Jobs at Risk of Automation in the USA: Implications for Community College

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Abstract

Advancing technology such as artificial intelligence and robots is steadily replacing jobs in the USA. Continuous skill-upgrading and re-skilling are critical for workers to remain employable throughout their careers. In these social and economic contexts, community colleges play significant roles to provide workforce education and training because of their open admission, lower tuition, and shorter and more specific occupational programs compared to four-year universities. However, the detailed data of jobs at risk of automation are currently unavailable. This study used the national occupation and risk-of-automation data (Frey & Osborne, 2017) to estimate specific numbers of jobs at risk by industries and age groups. Results showed that approximately 48% of the jobs could be replaced within two decades. Four industries (1) service; (2) sales and office; (3) natural resources, construction

and maintenance; and (4) production, transportation, and material moving were at a particularly higher risk (up to 75%). At the same time, computer, engineering, and health care occupations had a lower risk (up to 12%). The estimated numbers of jobs at risk informs community colleges' strategic planning.

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Keywords: sub-baccalaureate; higher education; lifelong learning

Introduction

The current study estimated the number of jobs at risk of automation to inform community college strategic plans. Advancing technologies such as artificial intelligence and robots are steadily replacing jobs across industries (Frey & Osborne, 2017; U.S. Government Accountability Office, 2019). Also, adults who are older and/or with lower educational attainment tend to work in industries at high risk of automation (e.g., sales) (Muro, Maxim, & Whiton, 2019). Workers are expected to adapt to the automation trends to remain employable throughout their careers. Also, working past the typical retirement age (e.g., 25-35% of older

adults age 60+ work) has become a norm due to longer life expectancy and changing pension programs (e.g., delayed age eligibility) (Bosworth, Burtless, & Zhang, 2016). Thus, regardless of age, upgrading human capital (i.e., knowledge, skills) is critical to secure employment and to have a capable workforce over time (Becker, 1993; Cummins, Taylor, & Kunkel, 2015).

Community colleges play a critical role in training and re-skilling the workforce. (Baime & Baum, 2016). The advantages of community colleges include open admission, lower tuition, and shorter and more specific occupational programs (e.g., certificate programs) (Baime & Baum, 2016). Associate degree and postsecondary certificates are linked to greater wage and employment security compared to high school degrees (Frey & Osborne, 2017). A bachelor's degree has been considered a desired human capital indicator in the labor market although only about one in three (36%) of adults have bachelor's degrees or higher (U.S. Census Bureau, 2020). Obtaining a bachelor's degree is resource-intensive (i.e., cost, time). The average annual tuition fees are $26,593 for 4-year bachelor's programs while $10,598 for 2-year associate degree programs (Snyder, de Brey, & Dillow, 2019). Today, not all high-growth occupations require bachelor's degrees. For instance, occupations in health care (e.g., medical assistant, nurse) and technology (e.g., computer network specialist, web developer) industries often require only sub-baccalaureate credentials (Fayer, Lacey, & Watson, 2017).

Developing strategic plans (e.g., a new program, program expansion) for community colleges to meet education and training demands is crucial. However, the numbers of jobs at risk by detailed occupations and a key demographic characteristic (i.e., age), are currently unavailable at the national level. Such information is critical not only for community colleges to plan ahead but also for students/workers for their career decisions.

Methods

Occupation data were obtained from the 2019 Current Population Survey --- the primary data source for national labor statistics in the USA (U.S. Bureau of Labor Statistics, 2020). The current study adopted the risk of automation from Frey and Osborne (2017), who estimated the risk over the next two decades by 6 major and 22 sub-categories of 702 occupations per the standard occupational classification system codes. The analysis focused on 156.0 million (99.0 percent of 157.5 millions in 2019) of employed persons after excluding 17 occupations that are listed in the CPS but lacked estimated risks of automation. The risks of each occupation were matched to the CPS data and computed numbers and proportions of jobs-at-risk of automation. The estimated numbers of jobs-at-risk were also summarized by the six major- and 22 sub-industries. This method employed in the present study is consistent with the previous research (Taylor & Smith, 2017).

Results

Results are reported in Tables 1 and 2. Approximately half (48 percent) of the jobs were classified as at risk of automation for the next couple of decades. The number is equivalent to roughly 75 million jobs. Four industries (1) service; (2) sales and office; (3) natural resources, construction and maintenance; and (4) production, transportation, and material moving had appreciably higher risks at 60-75 percent compared to management, business, and financial operations and professional and related occupations (14-27%). All age groups had similar proportions of jobs at risk (Belbase & Eschtruth, 2020). However, younger age groups 16-19 and 20-24 had greater proportions of jobs-at-risk (74% and 61%, respectively). One in two current jobs may be at risk of automation. Even with potentially large estimation errors (e.g., 50% over-estimation is still 38 million or one in four jobs), the implications for community college strategic planning remain the same.

Discussion and Implications for Policy and Practice

This study provided a simple yet useful national profile of the jobs-at-risk of automation to inform community colleges' career and technical training programs. In current job automation and demographic (e.g., population aging) trends, community colleges are expected to provide more education and training to workers who need to enhance human capital throughout their careers (Cummins et al., 2015).

Several preliminary implications are worth discussing. First, jobs in high-risk industries such as sales and office occupations are likely to move to the growing industries such as STEM-related fields (e.g. computer sciences, engineering). Second, low risks of automation could also mean the consistent high demand for workers and even the growth of the industries, such as health care (Fayer et al., 2017). Third, national data could be a point of comparison but detailed data analysis at the local level could produce relevant information to specific communities. At the same time, the use of online education platforms may alleviate the geographic differences. Fourth, younger adults should expect constant needs for skill-upgrading and re-skilling. Finally, community college programs may experience increasingly multigenerational student populations in classrooms. Thus, community colleges may need to accommodate different needs and preferences in terms of instructional formats through appropriate pedagogical approaches to multigenerational student populations (Sánchez & Kaplan, 2014).

Table 1. Estimated Number of Jobs at Risk of Automation by Industry, Occupation Types, and Age Group (in Thousands)

Industry *& Occupation*	*All ages*	*16-19*	*20-24*	*25-34*	*35-44*	*45-54*	*55-64*	*65+*
Total	75026	3817	8527	16552	14369	14280	12662	4795
Management, business, and financial operations occupations	7149	17	298	1604	1588	1645	1397	598
Management occupations	2880	7	75	528	643	704	637	285
Business and financial operations occupations	4269	10	223	1076	944	941	760	313
Professional and related occupations	5136	86	444	1287	1130	1046	846	297
Computer and mathematical occupations	851	5	52	235	223	191	118	30
Architecture and engineering occupations	357	2	31	84	70	81	69	18
Life, physical, and social science occupations	337	4	41	97	69	57	53	17
Community and social service occupations	86	0	6	22	20	19	14	5
Legal occupations	633	2	44	157	119	132	125	54
Education, training, and library occupations	1206	25	109	246	265	261	215	83
Arts, design, entertainment, sports, and media occupations	534	34	54	143	108	92	64	39
Healthcare practitioners and technical occupations	1132	14	106	302	256	213	188	52
Service occupations	15937	1593	2499	3480	2663	2561	2247	896
Healthcare support occupations	1623	50	235	431	300	275	248	86
Protective service occupations	1366	67	149	360	250	234	210	96
Food preparation and serving related occupations	6717	1207	1531	1486	899	764	608	222
Building and grounds cleaning and maintenance occupations	4211	154	305	797	871	942	832	308
Personal care and service occupations	2020	116	278	406	343	346	348	184
Sales and office occupations	23516	1466	2994	4975	4034	4229	4041	1769
Sales and related occupations	10490	1012	1532	2097	1683	1735	1587	841
Office and administrative support occupations	13026	454	1462	2878	2352	2494	2454	928
Natural resources, construction, and maintenance occupations	9482	248	900	2216	2290	1913	1514	395
Farming, fishing, and forestry occupations	949	63	104	208	202	166	149	58
Construction and extraction occupations	5576	127	522	1343	1441	1119	814	207
Installation, maintenance, and repair occupations	2958	58	275	665	647	628	551	131
Production, transportation, and material moving occupations	13806	407	1391	2989	2664	2887	2618	840
Production occupations	6141	136	599	1377	1228	1285	1204	301
Transportation and material moving occupations	7665	271	792	1613	1436	1602	1415	538

Data source: 2019 Labor Force Statistics from the Current Population Survey, Employed persons by detailed occupation and age
The estimation was done according to the published risk estimations in Appendix in Frey & Osborne (2013, p 57-72)

Table 2. Estimated Percentage of Jobs at Risk of Automation by Industry, Occupation Types, and Age Group.

Industry *& Occupation*	*All Ages*	*16-19*	*20-24*	*25-34*	*35-44*	*45-54*	*55-64*	*65+*
Total	48%	74%	61%	47%	44%	45%	48%	47%
Management, business, and financial operations occupations	27%	21%	31%	29%	25%	26%	26%	27%
Management occupations	15%	11%	14%	15%	14%	15%	16%	17%
Business and financial operations occupations	54%	50%	52%	53%	53%	55%	56%	57%
Professional and related occupations	14%	25%	18%	13%	13%	14%	14%	12%
Computer and mathematical occupations	11%	17%	15%	10%	10%	12%	10%	10%
Architecture and engineering occupations	11%	17%	15%	10%	10%	12%	10%	10%
Life, physical, and social science occupations	23%	40%	30%	23%	22%	22%	23%	17%
Community and social service occupations	3%	3%	4%	3%	3%	4%	3%	2%
Legal occupations	32%	49%	81%	39%	27%	30%	34%	21%
Education, training, and library occupations	13%	20%	16%	11%	12%	13%	14%	12%
Arts, design, entertainment, sports, and media occupations	16%	34%	19%	16%	16%	16%	15%	14%
Healthcare practitioners and technical occupations	12%	29%	20%	12%	11%	11%	12%	9%
Service occupations	60%	75%	66%	58%	56%	55%	59%	59%
Healthcare support occupations	45%	48%	47%	44%	44%	44%	45%	46%
Protective service occupations	45%	69%	60%	44%	37%	37%	54%	61%
Food preparation and serving related occupations	80%	88%	85%	7%	76%	74%	77%	80%
Building and grounds cleaning and maintenance occupations	73%	75%	74%	75%	74%	72%	72%	72%
Personal care and service occupations	34%	34%	34%	32%	32%	32%	38%	38%
Sales and office occupations	72%	86%	80%	71%	69%	69%	72%	75%
Sales and related occupations	67%	92%	81%	65%	61%	60%	63%	68%
Office and administrative support occupations	77%	74%	78%	76%	76%	76%	78%	82%
Natural resources, construction, and maintenance occupations	66%	74%	69%	67%	66%	65%	65%	66%
Farming, fishing, and forestry occupations	82%	84%	82%	81%	82%	83%	82%	84%
Construction and extraction occupations	67%	74%	70%	68%	67%	66%	65%	65%
Installation, maintenance, and repair occupations	61%	65%	63%	61%	60%	60%	61%	62%
Production, transportation, and material moving occupations	75%	76%	78%	75%	74%	74%	75%	77%
Production occupations	73%	84%	80%	74%	71%	71%	72%	77%
Transportation and material moving occupations	77%	73%	77%	76%	77%	76%	78%	78%

Data source: 2019 Labor Force Statistics from the Current Population Survey, Employed persons by detailed occupation and age
The estimation was done according to the published risk estimations in Appendix in Frey & Osborne (2013, p 57-72)

References

Baime, D., & Baum, S. (2016). *Community Colleges: Multiple Missions, Diverse Student Bodies, and a Range of Policy Solutions*. Retrieved from Washington, DC: https://www.urban.org/sites/default/files/publication/83551/2000899-community-colleges-multiple-missions-diverse-student-bodies-and-a-range-of-policy-solutions_2.pdf

Becker, G. S. (1993). *Human capital: A theoretical and empirical analysis, with special reference to education* (3 ed.). Chicago: University of Chicago Press.

Belbase, A., & Eschtruth, A. D. (2020). *How Will Emerging Computers Affect Older Workers by 2040?* Retrieved from Boston, MA: https://crr.bc.edu/wp-content/uploads/2019/12/IB_20-1.pdf

Bosworth, B., Burtless, G., & Zhang, K. (2016). *Later retirement, inequality in old age, and the growing gap in longevity between rich and poor*. Retrieved from Washington DC: https://www.brookings.edu/wp-content/uploads/2016/02/bosworthburtlesszhang_retirementinequalitylongevityfullpaper.pdf

Cummins, P., Taylor, P., & Kunkel, S. (2015). Working Longer, Learning Longer. *Public Policy & Aging Report, 25*(4), 120-124. doi:10.1093/ppar/prv025

Fayer, S., Lacey, A., & Watson, A. (2017). *STEM occupations: past, present and future*. Retrieved from Washington, DC: https://www.bls.gov/spotlight/2017/science-technology-engineering-and-mathematics-stem-occupations-past-present-and-future/pdf/science-technology-engineering-and-mathematics-stem-occupations-past-present-and-future.pdf

Frey, C. B., & Osborne, M. A. (2017). The future of employment: How susceptible are jobs to computerisation? *Technological Forecasting and Social Change, 114*, 254-280. doi:https://doi.org/10.1016/j.techfore.2016.08.019

Muro, M., Maxim, R., & Whiton, J. (2019). *Automation and artificial intelligence*. Retrieved from Washington, D.C.: https://www.brookings.edu/wp-content/uploads/2019/01/2019.01_BrookingsMetro_Automation-AI_Report_Muro-Maxim-Whiton-FINAL-version.pdf

Sánchez, M., & Kaplan, M. (2014). Intergenerational learning in higher education: Making the case for multigenerational classrooms. *Educational Gerontology, 40*(7), 473-485.

Snyder, T. D., de Brey, C., & Dillow, S. A. (2019). Digest of Education Statistics: 2017. Retrieved from https://nces.ed.gov/pubs2018/2018070.pdf

Taylor, P., & Smith, W. (2017). *What's Age Got To Do With It? Towards a New Advocacy on Ageing and Work*. Retrieved from Melbourne, Australia: https://percapita.org.au/our_work/whats-age-got-to-do-with-it/

U.S. Bureau of Labor Statistics. (2020). Labor force statistics from the Current Population Survey. Retrieved from https://www.bls.gov/cps/

U.S. Census Bureau. (2020). Educational attainment in the United States: 2019. Retrieved from https://www.census.gov/data/tables/2019/demo/educational-attainment/cps-detailed-tables.html

U.S. Government Accountability Office. (2019). *Workforce automation*. Retrieved from Washington, DC: https://www.gao.gov/assets/700/697365.pdf