Apprenticeship Training and the Future of Work in New Jersey: Targeting Occupations that will Thrive with Emerging Technologies

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Introduction

Workers in New Jersey face a future of disruption and opportunity from emerging technologies, along with the natural ebb and flow of employment across industries and occupations over time. Workforce development policy needs to be cognizant of these concerns, while avoiding the mistake of locking in policy solutions that cannot adapt to unexpected developments. Workforce development policy should be directed at expanding job opportunities in fields that will weather automation and technical change, and ensuring the availability of retraining opportunities for workers in sectors that will face greater disruption from technological change. However, a job that is insulated from the negative effects of automation may not offer good prospects for future job growth. Policymakers should therefore target training for jobs that are insulated from automation and have high growth prospects.

Expanding registered apprenticeship training in a way that is targeted specifically at occupations with low risk of job loss from technological change and high job growth prospects can serve as a key component of a forward-looking New Jersey workforce development policy. Apprenticeship combines structured on-the-job training with formal related technical instruction, and has been proven to improve worker earnings and employer return on investment.[1] Since

[1] For earnings effects, see Reed, D., Liu, A. Y. H., Kleinman, R., Mastri, A., Reed, D., Sattar, S., & Ziegler, J. (2012). *An effectiveness assessment and cost-benefit analysis of registered apprenticeship in 10 states*. Mathematica Policy Research. For Return on Investment effects, see Helper, S., Noonan, R., Nicholson, J. R., & Langdon, D.

apprenticeship is employer-driven, it is also nimble in the face of unexpected labor market trends.

This report identifies apprenticeable occupations specific to conditions in New Jersey that have a low risk of job loss from technological change and high projected job growth. It also highlights obstacles to the expansion of apprenticeship in New Jersey, and proposes policy solutions to those obstacles. The research is mixed method, including quantitative analysis of administrative data on New Jersey apprentices and qualitative interviews of New Jersey apprenticeship coordinators.

This report begins by describing the nature of apprenticeship in New Jersey, relying on administrative data on apprentices as well as interviews with federal representatives of the Office of Apprenticeship (OA) and state apprenticeship coordinators. After describing the unique characteristics of apprenticeship in New Jersey, the report discusses the automation risk faced by New Jersey apprentices.

The New Jersey apprentices fall into each of four categories. This will help to answer the Task Force's **second research question** about which groups of residents in New Jersey will be most affected by technological change. Then, the report identifies the occupations that will not be threatened by technological change and have strong prospects for growth. It also reports on how these programs are structured, including their length, use of competency-based education, program sponsorship, etc. This will help to answer the Task Force's **fourth research question** about how in the face of technological change New Jersey can improve workplace conditions, create better jobs, and grow.

(2016). *The benefits and costs of apprenticeships: A business perspective*. Washington, D.C.: U.S. Department of Commerce. The New Jersey Institute for Justice highlights the role of apprenticeship in advancing equity in New Jersey in its report, *Becoming the United States of opportunity: The economic equity and growth case for apprenticeships*.

Data Sources. Data informing this report come from four principle data sources that are commonly used to study apprenticeship, automation, and the future of work:

Data on individual registered apprentices come from the Registered Apprenticeship Partners Information Data System (RAPIDS). RAPIDS is the federal administrative data system that has tracked registered apprentices since 1999.[2] Since only some data from 1999 are included, the sample for this report is restricted to apprentices employed with a program registered in New Jersey from 2000 to 2016.[3] Analysis of the RAPIDS data identifies a total of 39,198 apprentices registered with programs that are registered in New Jersey, distributed across 180 detailed apprenticeable occupations. RAPIDS occupational codes used for the administration of the apprenticeship system are not exactly comparable to national Standard Occupational Classification (SOC) codes. For example, there are many different RAPIDS codes for different types of electricians. However, every RAPIDS code does have an associated SOC code. These SOC codes are used to measure the automation risk and job growth prospects faced by individual apprentices. The RAPIDS data contains detailed individual-level information on apprentices' demographics, occupation, wages, and program characteristics. Besides summarizing the current state of apprenticeship in New Jersey, this information will not be used extensively in this report.

Data on occupational automation risk comes from occupational level risk scores reported in Carl Frey and Michael Osborne's (2017) widely cited study of the technological change risk for detailed U.S. occupational groups.[4] Frey and Osborne (2017) use information on

[2] The U.S. Department of Labor is currently in the process of revising the RAPIDS data system, but this change should not affect the timeline for this analysis.

[3] RAPIDS identifies the state where the apprentice lives and the state where the apprentice's program is registered. Since New Jersey workforce policy only affects programs registered in New Jersey, the analyses exclude the small number of apprentices who live in New Jersey but work with programs registered in other states (e.g., Pennsylvania or New York). This decision does not substantively affect the results.

[4] 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. Other analyses of technological change risk are available, including work by the Organisation for Economic Co-operation and Development and PwC. Frey and

occupational tasks from the O*NET database to quantify the susceptibility of detailed occupations to technological change. Frey and Osborne's (2017) measure is a highly regarded measure of automation risk, and has been cited over 3,000 times to date, which is extraordinarily high for such a recent paper. The automation risk score ranges from zero (no automation risk) to one (high automation risk). A risk of technological change does not indicate that a given job will be completely eliminated, only that certain elements of the job may be at risk. Some jobs may be at risk because automation and computers make workers more efficient at their job, thus requiring fewer workers.

Projected state-level job growth comes from Projections Management Partnership's analysis of Bureau of Labor Statistics data on state-level employment projections. Projections are made publicly available at www.projectionscentral.com. Much like the automation risk scores, projected job growth is estimated at the detailed occupational level. The most recent job growth estimates are for growth between 2016 and 2026, and are provided in levels (i.e., the number of new jobs) and percentage change. This report follows the common practice of using percentage change estimates to identify high growth jobs.

Both projected job growth and automation risk are linked to the individual-level RAPIDS data using detailed SOC codes. Registered apprentices are also assigned RAPIDS occupational codes specific to the registered apprenticeship system (known as "apprenticeable occupations"), but the RAPIDS database maps these onto SOC codes, which allows for occupation-level matching to the other datasets used in this report.

Interviews with state apprenticeship coordinators and OA representatives provide additional qualitative data. In addition to the quantitative data discussed above, this study draws

Osborne (2017) have the advantage of making the occupation-level data required for the analysis readily available, being broadly understood and respected in the research literature, and maintaining a focus on the United States that the Organisation for Economic Co-operation and Development and PwC lack.

on semi-structured interviews with state apprenticeship coordinators and U.S. Department of Labor representatives of the OA responsible for New Jersey. The response rate to interview requests was low because the study period coincided with the holiday season and because the study period was so short. Only three individuals agreed to be interviewed. Nevertheless, these three interviewees provided important information from both the federal and state perspective on apprenticeship in New Jersey.

Apprenticeship in New Jersey

Registered apprenticeship is a structured approach to occupational training that combines classroom-based related technical instruction (RTI) and on-the-job training. Federal regulations require a minimum of 144 hours of RTI and 2,000 hours of on-the-job training. Apprentices must be paid employees and apprenticeship programs must incorporate wage increases associated with progress through the program. Upon completion, all apprentices must receive a nationally recognized certificate. At a minimum, this is a U.S. Department of Labor apprenticeship completion certificate, but it may include other industry-recognized certificates.

There are four types of apprenticeship programs in the United States defined along two dimensions. An apprenticeship program can be an "individual" program (one employer) or a "group program" (multiple employers), and it can be operated "jointly" by a union and an employer, or it can be non-joint (just an employer). In New Jersey, most apprentices are employed in group joint programs (see Table 1); that is, programs that involve multiple employers and are jointly operated with unions. Group joint programs are the traditional organizational form for the building trades (e.g., carpenters, electricians, plumbers, laborers), which accounts for their high representation among apprentices. The next most common program type is the individual non-joint program, which accounts for a little less than a quarter

of New Jersey apprentices. Joint programs are less common in states with lower unionization rates than New Jersey. Program types are important for apprenticeship policymaking because group programs (whether or not they are associated with unions) significantly reduce the program design and registration costs for employers. Employers can effectively sign on to an existing set of apprenticeship standards, provided the program is appropriate for their needs. The federal OA representative interviewed for this report indicated that New Jersey would benefit from investing in intermediaries that would sponsor these group apprenticeship programs for employers. Community colleges or industry associations could serve as such an intermediary.

Reflecting national patterns, an abysmally low share of apprentices in New Jersey are women (5.88%, see Table 1). To a considerable extent, the underrepresentation of women is driven by occupational segregation and the concentration of apprenticeships in a small number of male-dominated jobs (primarily in the building trades). There are two primary approaches to addressing gender gaps and occupational segregation in apprenticeship: 1) register more apprenticeship programs in occupations that employ more women, and 2) break down barriers for employing women in male-dominated trades. The first approach has been more successful than the second approach, although the U.S. Department of Labor and state agencies are actively pursuing both (Lerman, Eyster, & Kuehn, 2014; Kuehn, 2017). Registered apprentices more closely reflect the racial and ethnic composition of New Jersey than the gender composition. White non-Hispanic workers are somewhat overrepresented (66.8% of apprentices compared to 55.1% for the state) and Hispanic workers are somewhat underrepresented (13.3% of apprentices compared to 20.4% for the state), but there is considerably more racial and ethnic inclusivity in

apprenticeship than gender inclusivity.[5] The large majority of apprentices have only a high school diploma (85.99%).

[Insert Table 1 About Here]

New Jersey is one of 25 states that register apprentices and apprenticeship programs through the federal OA, rather than through a state apprenticeship agency. Stereotypically, "OA states" such as New Jersey are more efficient in registering new programs, while "State apprenticeship agency states" have more cumbersome registration processes. OA states maintain considerable policy initiative even if the OA registers programs. South Carolina is an example of a state that has experienced significant growth in apprenticeship through state initiatives despite being an OA state. New Jersey recently made $4.5 million available in "Growing Apprenticeship in Nontraditional Sectors" (GAIN) grants to expand registered apprenticeship beyond the building trades.

Because New Jersey is an OA state, all registration responsibilities lie with the OA representatives and apprenticeship training representatives rather than with the state apprenticeship coordinators. New Jersey has one federal apprenticeship director and four apprenticeship training representatives responsible for all apprenticeship programs in the state. One representative of the federal OA responsible for New Jersey was interviewed for this report. He indicated that currently in New Jersey, the federal representatives do most of the work engaging employers, helping them design their programs, and completing the paperwork to get their programs registered. Interviews with two state apprenticeship coordinators confirmed his assessment that the state coordinators are not deeply involved in the program design and registration process. State apprenticeship coordinators are primarily responsible for connecting employers with classroom-based related technical instruction opportunities in New Jersey, and

[5] State demographics are available at https://www.census.gov/quickfacts/nj.

for advertising apprenticeship at job fairs and similar events. Nevertheless, the OA representative communicated high hopes that new investments in apprenticeship by the state would move New Jersey to what he called a "South Carolina model," where OA representatives would continue to register programs and provide technical assistance but state apprenticeship staff would bear primary responsibility for engaging employers and helping to design apprenticeship programs. The expectation that New Jersey might follow the "South Carolina model" is highly ambitious. South Carolina is celebrated in the world of apprenticeship for its ambitious apprenticeship marketing efforts and dramatic increases in program registration, rapid growth in registering programs in non-traditional occupations, and success in leveraging the technical college system to support apprenticeship. The OA representative identified the GAIN grants as a particularly important investment in apprenticeship in the state. State apprenticeship coordinators indicated that another important policy change in apprenticeship in the state had been the shift in responsibility for apprenticeship from the state Department of Education to the state Department of Labor around the time of the Great Recession.

State apprenticeship coordinators highlighted the importance of their work connecting employers to RTI providers in light of the changing landscape for traditional RTI providers. One coordinator noted that some vocational schools in his region dropped critical occupational courses entirely, or dropped the night and weekend courses that are utilized by many apprentices who work full time. He indicated, "Our machine shop at the high school level died down to where we couldn't get ninth graders interested in the manufacturing trade." Navigating the diminishing options for RTI is often difficult for apprentices and employers, and coordinators use their networks and connections with trainers to assist in finding classroom training. A second

state apprenticeship coordinator suggested that they often had to refer apprentices to online classes or to colleges in other counties.

State apprenticeship coordinators also attend job fairs to promote apprenticeship. One coordinator interviewed for this report suggested that he primarily attends these job fairs to talk with the employers rather than the job seekers. He noted, "When I go to a career fair, I'm there to see the employers. I go from table to table. I'm targeting different types of employers. I'm a creature of habit so I'm go to with what I think is an easy match." For this coordinator, "an easy match" meant employers in traditional sectors like construction, but also in non-traditional sectors like information technology and health care where employers are hungry for skilled workers. However, both state apprenticeship coordinators and the OA representative indicated that they did not target specific occupations for selling apprenticeship. They did not consider automation risk in their employer engagement activities and in most cases, they did not even consider whether a job was "high growth" or not. Resources were focused on targeting employers that would be responsive or simply employers that would listen.

Automation Risk and Growth Prospects for Apprenticeable Trades

The first task is to characterize the automation risk facing apprentices in New Jersey. Occupational risk of disruption from automation and technological change is measured using the risk score from Frey and Osborne (2017), which ranges from zero (low automation risk) to one (high automation risk). The distribution of automation risk scores for New Jersey apprentices in the RAPIDS database is presented in Figure 1.

[Insert Figure 1 About Here]

The distribution of automation risk for New Jersey apprentices (Figure 1) has similarities to and differences with the distribution of automation risks for the entire U.S. workforce as

estimated by Frey and Osborne (2017, Figure 3). Frey and Osborne (2017) show large portions of the workforce at either very high levels of automation risk (approximately 0.8) or very low levels of automation risk (approximately 0.2), with fewer workers experiencing intermediate ranges of automation risk. New Jersey apprentices are also concentrated at the high and low end of the automation risk scale, rather than being evenly distributed. However, a large number of apprentices are also concentrated at just below 0.4 automation risk. In other words, a higher share of New Jersey apprentices are concentrated at intermediate levels of automation risk than workers generally.

Obviously, automation risk varies widely by occupation. To understand what levels of automation risk common apprenticeable occupations face, the 20 largest apprenticeship occupations in New Jersey are presented in Table 2. Table 2 provides the RAPIDS occupational title that is used in the apprenticeship system (not SOC occupational titles), along with the total number of apprentices registered between 2000 and 2016 and the automation risk score for each occupation. The largest apprenticeship occupations in New Jersey are in the building trades, which is also true of apprenticeship nationally. These occupations exhibit a wide range of automation risk scores. Electricians — a very traditional apprenticeable trade — has a low automation risk score of 0.15, which is rivaled only by child care development specialists (a non-traditional but growing occupation), which has a score of 0.08. Other large occupations are at considerably greater risk of automation, including operating engineers (0.95), roofers (0.90), stationary engineers (0.89), and many other traditional trades. *Because of the wide variation in automation risks, policymakers and apprenticeship program operators cannot make broad generalizations about how the traditional trades will fare in the future.* Electricians and plumbers require significant situational awareness and expert judgment that cannot be easily routinized,

insulating these occupations from automation risk. The state apprenticeship coordinators identified other occupations that have persisted but which have been subject to change due to automation. One coordinator highlighted machinist apprenticeships which are "now all CNC, whereas 15 or 20 years ago" CNC programming was not a prominent element of machinist training.

[Insert Table 2 About Here]

Despite the excitement around "non-traditional" apprenticeship occupations in New Jersey and nationally, some non-traditional occupations have high automation risks. For example, computer operators have an automation risk score of 0.78, hotel and restaurant cooks have a score of 0.96, and pharmacy assistants have a score of 0.92. Non-traditional occupations should be pursued as opportunities to scale up apprenticeship where it is not currently utilized, but many of these occupations still face serious technological headwinds that need to be anticipated by policymakers, employers, and educators.

Although policymakers should be cognizant of technological change and automation risk, it would be counterproductive to expand apprenticeship in occupations with low automation risk but that also have low growth prospects. The Bureau of Labor Statistics produces state-level employment growth projections that can help to identify which occupations have both low automation risk and high growth potential among current apprenticeable occupations in New Jersey. Since these occupations are currently apprenticeable, it is not necessary to write and approve new apprenticeship standards to start new programs. All New Jersey apprentices are divided into four categories:

- *High automation risk/low growth occupations:* The least secure category with above-average automation risk and below-average job growth projections.

- *High automation risk/high growth occupations:* Jobs that have above-average automation risk but still have above-average job growth projections. These jobs will provide steady employment growth in New Jersey but may face disruptions from technological change.
- *Low automation risk/low growth occupations:* Jobs that have below-average automation risk and job growth projections. These jobs will not be disrupted by technological change but will not be an important source of job growth.
- *Low automation risk/high growth occupations:* The most secure jobs that offer ample employment prospects and that will not be substantially disrupted by technological change.

A plurality of New Jersey apprentices (38.69%) are or have been registered in the least secure category of occupations facing high automation risk and low growth job prospects (see Table 3). These are essential jobs for the functioning of the New Jersey economy, but they may face disruption in the future and they do not offer the prospect of broader growth in high-quality employment. About the same number of apprentices are or have been employed in "high automation risk/high growth jobs" and "low automation risk/high growth jobs."

[Insert Table 3 About Here]

Although employment in the groups listed in Table 3 has been fairly stable over time, there are important trends (particularly in recent years) that require comment. Figure 2 plots trends in registering apprentices in each of the four groups from 2000 to 2016. In 2000, registrations of "high automation risk/low growth," "high automation risk/high growth," and "low automation risk/high growth" occupations were similar, clustered around 30% of all apprentices registered in that year. However, after 2010, these groups began to diverge, with a

marked decline in registrations of apprentices with low automation risk and high growth prospects, and a substantial increase in the registration of occupations with high automation risk and low job growth prospects. These are problematic trends and New Jersey policymakers should focus their attention on reversing those trends and supporting registered apprenticeships with low automation risk and high growth prospects.

[Insert Figure 2 About Here]

Table 4 lists the detailed occupations with lower-than-average automation risks and higher-than-average job growth prospects, sorted by the total number of apprentices registered in the occupation. This group of occupations is an interesting mix of traditional and non-traditional trades. The largest single occupation in the group is electricians (including an additional 158 maintenance electricians). Electricians are the classic apprenticeable building trades occupation, and their inclusion in Table 4 clearly indicates that preparing New Jersey for technological change and the future of work does not mean that traditional apprenticeships should be abandoned. These data reflect a sentiment expressed by one of the apprenticeship coordinators when asked about how automation affects apprenticeship. He responded, “I see electricity wherever I go. Whatever automation goes on, there’s always an electrician.” Electrician apprentices may learn new tasks in different job sites — for example, an automated factory floor — but the fundamental skills of the trade will continue to be valued in the labor market. Other traditional apprenticeable trades included in Table 4 are plumbers and pipefitters. All of these occupations are disproportionately sponsored by joint program sponsors (i.e., a partnership between unions and employers).

[Insert Table 4 About Here]

Although traditional trades and unionized trades are well represented in the group of "low automation risk/high growth" occupations (and employ the lion's share of apprentices), several non-traditional occupations are represented as well. These include direct support specialists, dental assistants, and ambulance attendants — all health care occupations. Few apprentices have been employed in these occupations in New Jersey, but since apprenticeship standards are written for them, they could be scaled up more quickly than occupations without existing standards. Table 4 also includes several technician occupations, including quality control technicians, mechanical engineering technicians, and various drafting occupations. Technicians and drafters are well-paid science and engineering workers that do not require a bachelor's degree. These occupations are well positioned to benefit from registered apprenticeship and employers that are currently using the apprenticeship model to train technicians have had positive experiences (National Academy of Engineering, 2017; Kuehn & Jones, 2018).

Conclusions and Recommendations

The principal recommendation of this report is that New Jersey policymakers should target the occupations listed in Table 4 for support and expansion in the registered apprenticeship system. These occupations are the most likely to weather technological change and the disruptions caused by automation while maintaining high job growth prospects. The occupations listed in Table 4 can be supported by directing funding from the GAIN grants toward programs offering apprenticeship training in those fields, or by supporting intermediaries charged with registering new programs.

One of the key conclusions of this report is that workforce development strategies do not need to abandon "traditional" trades to address the needs of emerging technology and the risks of automation. Many traditional apprenticeable trades such as electricians and plumbers are well

positioned for job growth and avoiding the risks associated with automation. Expansion of apprenticeship to non-traditional trades should be pursued as a strategy for scaling up apprenticeship, not as an effort to move past or neglect the traditional building trades. The building trades are the registered apprenticeship system's bread and butter, so there is little risk that staff involved in apprenticeship will ignore their needs.[6] Other state policymakers that may be more focused on non-traditional apprenticeable trades should recognize apprentices in the building trades as a key component of the future of work.

New Jersey has many opportunities to expand into non-traditional trades, particularly in sectors where the state excels, such as the biopharmaceutical industry. According to RAPIDS data, only 42 apprentices have ever been registered in biopharmaceutical manufacturing (NAICS code 32541), and all of these have been in traditional trades that are not specific to biopharmaceutical manufacturing (e.g., electricians, plumbers, and machinists). New Jersey can strike its own path in registered apprenticeship by writing apprenticeship standards for biopharmaceutical occupations that have not previously been registered.

The analyses in this report indicate that it may be necessary to rebalance the traditional trades away from occupations like carpentry and roofing, which have worse job growth prospects and higher automation risk, and toward occupations like electrical work and plumbing. Since apprenticeship is employer-driven, policymakers may have limited scope to spearhead this rebalancing, and employers will continue to need trained carpenters and roofers. But when policymakers are allocating scarce public monies to traditional apprenticeable trades, they should do so with a proper understanding of which of the traditional apprenticeable occupations have the best prospects in the future (e.g., electricians and plumbers rather than carpenters and

[6] The prominence of joint programs is not universal. One state apprenticeship coordinator interviewed for this report suggested that he worked with very few unions in his region.

roofers). To a considerable extent, the traditional trades already have a well-functioning apprenticeship training system and are responsive to market forces. In the registered apprenticeship system, these trades are fully capable of fending for themselves and responding to changes in market conditions. Policymakers are therefore freed to focus on other non-traditional occupations with low automation risk and high job growth prospects.

State apprenticeship coordinators can continue to play an important role in preparing New Jersey apprentices for technological change by anticipating and managing changes in requirements for RTI. In many cases, the apprenticeship coordinators suggested that giving apprentices the skills that they needed to cope with automation is simply a matter of adjusting RTI rather than changing what types of occupational programs are registered. One coordinator pointed out that construction positions could be preserved, provided that apprentices were taught certain digital skills that were required on the modern job site. He noted, "You're always hoping that at a vocational school every program has advisory committees and you're hoping that those committees facilitate those changes," but that sometimes changes to the RTI curriculum would have to be anticipated and suggested by the coordinators themselves.

The apprenticeship coordinators identified the registration paperwork as the greatest barrier to scaling apprenticeship, particularly in new occupations that would require the design and approval of new apprenticeship standards. One coordinator noted, "The sponsor [i.e., employer] is working all day long and the paperwork doesn't get back in a timely manner." The federal OA representative indicated that the typical solution to an employer that found the registration paperwork burdensome was for the OA representatives to help them complete the registration process. Since only four apprenticeship training representatives and one state director manage the entire state of New Jersey, there are limits to the level of assistance that can be

provided to employers. Supporting the state coordinators in the task of registering new apprenticeship programs would therefore assist in scaling up apprenticeship.

Policymakers are constrained in how much they can control the registered apprenticeship system without violating the employer-driven nature of this training model. Market forces should dictate the provision of apprenticeship training. However, when public investments are made to support apprenticeship, New Jersey policymakers should be cognizant of the different automation risks facing various occupations, as well as the growth projections for those occupations. To the extent possible, policymakers should target apprenticeable occupations that can weather future technological change and that have strong growth prospects.

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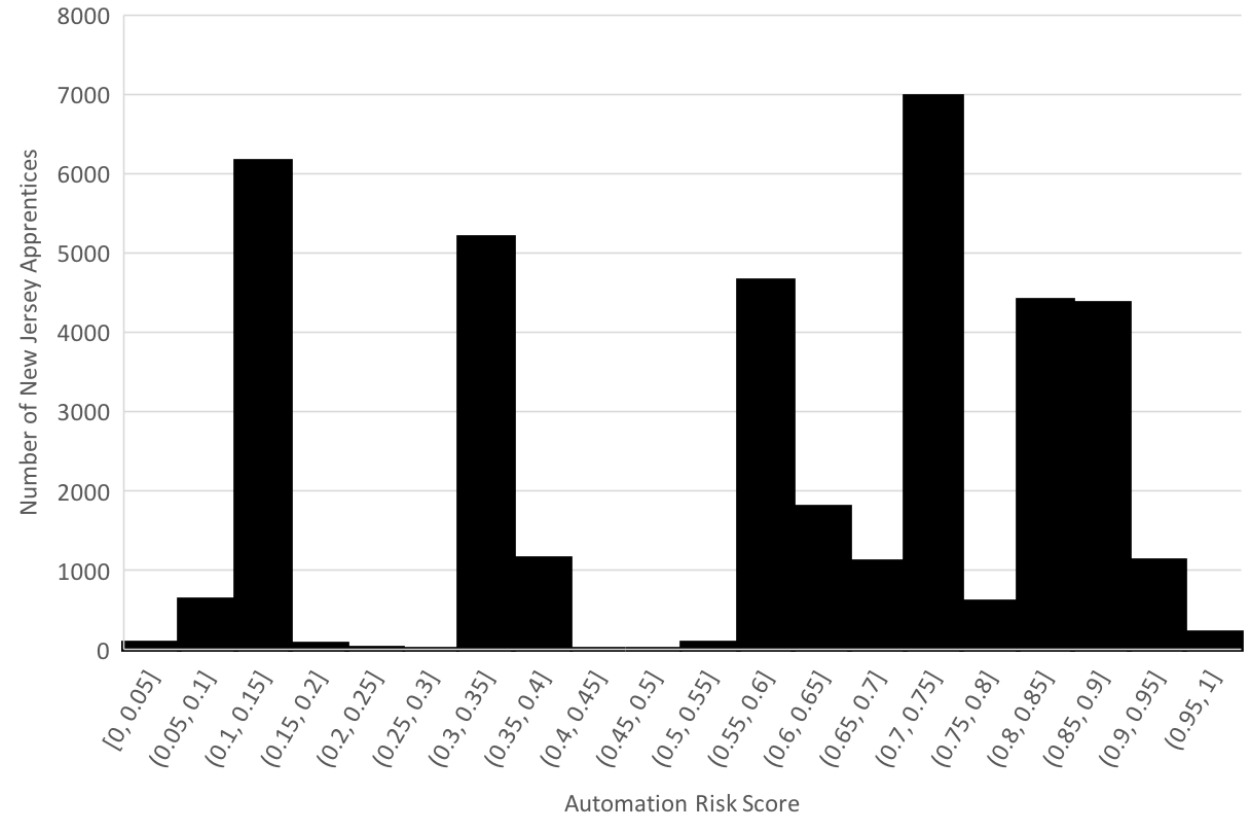
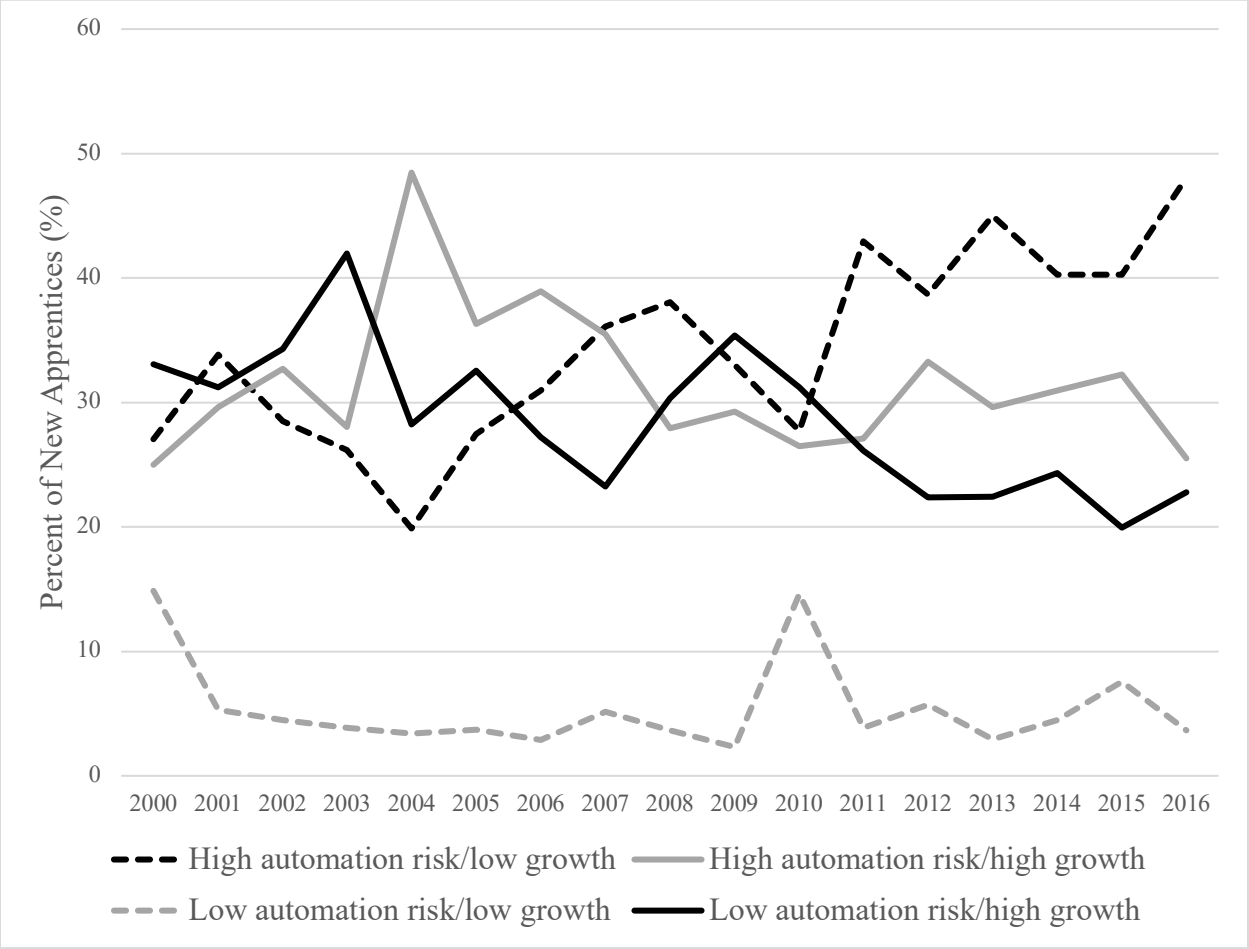
Figure 1. Distribution of Automation Risk Scores for New Jersey Apprentices, 2000-2016



Source: Author's calculations from RAPIDS and automation risk scores from Frey and Osborne (2017).

Notes: Apprentice sample includes all apprentices who live in New Jersey or who are registered with programs registered in New Jersey, 2000-2016.

Figure 2. Trends in the Registration of Automation and Job Growth Groups for New Jersey Apprentices, 2000-2016



Source: Author's calculations from RAPIDS, automation risk scores from Frey and Osborne (2017), and employment projections from the Employment and Training Administration's Projections Central website.

Notes: Apprentice sample includes all apprentices who live in New Jersey or who are registered with programs registered in New Jersey, 2000-2016.

Table 1. Characteristics of Apprentices in New Jersey, 2000-2016

Occupation	Share of Apprentices, 2000-2016	Total Apprentices, 2000-2016
Gender		
Male	94.12%	36,892
Female	5.88%	2,305
Race or Ethnicity		
White	66.83%	26,197
Black	16.44%	6,443
Hispanic/Latinx	13.36%	5,235
Asian	0.76%	299
Hawaiian Pacific Islander	0.27%	104
Native American	0.36%	140
Unknown race/ethnicity	1.99%	780
Educational Attainment		
Less than 8th grade	0.18%	71
9th to 12th grade (no diploma)	4.01%	1,571
GED	4.00%	1,566
High school diploma	85.99%	33,708
Post-secondary or technical training	4.16%	1,631
Unknown educational attainment	1.66%	551
Program Type		
Individual non-joint	22.20%	8,702
Individual joint	12.23%	4,795
Group non-joint	0.56%	220
Group joint	64.97%	25,466

Source: Author's calculations from RAPIDS.

Notes: Apprentice sample includes all apprentices who live in New Jersey or who are registered with programs registered in New Jersey, 2000-2016.

Table 2. Twenty Largest Apprenticeship Occupations in New Jersey, 2000-2016

Occupation	Automation Risk Score	Total Apprentices
Electrician	0.15	6,006
Correction Officer	0.60	4,200
Plumber	0.35	3,961
Carpenter (time-based program)	0.72	3,792
Construction Craft Laborer	0.88	2,133
Carpenter (hybrid program)	0.72	1,705
Roofer	0.90	1,412
Structural Steel/Ironworker	0.83	1,325
Pipe Fitter (construction)	0.35	1,221
Refrigeration Mechanic	0.65	1,158
Telecommunications Technician	0.36	1,117
Bricklayer (construction)	0.82	969
Sheet Metal Worker	0.82	934
Painter (construction)	0.75	680
Stationary Engineer	0.89	675
Cook	0.83	593
Housekeeper	0.69	529
Operating Engineer	0.95	524
Child Care Development Specialist	0.08	431
Boilermaker II	0.68	406

Source: Author's calculations from RAPIDS and automation risk scores from Frey and Osborne (2017).

Notes: Apprentice sample includes all apprentices who live in New Jersey or who are registered with programs registered in New Jersey, 2000-2016.

Table 3. Automation and Job Growth Groups for Apprentices in New Jersey, 2000-2016

Group Description	Percent of New Jersey Apprentices (2000-2016)
High automation risk/low growth	38.69%
High automation risk/high growth	27.21%
Low automation risk/low growth	5.52%
Low automation risk/high growth	28.58%

Source: Author's calculations from RAPIDS, automation risk scores from Frey and Osborne (2017), and employment projections from the Employment and Training Administration's Projections Central website.

Notes: Apprentice sample includes all apprentices who live in New Jersey or who are registered with programs registered in New Jersey, 2000-2016.

Table 4. Apprenticeable Occupations in New Jersey with Below-Average Automation Risk and Above-Average Projected Job Growth

Occupation Title	Total Apprentices, 2000-2016
Electrician	6,349
Plumber	4,079
Pipe Fitter (construction)	1,436
Pipe Fitter - Sprinkler Fitter	267
Elevator Construction Mechanic	257
Electrician, Maintenance	158
Stage Technician	61
Chief Cook (water transportation)	57
Quality Control Technician	52
Animal Trainer	26
Dental Assistant	13
Residential Electrical Wireman	7
Ambulance Attendant (EMT)	4
Drafter, Structural	4
Medical Assistant	4
Apprenticeship Representative	3
Drafter, Civil	2
Mechanical Engineering Technician	2
Construction Equipment Mechanic	1
Direct Support Specialist (competency based)	1
Drafter, Architectural	1
Plumber (hybrid)	1
Street-Light Servicer	1

Source: Author's calculations from RAPIDS, automation risk scores from Frey and Osborne (2017), and employment projections from the Employment and Training Administration's Projections Central website.

Notes: Apprentice sample includes all apprentices who live in New Jersey or who are registered with programs registered in New Jersey, 2000-2016. Average automation risk and projected job growth is calculated as the average of all apprentices in New Jersey registered between 2000 and 2016.