critical questions in the fight against poverty.

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