Evaluating the Higher-Level Skill Content of the Iowa Workforce and Its Competitiveness with the Rest of the Nation

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Findings Overview

This study evaluates the demand for high-skilled workers in Iowa using information about the state's current and projected occupational structure and its net migration exchanges with other states. The purpose of the research was to discern the degree to which Iowa jobs require higher levels of education, skills, or job preparation and the capacity of the state's economy to absorb more of that talent. This is not a study of Iowa's ability to accommodate "middle-skill" jobs and job growth, as has been so popular in recent years; to the contrary, the study is primarily aimed at evaluating Iowa's current and future higher-skill demands.

- Nationally, 25.6 percent of all occupations are filled by persons expected to have a bachelor's degrees or higher compared to 21.4 percent for Iowa. Conversely, 40.7 percent of Iowa occupations only require a high school degree or equivalent compared to 36.5 percent of all occupations at the national level. Iowa is more dependent on middle skilled workers than the U.S. norm, and it needs fewer persons with college degrees.

- Initially and importantly, when controlling just for education level and considering occupational growth from 2014 to 2024, Iowa is expected to demand twice as many new jobholders possessing bachelor's degrees or higher than jobholders possessing post high school certificates, some college, or associates degrees.

- Iowa, by 2024 will demand substantially fewer low skilled or minimal preparation job holders and substantially more job holders with considerable to significant levels of preparation, skills, and knowledge. The fraction of the state's workforce working in middle skill occupations is expected to remain essentially constant comparing 2014 with projections to 2024.

- This study selected out occupations ranking high in terms of three high-skill dimensions. Of future occupation growth, 26 percent of that growth will be in occupations with high critical basic skills, 29 percent in occupations with high problem solving skills, and 9 percent in occupations with high-level technical skills.

- Nearly half of the projected growth in occupations in high critical basic skills will be in in architecture and engineering along with life, physical and social sciences, management occupations, and in health care and related technical jobs.

- Considering recent occupational migration exchanges (workers moving in minus those moving out) among the states between 2011-15, Iowa is comparatively more attractive to younger persons working in occupations requiring less education and low to medium levels of overall preparation. In terms of the selected sets of higher skills, Iowa is less competitive on an occupational exchange basis for people with college degrees, and those in occupations requiring higher critical basic skills, problem solving skills, and in occupations requiring high-level technical skills.

Overall, Iowa also has a net comparative outflow of higher skilled, higher prepared, and higher educated workers. This study demonstrated that Iowa's industrial structure requires fewer higher educated or higher skilled workers than the national average, but that the state is expected to have comparatively faster growth in occupations needing higher levels of education and preparation than had been case historically. If those projections eventuate, then the net outflow of Iowa's higher skilled and higher educated adults would be expected to decrease.

Introduction

Iowa's workers possess, collectively, a bundle of skills that have evolved in tandem with the state's key industries. Some of the skills are common and basic, some are specialized and intricate, and some are advanced. To compete nationally, Iowa must not only maintain the core skills staffing its current major industries but also develop and attract workers to meet new skill demands of emerging industries.

Recent skills-related research suggests two labor force challenges with particular relevance in Iowa: first, evidence indicates growing competition across a range of industries for workers with sets of higher technical, scientific, or mathematical skills, and second, urban areas appear to hold strong advantages over rural areas in that competition.[1] Urban areas attract a steady stream of workers with a range of skills, including those with advanced skills. More rural areas cannot compete and find their workforces becoming less diversified and, comparatively, less skilled over time.[2]

This analysis begins as a basic audit of Iowa's occupational composition to gauge the state's comparative standing on several measures of educational and skills requirements. Next, the state's recent competitiveness in attracting workers with different skill and preparation levels is assessed. This inquiry relies on occupation and employment statistics (OES) from the Bureau of Labor Statistics (BLS) and O*NET data from the Department of Labor to score occupational designations on the basis of expected

[1] Following is a selected list of studies exploring claims of skills gaps in regional and U.S. workforces: Loritz, Megan, Ben Nerad, Phil Sletten, and Jennifer Cunha. 2013. Examining the Skills Gap in Wisconsin. Robert M. La Follette School of Public Affairs, University of Wisconsin. Quesada, Allison Dickson, Frank Manzo IV, and Robert Bruno. 2013. A Manufactured Myth: Why Claims of a "Skills Gap" in Illinois Manufacturing are Wrong. Labor Education Program, University of Illinois at Urbana-Champaign. Levine, Marc V. 2013. The Myth of the Skills Gap in Wisconsin: Research Update. Center for Economic Development. University of Wisconsin – Milwaukee. Şahin, Ayşegül, Joseph Song, Georgio Topa, and Giovanni L. Violante. 2012. Mismatch Unemployment. Working paper. Federal Reserve Bank of New York. Lazear, Edward P. and James R. Spletzer. 2012. The United States Labor Market: Status Quo or a New Normal? Working Paper #18386. National Bureau of Economic Research. Elsby, Michael, Bart Hobijn, Ayşegül Şahin, and Robert G. Valletta. 2011. The Labor Market in the Great Recession: An Update. Brookings Papers on Economic Activity. Autor, David. 2010. The Polarization of Job Opportunities in the U.S. Labor Market. The Hamilton Project and the Center for American Progress. Jaimovich, Nir and Henry E. Siu. 2012. The Trend Is the Cycle: Job Polarization and Jobless Recoveries. Working Paper #18334. National Bureau of Economic Research. Osterman, Paul and Andrew Weaver. 2014. Why Claims of Skills Shortages in Manufacturing are Overblown. Report on Trade and Globalization. Economic Policy Institute. Bivens, Josh and Heidi Shierholz. 2014. Lagging Demand, Not Unemployability, is Why Long-Term Unemployment Remains So High. EPI Briefing Paper. Economic Policy Institute. Finally, there is this classic essay on why there is no skills gap by Paul Krugmam, "Jobs and Skills and Zombies," The New York Times, March 30, 2014. Found at https://www.nytimes.com/2014/03/31/opinion/krugman-jobs-and-skills-and-zombies.html?_r=0

[2] Eathington, Liesl and David Swenson. Exploring the Middle Skills Gap in Iowa. Department of Economics Staff Report, Iowa State University, June 2015. Found at http://www.icip.iastate.edu/sites/default/files/uploads/reports/Exploring%20the%20Skills%20Gap%20in%20Iowa.pdf

skill sets. The resulting scoring allows Iowa's overall workforce to be characterized using focused measures of skill and preparation. In addition, this analysis calculates the net exchanges states realize from people moving from one state to another using Public Use Microdata Sample (PUMS) data from the U.S. Census Bureau's 2015 American Community Survey (ACS) 5-year data set. This analysis of worker exchanges helps us determine the types of demand signals that Iowa and other states send to prospective workers across a range of skill levels.

This study looks at three dimensions of the Iowa's occupational composition to assess its current standing and its prospects in meeting the future skill and knowledge needs of the Iowa economy. They are

1. The expected educational attainment of persons in occupations
2. Importance ratings for three categories of higher-level skills :
    - Critical basic skills (critical thinking, mathematics, science, and writing)
    - Problem solving skills (complex problem solving, judgement and decision making, and systems analysis and evaluation)
    - High-level technical skills (operations analysis, programming, and quality control analysis)
3. Job preparation requirements, which consider training and experience as well as education, and range from a low of little to no preparation to a high of considerable to substantial preparation.

These different dimensions allow us to characterize subsets of Iowa's occupational structure that demand higher levels of education, skills, or preparation.

This research indicates that Iowa is likely well-positioned to accommodate low-to-middle-skill occupational growth, but may look forward to substantial growth in occupations that demand higher educations, higher skills, and higher overall job preparation.

The details of the data used in this analysis, their sources, transformations, and the assumptions and methods employed are contained in the appendix.

Iowa's Occupational Situation and Skilled Worker Outlook

Before looking at interstate skill exchanges, it is first useful to put Iowa and the U.S. into perspective regarding basic characteristics of jobholders. As has already been indicated, several aspects relating to the skill content of Iowa's workforce may be inferred by looking at the state's overall occupational composition. This study compares education levels, specific sets of higher-level skills, and overall job zone (or preparation) indicators. All of these help us distinguish where Iowa has strengths or weaknesses regarding current and longer-term occupational competitiveness.

Education

Information about the typical education levels for occupations comes from the BLS. Combining this information with occupational employment projections from Iowa Workforce Development, we can summarize Iowa's current and projected occupational staffing by the levels of education that would be

expected. Table 1 compares expected education attainments in Iowa occupations with the national averages. Nationally, 25.6 percent of all jobs are filled by persons with bachelor's degrees or higher compared to 21.4 percent for Iowa. Conversely, 40.7 percent of Iowa occupations only require a high school degree or equivalent compared to 36.5 percent of all occupations at the national level. This at the outset tells us much about Iowa's industrial structure: it is more dependent on middle skilled workers than the U.S. norm, and it needs fewer persons with college degrees.

Table 1

Comparison of Iowa and U.S. Occupational Staffing by Expected Education Level

	2014 Employment			
Typical entry-level education	U.S. (in 1,000s)	Percent Distribution	Iowa	Percent Distribution
Total, all occupations	150,539.9	100.0%	1,693,505	100.0%
Doctoral or professional degree	4,111.5	2.7%	29,650	1.8%
Master's degree	2,518.8	1.7%	28,235	1.7%
Bachelor's degree	31848.6	21.2%	304,930	18.0%
Associate's degree	3,458.2	2.3%	25,335	1.5%
Postsecondary award	9,090.7	6.0%	116,290	6.9%
Some college, no degree	3,785.8	2.5%	47,750	2.8%
High school diploma or equivalent	54,927.4	36.5%	688,610	40.7%
No formal educational credential	40,799.0	27.1%	452,705	26.7%

How Iowa was staffed in 2014 also helps us to understand our preparedness for projected future changes in occupational demand (see Table 2). While the state's occupational structure demanded college degrees from 21.4 percent of the workforce, 27 percent of job growth over that decade will require a bachelor's degree or higher. In contrast, where 40.7 percent of the jobs only needed a high school education in 2014, just 32.8 percent of growth over the decade will require that level of education. It is clear from this that the overall education levels demanded of Iowa's workers will increase progressively over the decade of this projection.

Table 2

Occupational Projections for the State of Iowa by Level of Education

Education Levels	2014 Estimate	Percent of Total	2024 Projection	Percent of Total	Change 2014-2024	Percent of Total Change 2014-2024
No formal education required	452,705	26.7%	493,590	26.8%	40,885	27.1%
High school	688,610	40.7%	738,060	40.0%	49,450	32.8%
Some college	47,750	2.8%	49,125	2.7%	1,375	0.9%
Post-secondary award	116,290	6.9%	131,060	7.1%	14,770	9.8%
Associate's degree	25,335	1.5%	28,815	1.6%	3,480	2.3%
Bachelor's degree	304,930	18.0%	337,625	18.3%	32,695	21.7%
Master's degree	28,235	1.7%	32,345	1.8%	4,110	2.7%
Doctorate or professional deg.	29,650	1.8%	33,580	1.8%	3,930	2.6%
Total	1,693,505	100.0%	1,844,200	100.0%	150,695	100.0%

Further, much has been made in recent years of the need to boost middle skills development in Iowa's workforce. The projection data indicate, however, that the state's economy is expected to demand many more new jobs requiring a bachelor's degree or higher than it will demand jobs for persons with some college, postsecondary awards, or associate's degrees. Four-year college or higher job growth is projected to be 40,735 by 2024, but occupations requiring more than a high school diploma, but no bachelor's degree, are anticipated to grow by 19,625 – just half as many.

Workforce Preparedness: Job Zones

Table 3 presents the preparation zone distribution of the current U.S. workforce, as well as expected growth over the 2014-24 BLS occupation projection period.[*] The zones range from one, with little or no preparation, to five, with extensive preparation. Nearly two-thirds of U.S. workers were in Zones 2-3, and just a quarter of the workforce was in Zones 4-5 in 2016. There are, however, clear zone preparation demand changes expected by 2024. Zone 2 occupations requiring "some" preparation are expected to contribute about one third of new jobs, down from 39 percent in the baseline measure. Zone 3 occupations requiring moderate preparation are expected to make up nearly 27 percent of new jobs compared to 24 percent in the baseline measure. Jobs in Zones 4 and 5 requiring "considerable" to "extensive" preparation are expected to make up one third of all job growth over the forecasted period even though they constituted just 25 percent of current occupations nationally in 2016.

[*] Table 3 was revised on 9/13/17 with new percentage values for projected U.S. job growth by job zone. The values for Zones 1,2,4, and 5 were incorrectly reported in the original release of this paper.

Table 3

Characteristics of U.S. Occupations by Preparation Zone Level

Preparation Zone	Percentage of All U.S. Occupations in 2016	Percentage of Forecasted U.S. Growth, 2014-2024
1 – Little or none	11.7%	6.8%
2 – Some	39.3%	32.9%
3 – Medium	23.9%	26.9%
4 – Considerable	18.9%	21.5%
5 – Extensive	6.1%	12.0%

Iowa's workforce was gauged similarly and also compared with the nation's in terms of job zone composition (see Table 4). Most notably, where U.S. Zone 2 jobs are expected to contribute a much smaller fraction of growth over the projection period, Iowa's change in this category is more subtle. And where U.S. Zone 4 and 5 jobs are expected to increase sharply, Iowa's growth rises more moderately.

Zones 4-5 occupations made up 22.2 percent of Iowa jobs in 2016, and those occupations will make up 25.9 percent of expected growth over the projection period. If we assume that Zones 2-3 represent middle-skill occupations, they constituted 66.5 percent of jobs in 2016 and will make up 65.5 of expected job growth over the 2014 through 2014 forecast period.

Table 4

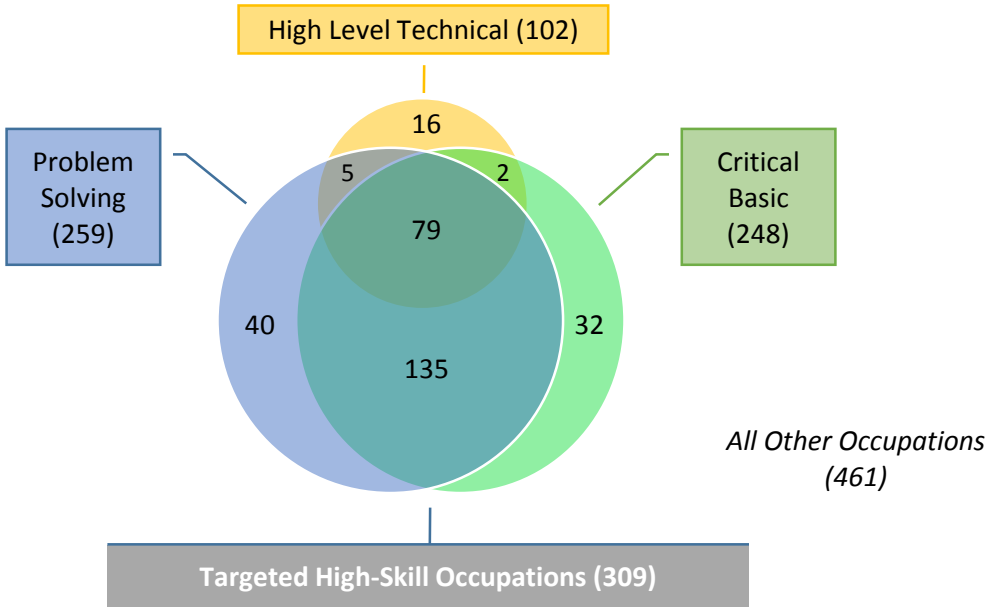
Characteristics of Iowa Occupations by Preparation Zone Level

Preparation Zone	Percentage of All Occupations in 2016	Percentage of Forecasted Growth, 2014-2024
1 – Little or none	11.3%	8.6%
2 – Some	42.2%	40.2%
3 – Medium	24.3%	25.3%
4 – Considerable	16.6%	18.7%
5 – Extensive	5.6%	7.2%

Skill Sets

Many higher-level analytical and technical skills are widely applicable across a range of occupations, industries, and regions. The U.S. Department of Labor monitors the importance of various skill sets in the U.S. economy by conducting periodic occupational surveys and evaluations. Using that information for this study, 770 distinct occupations were ranked from highest to lowest based on their scores for three targeted skill sets: critical basic skills, problem-solving skills, and high-level technical skills. Readers are referred to Table A2 in the appendix for the particular types of skills comprising each set as well as the logic of choosing and scoring those dimensions. Occupations with the highest scores for each skill set were identified and grouped for additional analysis. The top 30 percent of occupations were selected into the critical basic and problem solving groups. Only the top 12 percent of occupations were chosen for the high-level technical group. Figure 1 illustrates the distribution of occupations and degree of overlap among the three groups. In all, 309 of a possible 770 occupations met the selection criteria for at least one target group and 79 occupations qualified for all three.

Figure 1



A demonstration of the longer term expected importance of the targeted skill sets is contained in Table 5, which contains projected U.S. growth rates through 2024 for occupations in each group. Occupations in the critical basic group were just shy of 24 percent of all U.S. jobs in 2016, but would constitute nearly 37 percent of projected net job growth from 2014-24. Occupations in the problem solving group would likewise make up nearly 37 percent of new jobs. And the high-level technical jobs would be 11 percent of new jobs compared to their current share of just 8 percent. Taken together, occupations in the three targeted skill groups represent 43 percent of expected future job growth, a healthy fraction considering their current 31 percent share in the economy.

Table 5

Characteristics of U.S. Occupations in Targeted High-Skill Groups

Target Occupation Group	Percentage of All Occupations in 2016	Percentage of Forecasted U.S. Growth 2014-2024
Critical Basic	23.8%	36.7%
Problem Solving	26.9%	36.6%
High-level Technical	8.0%	11.1%
All Targeted Occupations	30.6%	42.9%

Table 6 shows current staffing and expected 2014-24 growth in the targeted skill groups for the state of Iowa. Collectively, the higher-skill occupations represent 27.4 percent of current Iowa jobs and 32.8 percent of projected job change through 2024. Although Iowa's expected future demand is notably higher than its current staffing levels, the state's current and projected percentages are consistently lower than the national averages across all categories. As has already been demonstrated, Iowa demands fewer more highly-prepared or educated workers given its overall industrial structure. One would expect a proportionately lower concentration of occupations requiring the highest levels of skills.

Table 6

Characteristics of Iowa Occupations in Targeted High-Skill Groups

Target Occupation Group	Percentage of All Occupations in 2016	Percentage of Forecasted IA Growth, 2014-2024
Critical Basic	21.2%	25.7%
Problem Solving	24.4%	29.1%
High-level Technical	6.4%	8.7%
All Targeted Occupations	27.4%	32.8%

Table 7 shows Iowa's 2014-24 job growth forecast in greater occupational detail. For 22 broad job categories, the table shows the percentage share of growth expected to occur within the critical basic, problem-solving, and high-level technical occupation groups. Percentage values for the critical basic group were used to determine the sorting order for job categories listed in the table.

All of Iowa's growth in architecture and engineering jobs and life, physical and social sciences jobs is expected to occur among occupations in the critical basic skills group. More than half of the growth in management, health care, legal, business and financial, and computer and mathematical jobs would also occur in occupations requiring high levels of critical basic skills. In these same seven broad fields, a majority of new jobs will require high levels of problem-solving skills as well. Problem-solving occupations will constitute more than half of new jobs in three additional fields: community and social services, education, and arts, design, entertainment, sports, and media.

High-level technical skills will be most important in computer and mathematical and architectural and engineering fields, and to a lesser degree, in life, physical and social sciences. High-level technical occupations will contribute about one quarter of new management and business and financial jobs, and just 12 percent of new production jobs.

The variability of occupational growth projections relative to higher-level skill demands is clearly evident. The percentage values for the three targeted skill groups range considerably across many of the job categories. For example, health care job growth will be concentrated in occupations scoring highly on critical basic or problem solving skills, but comparatively few jobs, 5 percent, will require high-level technical skills. Community and social service job growth will demand more problem solving skills than critical basic or high level technical skills. Computer and mathematical job growth will require high level technical skills more so than critical basic skills. Among the bottom twelve job categories listed in the table, little growth is projected for occupations in any of the targeted skill groups.

Table 7

Expected Demand for Targeted High-Skill Occupations in Iowa, 2014-2024, Sorted by Critical Basic Percentages

		Percentage of Jobs in Targeted Skill Groups		
	Expected Job Growth, 2014-2024	Critical Basic	Problem Solving	High-level Technical
Architecture and engineering	1,155	100%	95%	95%
Life, physical, and social sciences	970	100%	78%	48%
Management	7,305	86%	87%	23%
Healthcare practitioners and technical	12,260	86%	79%	5%
Legal	725	74%	74%	--
Business and financial operations	8,325	70%	75%	25%
Computer and mathematical	6,045	69%	78%	96%
Community and social service	4,345	46%	82%	9%
Education, training, and library	9,240	46%	58%	--
Arts, design, entertainment, sports, and media	1,105	39%	65%	14%
Sales and related	14,195	11%	6%	--
Healthcare support	9,040	7%	--	--
Protective service	1,345	3%	3%	--
Installation, maintenance, and repair	7,110	1%	5%	1%
Construction and extraction	10,220	1%	15%	--
Food preparation and serving related	11,410	--	--	--
Building and grounds cleaning and maintenance	5,730	--	--	--
Personal care and service	6,475	--	3%	--
Office and administrative support	13,730	--	9%	--
Farming, fishing, and forestry	55	--	--	--
Production	5,985	--	7%	12%
Transportation and material moving	13,575	--	2%	--
Total	150,345	26%	29%	9%

Iowa's Competitiveness for Higher-Skilled Workers

As indicated in the introduction of this report, the Public Use Microdata Sample (PUMS) data set of the American Community Survey (ACS) for 2011 through 2015 was tapped to isolate respondents who indicated that they worked during the survey period and who had moved from one state to another. This very large sub-sample of the ACS was then used to track the inflow and the outflow of workers across state lines. The data set also controlled for the age of the respondent, education levels, and the occupation the respondent listed. That data set was then matched up with the O*NET occupational data in order to obtain job zone scores for each occupation in the survey as well as scores for the three higher-level skill groups that have been analyzed in this study: critical basic, problem solving, and high-level technical skills.

Table 8 is a comprehensive breakdown of the major variables in this analysis. It controls for the age of the migrating occupational flows, education levels, the job preparation zones, and the three high-skill designations specified in this analysis. It lists the inflow, the outflow, the net inflow, and the ratio of inflow to outflow to provide a standardized basis for comparing the migration statistics.

Overall, Iowa had a positive inflow of workers over the survey period of 1,125 persons. This net inflow was explained in full by workers moving to Iowa who were under the ages of 45. Those 45 and older posted relatively strong outflows.

In controlling for education level, inflows exceeded outflows among workers who had only a high school diploma and were under age 45. Older high school only persons posted net outflows. Somewhat more balanced exchanges were noted among those with post high school training below the bachelor's degree level. This is by far the smallest group of movers, and net inflow was explained solely by younger workers moving into the state. For persons with four or more years of college, the net outflow was stark. Interestingly, the ratios of both young and older college graduates were essentially the same. There were around 71 in-migrants for every 100 out-migrants with these superior education credentials.

Given the preceding, we see that combined Job Zones 2 and 3, the middle-skill occupations posted net inflows and that gain is totally explained by young in-migrants. Preparation Zones 4 and 5, the higher skill and education occupations, post strong outflows with the highest rate among the younger jobholders.

Much the same pattern of outflow is found in the three high-skill categories. All three have net outmigration with the greatest outflow proportionately occurring among younger workers in high-level technical occupations. However, the rate of outflow for the critical basic occupations and for the problem solving occupations was highest for the older movers.

In summary, given worker flows over the 2011-2015 survey period of the ACS, Iowa is most attractive to younger persons working in occupations requiring less education and low to medium levels of overall preparation. In terms of the selected sets of higher skills, we are less competitive on an occupational exchange basis in the higher critical basic skills and in the high-level technical skills. The state's net negative exchange in the higher level problem solving occupations was not as severe as the other two.

Table 8

Iowa Occupational Migration Flows, 2011 - 2015 ACS Public Use Microdata Sample

	Inflow	Outflow	Inflow Minus Outflow	Ratio of Inflow to Outflow
by Age				
All Movers	**53,069**	**51,944**	**1,125**	**1.02**
16 to 44 Years	43,595	40,214	3,381	1.08
45 Years and Over	9,474	11,730	(2,256)	0.81
by Educational Attainment				
High School Only	29,107	22,062	7,045	1.32
Under 44, High School Only	24,192	16,545	7,647	1.46
45 and Over, High School Only	4,915	5,517	(602)	0.89
Post High School to Associate Degree	4,220	4,055	165	1.04
Under 44, Post High School to Assoc. Degree	3,281	2,890	391	1.14
45 and Over, Post High School to Assoc. Degree	939	1,165	(226)	0.81
4 Year College or More	15,869	22,223	(6,354)	0.71
Under 44, 4 Year College or More	12,836	17,996	(5,160)	0.71
45 and Over, 4 Year College or More	3,033	4,227	(1,194)	0.72
by Job Zones				
Job Preparation Zones 2 and 3	34,110	29,934	4,176	1.14
Under 44, Job Preparation Zones 2 and 3	28,428	23,037	5,391	1.23
45 and Over, Job Preparation Zones 2 and 3	5,682	6,897	(1,215)	0.82
Job Preparation Zones 4 and 5	15,504	18,279	(2,775)	0.85
Under 44, Job Preparation Zones 4 and 5	12,095	14,048	(1,953)	0.86
45 and Over, Job Preparation Zones 4 and 5	3,409	4,231	(822)	0.81
by Higher Skill Classifications				
Critical Basic	13,412	15,747	(2,335)	0.85
Under 44, Critical Basic	10,757	12,364	(1,607)	0.87
45 and Over, Critical Basic	2,655	3,383	(728)	0.78
Problem Solving	15,786	17,446	(1,660)	0.90
Under 44, Problem Solving	12,613	13,269	(656)	0.95
45 and Over, Problem Solving	3,173	4,177	(1,004)	0.76
High-Level Technical	4,570	5,923	(1,353)	0.77
Under 44, High-Level Technical	3,779	4,981	(1,202)	0.76
45 and Over, High-Level Technical	791	942	(151)	0.84

Interstate Comparisons

This section summarizes net domestic flows of lower-skilled and higher-skilled workers due to recent interstate migration exchanges. Migration data from the 2011-2015 PUMS data were tabulated for the entire U.S. for this assessment allowing for a comparison of all of the states across multiple worker attributes.

Table 9 shows each state's net gain or loss of workers given seven control variables: net overall worker exchange, workers ages 16 to 44, workers ages 45 and older, educational attainment through high school or junior college, workers with a bachelor's degree or higher educational attainment, and workers in the critical basic, problem solving, and high-level technical occupation subsets. Green shaded areas represent net gains from migration exchanges.

While 31 states posted overall net migration gains in that flows in were greater than flows out, just 19 had net inflows of 4-year college graduates, and 40 had net inflows of movers with a high school diploma or some college experience or 2-year degree. Seven states (Alaska, Connecticut, Illinois, Michigan, New Jersey, New Mexico, and New York) posted net outmigration across the whole array of variables. Eleven states (Arizona, Colorado, Florida, Louisiana, Maine, Nevada, North Carolina, Oregon, Tennessee, Texas, and Washington) realized net in-migration across all of the variables. The remaining states had mixed results where the left-side of the table was positive and the right side of the table had more variable results. The only exception to this pattern was California. It had negatives on the left side, but all positives on the right side, the high skill variables of the table. California, however, is one the more rapidly expanding economies in the U.S. – in this instance, it is notably better at both retaining and attracting workers in the higher skill and education occupations.

As has already been established, Iowa had positive values for all workers, young workers, and workers with a high school diploma or some post-secondary education below the bachelor's degree level. Iowa posted net declines across the higher education and the higher skill groupings.

Table 10 stratifies net migration by O*NET occupational preparation zones. Five states (Alaska, Connecticut, Massachusetts, Michigan, and New York) posted net declines in all five zones. In contrast, there were ten states that posted occupational migration gains in all zones. Only 16 states, however, posted net gains in both Zones 4 and 5, the occupations requiring higher levels of overall preparation, skill, and knowledge.

Iowa posted positive exchanges only in Zones 2 and 3 on this comparison.

Table 9

Worker Migration Net Exchanges Using the 2011 - 2015 PUMS Data of Movers

	All Workers	Age 44 or Younger	Age 45 or Older	High School or 2-Year Degree	Bachelor's Degree or Higher	Critical Basic	Problem Solving	High Level Technical
Alabama	+	+	+	+	-	-	-	-
Alaska	-	-	-	-	-	-	-	-
Arizona	+	+	+	+	+	+	+	+
Arkansas	+	+	+	+	-	+	+	+
California	-	-	-	-	+	+	+	+
Colorado	+	+	+	+	+	+	+	+
Connecticut	-	-	-	-	-	-	-	-
Delaware	+	+	+	+	-	-	+	+
District of Columbia	-	+	-	+	-	+	-	+
Florida	+	+	+	+	+	+	+	+
Georgia	-	-	+	+	-	-	-	+
Hawaii	-	+	-	+	+	+	+	-
Idaho	+	+	+	+	-	+	+	+
Illinois	-	-	-	-	-	-	-	-
Indiana	-	-	-	+	-	-	-	-
Iowa	+	+	-	+	-	-	-	-
Kansas	-	+	-	+	-	+	-	-
Kentucky	+	+	+	+	-	-	-	-
Louisiana	+	+	+	+	+	+	+	+
Maine	+	+	+	+	+	+	+	+
Maryland	-	-	-	-	+	+	+	-
Massachusetts	-	-	-	-	-	-	-	+
Michigan	-	-	-	-	-	-	-	-
Minnesota	-	-	-	-	+	+	-	+
Mississippi	-	-	+	+	-	-	-	-
Missouri	+	+	+	+	-	-	+	+
Montana	+	+	+	+	+	-	-	-
Nebraska	-	-	-	+	-	-	-	-
Nevada	+	+	+	+	+	+	+	+
New Hampshire	+	+	+	+	+	-	+	-
New Jersey	-	-	-	-	-	-	-	-
New Mexico	-	-	-	-	-	-	-	-
New York	-	-	-	-	-	-	-	-
North Carolina	+	+	+	+	+	+	+	+
North Dakota	+	+	+	+	-	+	+	-
Ohio	-	-	-	+	-	-	-	-
Oklahoma	+	+	+	+	-	-	-	-
Oregon	+	+	+	+	+	+	+	+
Pennsylvania	-	-	-	+	-	-	-	-
Rhode Island	-	-	-	+	-	-	-	-
South Carolina	+	+	+	+	-	+	+	+
South Dakota	+	+	-	+	-	-	-	-
Tennessee	+	+	+	+	+	+	+	+
Texas	+	+	+	+	+	+	+	+
Utah	+	+	+	+	-	-	-	-
Vermont	+	+	-	+	-	-	-	-
Virginia	+	+	-	+	+	+	+	-
Washington	+	+	+	+	+	+	+	+
West Virginia	+	+	-	+	-	-	-	-
Wisconsin	-	-	-	+	-	-	-	-
Wyoming	+	+	+	+	+	+	-	+

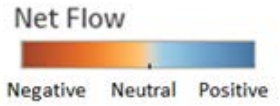
Table 10

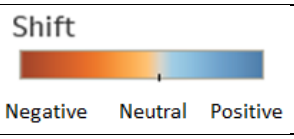
Worker Migration Net Exchanges Using the 2011 - 2015 PUMS Data of Movers by O*Net Zones

	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Alabama	+	+	+	-	+
Alaska	-	-	-	-	-
Arizona	+	+	+	+	+
Arkansas	-	-	+	+	+
California	-	-	-	+	+
Colorado	+	+	+	+	+
Connecticut	-	-	-	-	-
Delaware	+	+	+	-	+
District of Columbia	+	-	+	+	-
Florida	-	+	+	+	+
Georgia	+	-	+	-	-
Hawaii	+	-	+	+	-
Idaho	+	+	+	+	+
Illinois	-	-	-	-	-
Indiana	+	+	-	-	-
Iowa	-	+	+	-	-
Kansas	-	+	+	-	+
Kentucky	+	+	+	+	-
Louisiana	+	+	+	+	+
Maine	+	+	-	+	+
Maryland	-	-	-	-	+
Massachusetts	-	-	-	-	-
Michigan	-	-	-	-	-
Minnesota	-	-	-	+	+
Mississippi	+	-	-	-	-
Missouri	+	+	+	-	-
Montana	+	+	+	-	+
Nebraska	+	-	+	-	+
Nevada	+	+	+	+	+
New Hampshire	-	+	+	-	-
New Jersey	-	-	-	-	-
New Mexico	-	+	-	-	+
New York	-	-	-	-	-
North Carolina	+	+	+	+	+
North Dakota	+	+	+	+	-
Ohio	+	+	-	-	-
Oklahoma	+	+	+	-	-
Oregon	+	+	+	+	+
Pennsylvania	+	+	-	-	-
Rhode Island	+	-	+	-	-
South Carolina	+	+	+	-	+
South Dakota	-	+	+	-	-
Tennessee	+	+	+	+	+
Texas	+	+	+	+	+
Utah	+	+	+	+	-
Vermont	+	+	-	-	+
Virginia	-	+	+	+	+
Washington	+	+	+	+	+
West Virginia	+	+	-	+	-
Wisconsin	-	+	-	-	-
Wyoming	-	+	+	-	+

The Geography of Higher-Skilled Worker Flows

This section maps the magnitude of net migration change to allow for the visual determination of strong or weak higher-skilled worker movement across states. A series of maps illustrate net migration flows using either of two basic measures:

$$\textbf{Net inflow} = \frac{skill\ group\ inflow}{(skill\ group\ inflow + skill\ group\ outflow)}$$	
Central (or neutral) value:	0.50
Simplified map legend:	

$$\textbf{Net shift} = \frac{skill\ group\ inflow}{(skill\ group\ inflow + skill\ group\ outflow)} - \frac{state\ total\ inflow}{(state\ total\ inflow + state\ total\ outflow)}$$	
Central (or neutral) value:	0.00
Simplified map legend:	

The net inflow measure helps us understand the fraction of gain or loss given all migrating workers accessed in the PUMS sample. The shift calculation lets us understand relative competitiveness of the higher skill sectors given all in and out movement of workers in each state. A positive shift could either mean a state is gaining skilled workers more rapidly than it is gaining workers overall. It might also mean a state is suffering a net loss in total occupational exchanges, yet is losing skilled workers at a lower rate. Conversely, a shift would be in negative territory if a net flow of skilled workers was positive but nonetheless slower than the rate of gain for all workers in that state. Net shifts are displayed only for the younger age cohort of movers under age 45, as gains or losses among that cohort factor more strongly in state's economic growth prospects.

The following maps demonstrate the relative flow of workers considering high-level skills categories, preparation, or education. Concluding observations follow this section.

Figure 2 shows both the net flow in and out of all occupations in the PUMS 2011-2015 sample irrespective of the contrived higher-skill categories or preparation zones. As would be expected, the highest rate of positive net exchange is North Dakota, owing primarily to the shale oil boom in that state. Several other states with high positive net exchanges typically were high amenity states (Oregon, Montana, Utah, and Colorado) and a few states experiencing overall strong recoveries (Delaware and South Carolina, for example). New York, Connecticut, New Jersey, Illinois, and California had the higher rates of occupational net outmigration.

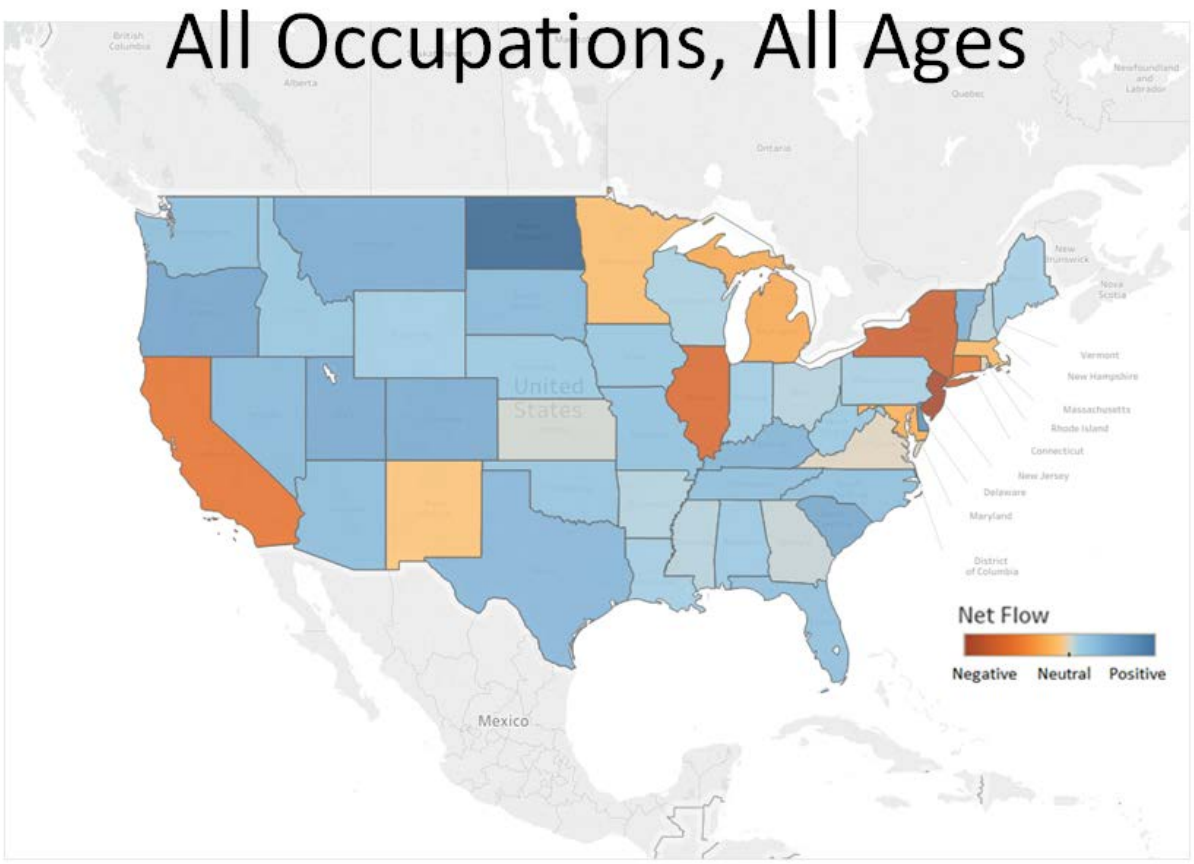


Figure 2

The pattern of occupational migration is decidedly different when controlling for higher skilled workers. Figure 3 shows the net flow of workers for the critical basic occupation group. This group included occupations with high ratings for critical thinking, math, science, and writing skills. Now, many of the states that posted positive net exchanges of all occupations instead post negative exchanges. Comparatively stronger positive results are evident for Maine, Florida, Texas, Colorado, Nevada, Oregon, and Washington. Stronger negative exchange states include New York, New Jersey, Rhode Island, Illinois, and South Dakota. Twelve states posting positive overall worker flows in Figure 2 had net negative high skill flows in this measure.

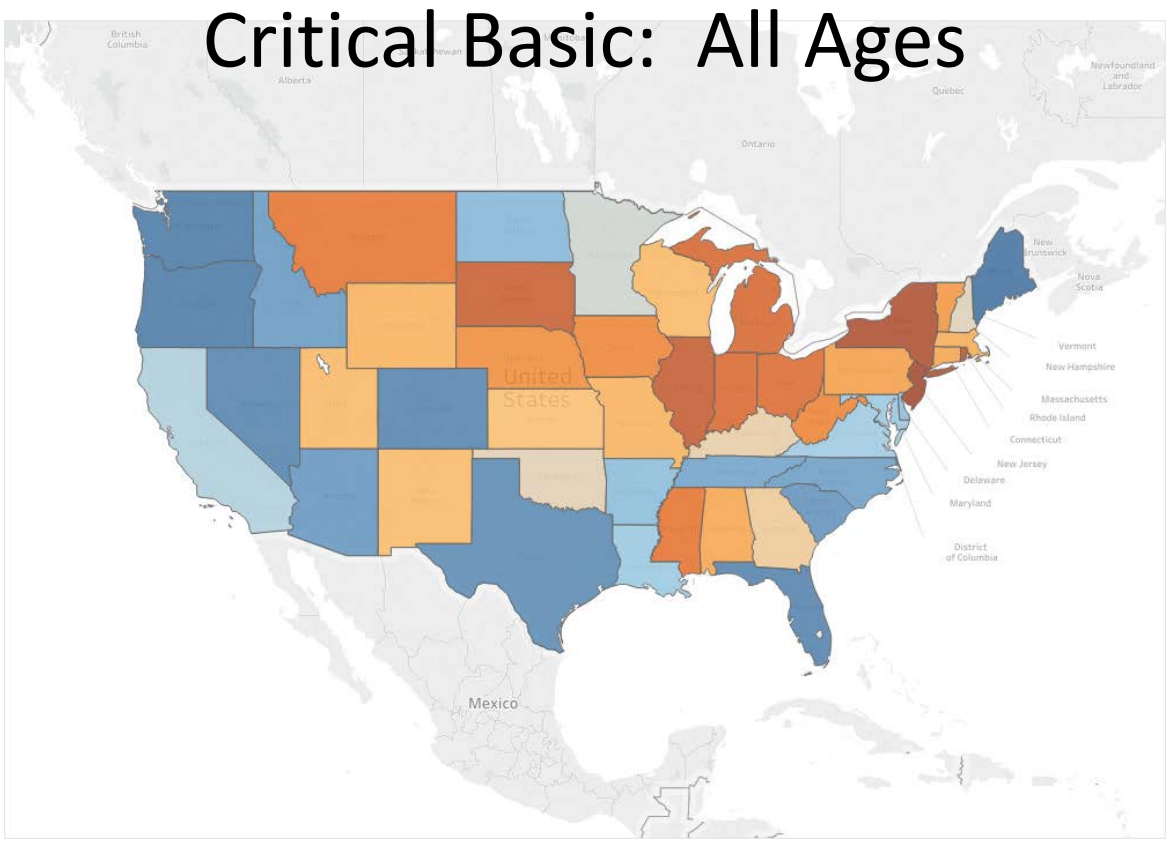


Figure 3

The age of the critical basic group migrant is measured next where the “young” migrants are those below 45 years. Those results are in Figure 4. Though there are minor changes in the magnitudes of shading, the only state that flipped was Delaware, which went from positive high skill occupational inflow to negative when measuring just the younger workers.

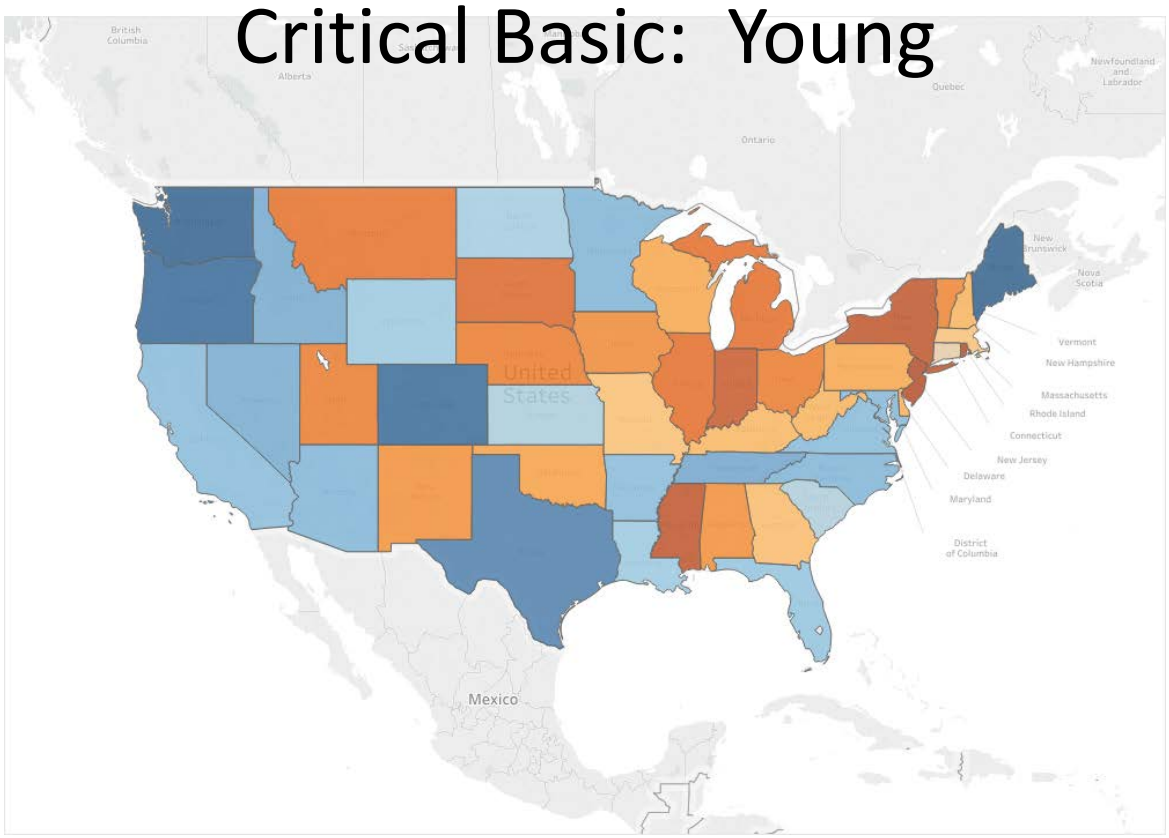


Figure 4

Figure 5 portrays the migration of young workers in the critical basic group on a net shifting basis. We focus here only on the young skilled worker shifts as this is a category of occupational demand that is acute, or perceived to be acute, for many states. The shifts measure the relative change in this occupational group as compared to overall occupational change in each state. While there are differences in relative magnitude compared with the previous graph, there are also several flips from positive to negative or vice versa. South Carolina, Louisiana, Florida, Nevada, Arizona, and North Dakota attracted these workers more slowly than their overall occupational growth would have suggested, while New York, Massachusetts, Connecticut, New Jersey, Illinois, and Kansas attracted or retained a greater than expected number of younger, higher skilled workers.

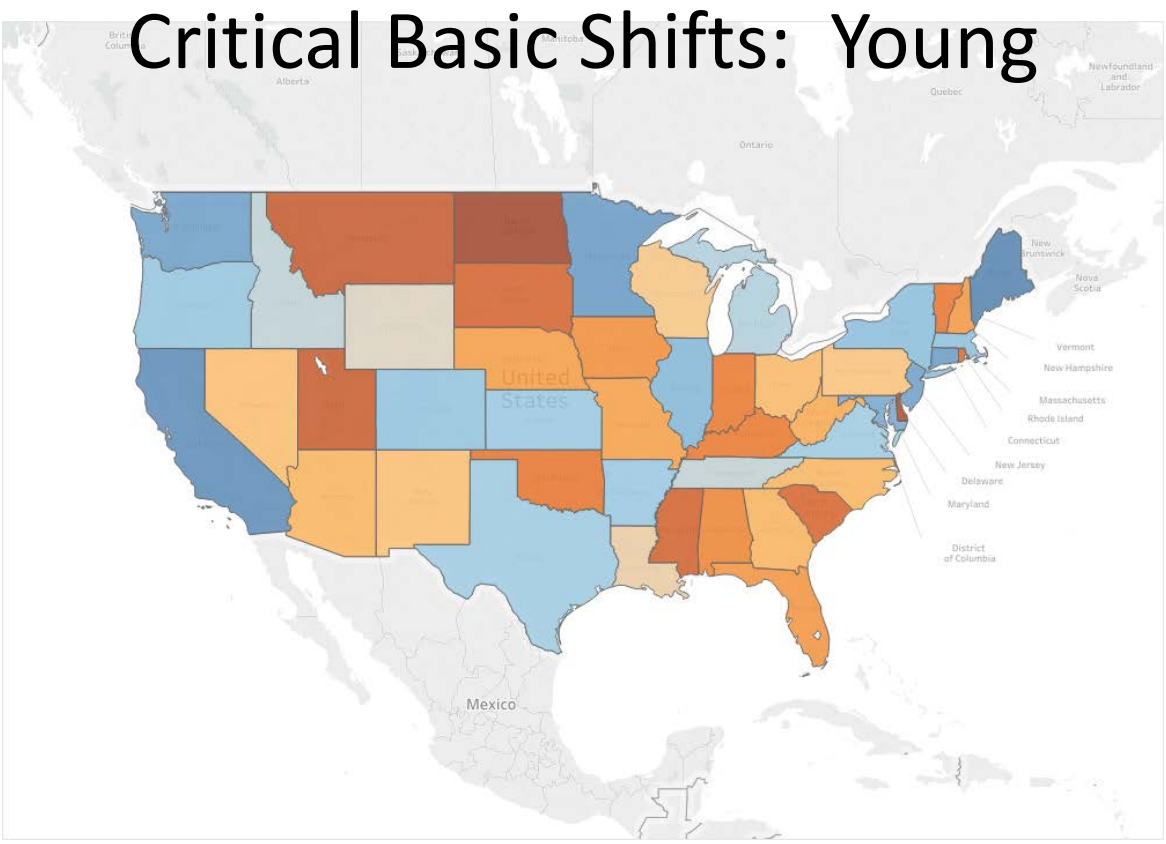


Figure 5

The problem solving skill group included complex problem solving, judgement and decision making, systems analysis, and systems evaluation. Figure 6 displays the net migration pattern for workers in the problem solving occupation group. Overall, the net flows aligned with the all ages graph for critical basic skills. Only New Hampshire flipped to positive, and only Minnesota moved to net negative on this measure.

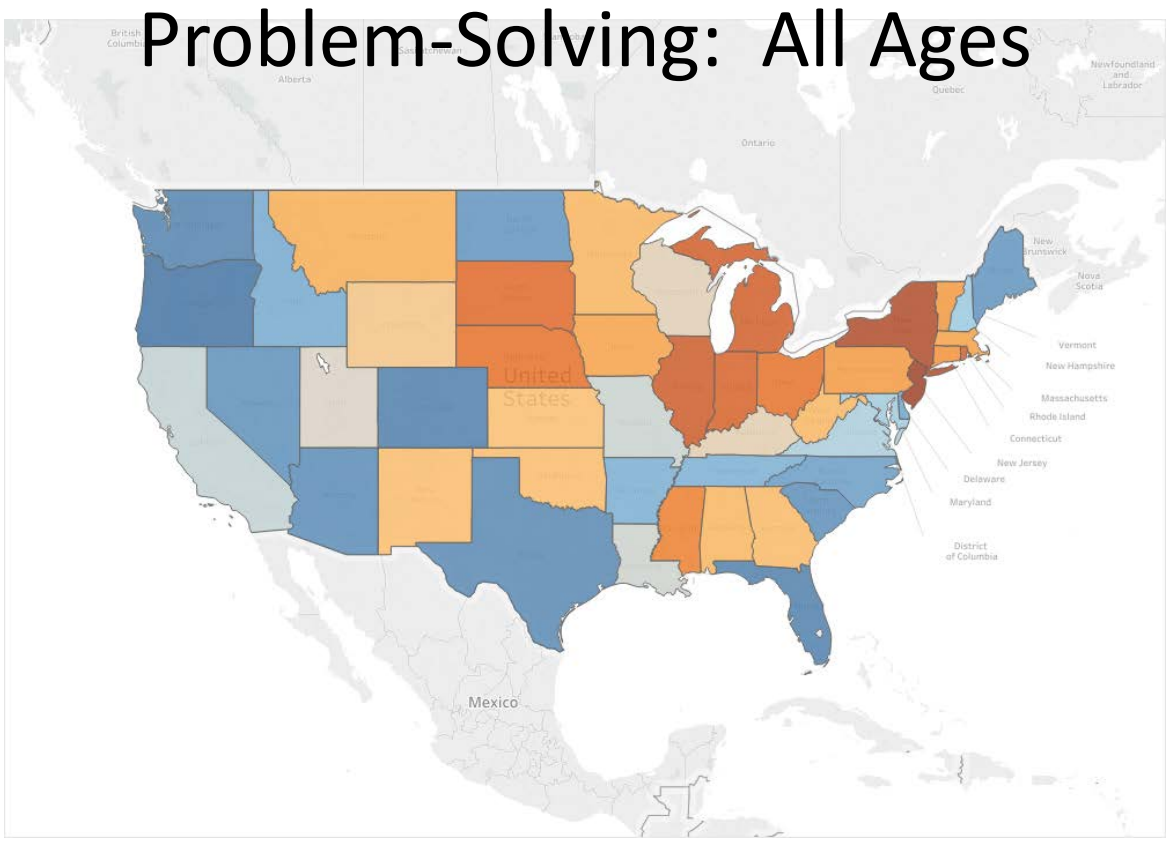


Figure 6

The younger migrant subset of the problem solving skill group yielded a slightly different pattern than for the overall group. Vermont and West Virginia turned net positive and Minnesota, Kansas, and Wyoming turned net negative. The number of states with relatively high positive flows decreased, but the number of states with relatively high negative flows stayed about the same.

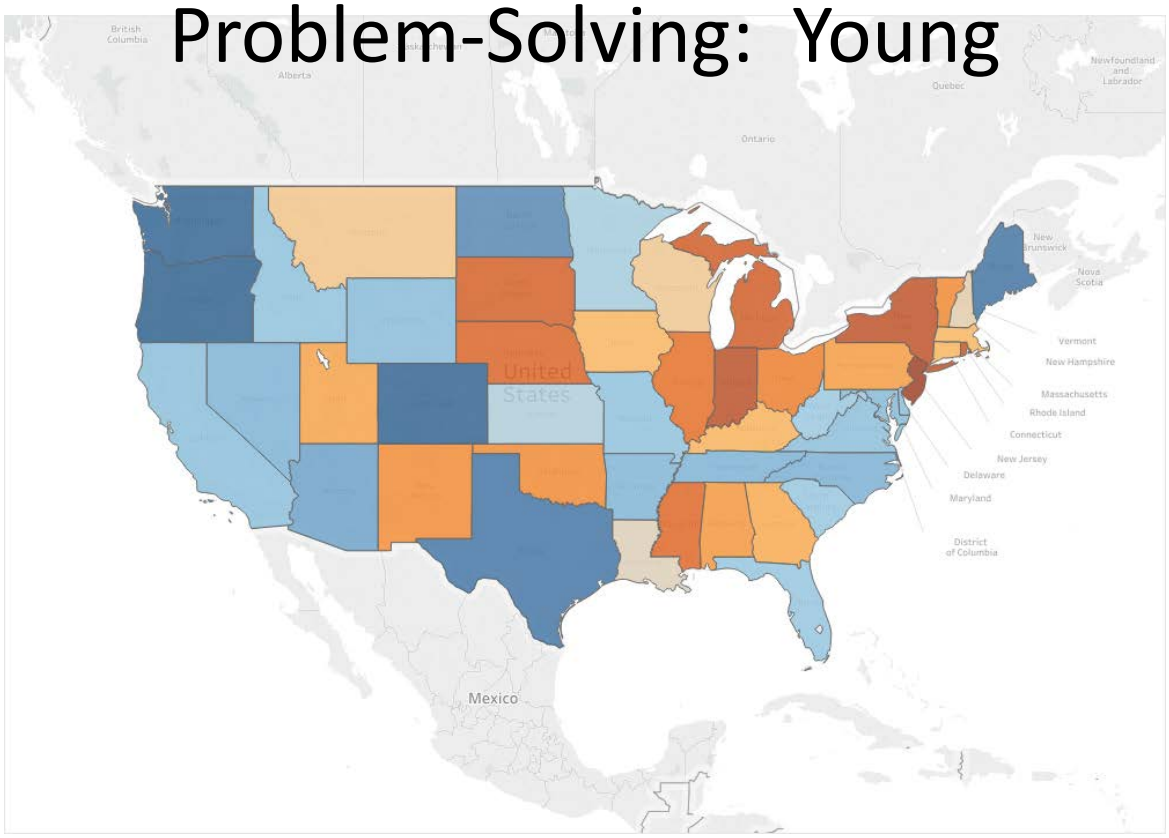


Figure 7

Figure 8 shows the migration of young workers in problem solving occupations on a net shift basis. As was the case in the critical basic skill group, there are substantial differences in states posting net *inflows* versus those with net positive or negative *shifts*. Positive shifts are seen for New York, Massachusetts, Connecticut, New Jersey, Illinois, and Wisconsin. Negative shifts, in comparison occurred in North Dakota, Idaho, Delaware, Tennessee, North Carolina, South Carolina, Florida, Missouri, Arizona, and Nevada. Again, the shifting measure shows where, considering all occupational flows, this skilled category did comparatively worse or better. And in this category, the highest intensity of positive shifting is California.

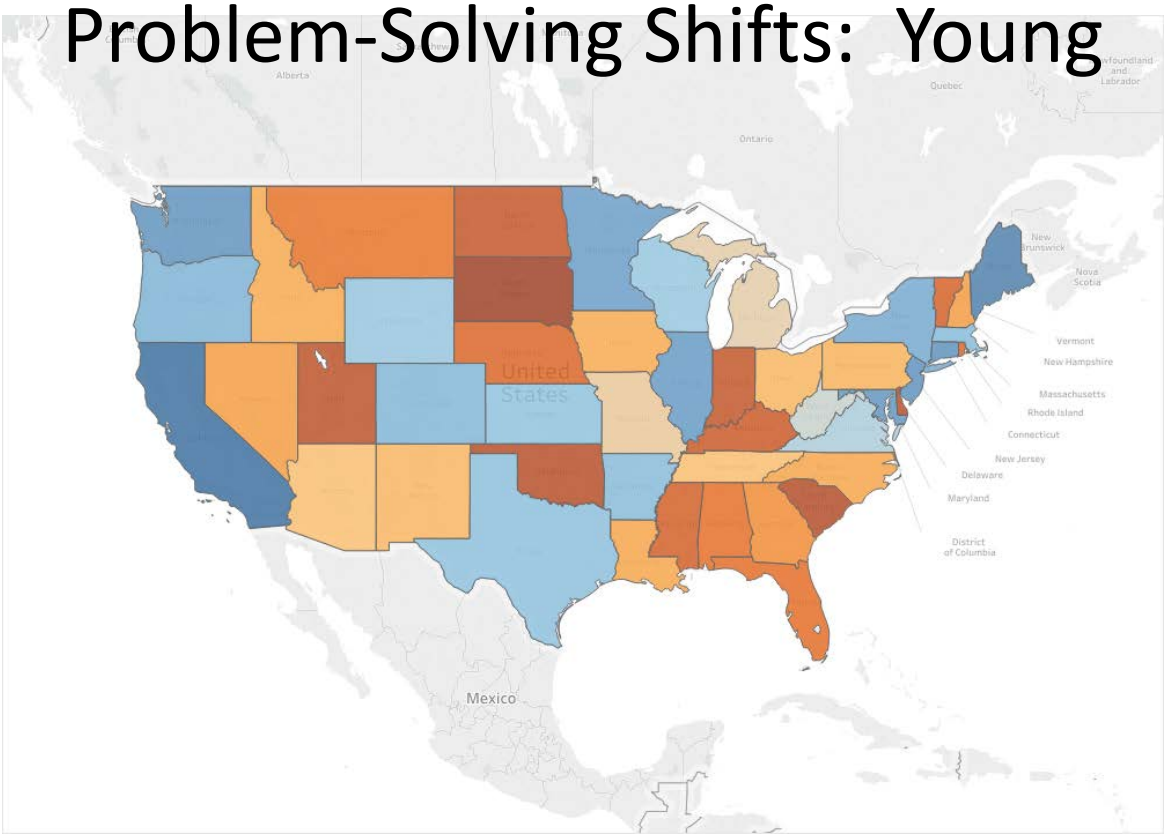


Figure 8

The high-level technical skills group involved the specific skills of operations analysis, programming, and quality control analysis. As the scoring for this targeted skill set was skewed sharply towards the lower end of the distribution by occupation, a smaller subset of occupations were chosen to represent this higher-skilled worker group as compared to the critical basic and problem solving groups.

Net inflows of the workers with the highest scoring occupations were not evident among nearly all of the Plains states and the Great Lakes region of the Midwest. Relative greater gain intensities were evident in Colorado, Nevada, and Oregon. Strong relative outflows were evident in North Dakota and South Dakota, Indiana, New York, New Jersey, West Virginia, and Rhode Island.

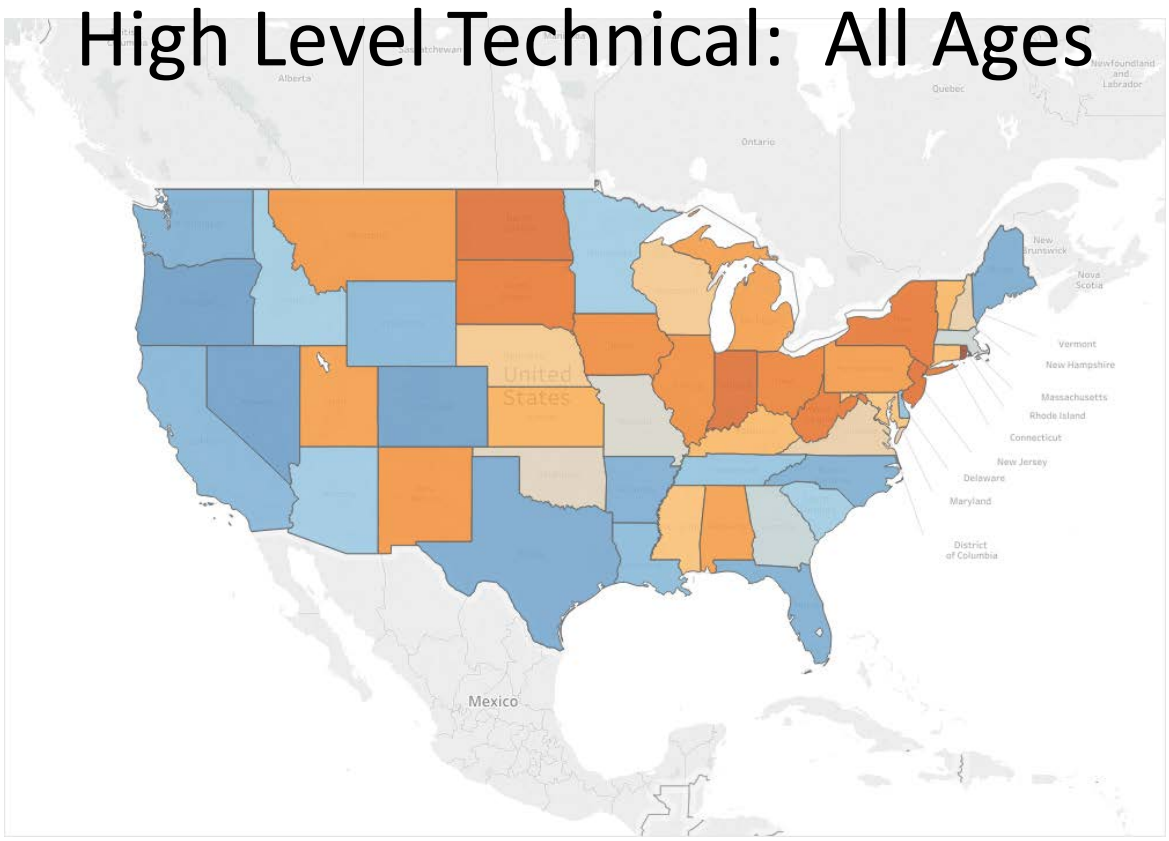


Figure 9

Controlling for the younger migrants (Figure 10) in the high level technical group, only minor differences in inflows and outflows are evident. Delaware, South Carolina, and Arizona move into the net outflow category.

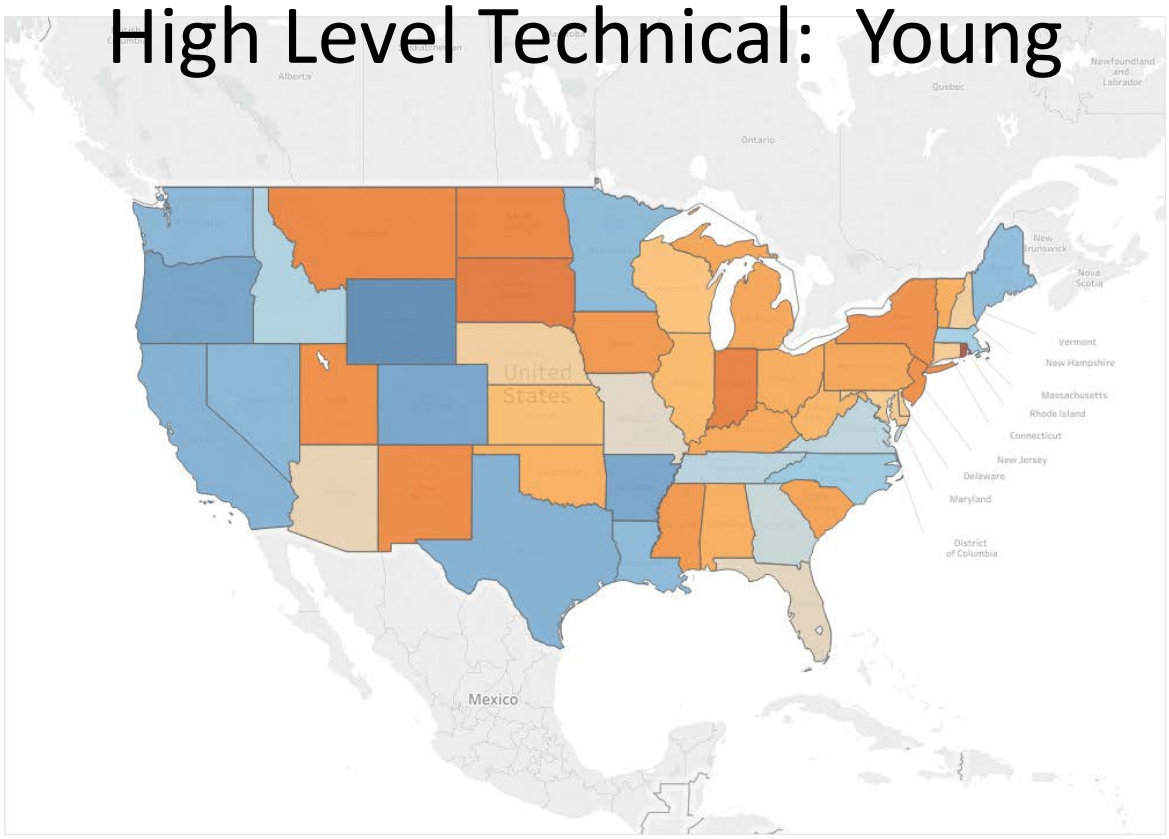


Figure 10

Net shifting of young workers across the high level technical skill group yielded some differences from just the net overall flow of young workers above. New York, Connecticut, New Jersey, North and South Carolina, and Illinois showed positive competitive shifts compared to overall change in their occupational migration flows. Florida moved from close to neutral to negative

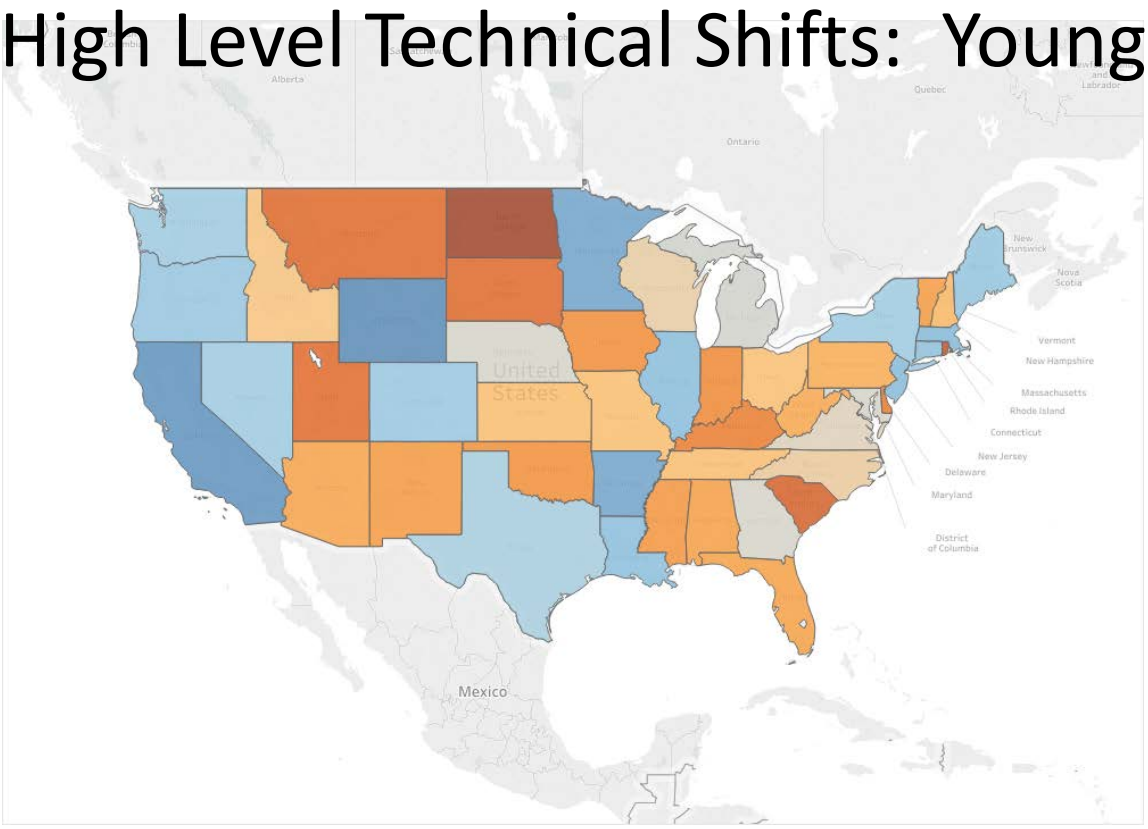


Figure 11

The remaining measures will display the net migration flows of higher and lower skilled occupations as measured by preparation zone and next by the highest level of education attained by the sampled person.

Figure 12 shows the flow of workers by Zones 4 and 5, those that required considerable-to-extensive preparation. Like many of the previous graphs, the geographic contrasts are stark. Much of the Great Plains, the Great Lakes, and the Deep South demonstrate net negative flows of workers with these higher scored occupations. The comparatively strongest outflow rates are in South Dakota, Illinois, Michigan, Ohio, New York, and New Jersey. Stronger inflow rates are in Maine, North and South Carolina, Florida, Texas, Colorado, Oregon, and Washington.

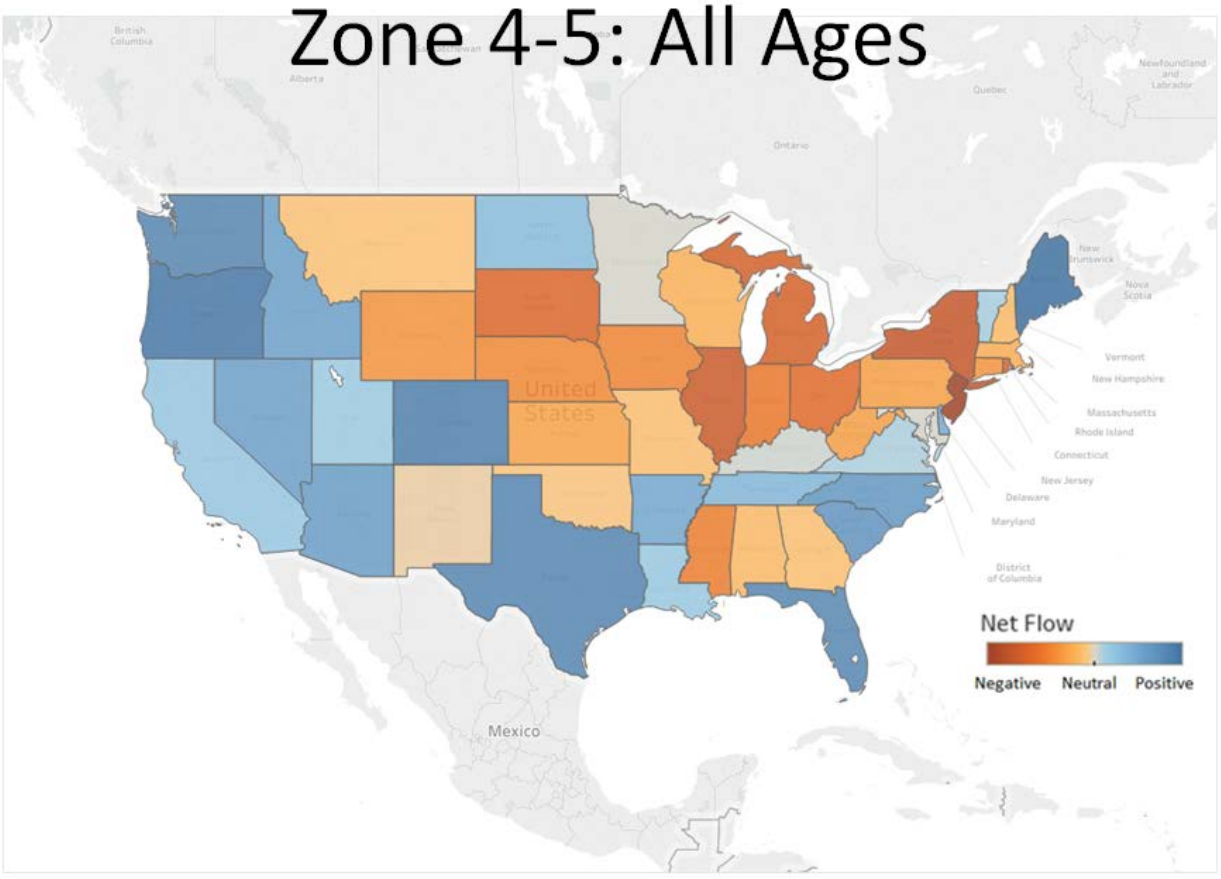


Figure 12

Figure 13 displays the relative flows of workers with low to middle levels of skill and knowledge preparation, according to the O*NET ordinal scale. Overall just 10 of the states realized net losses in this category, with New York, New Jersey, and Illinois showing the highest outflow rates. North Dakota had the strongest inflow rate, again, owing primarily to the shale oil boom.

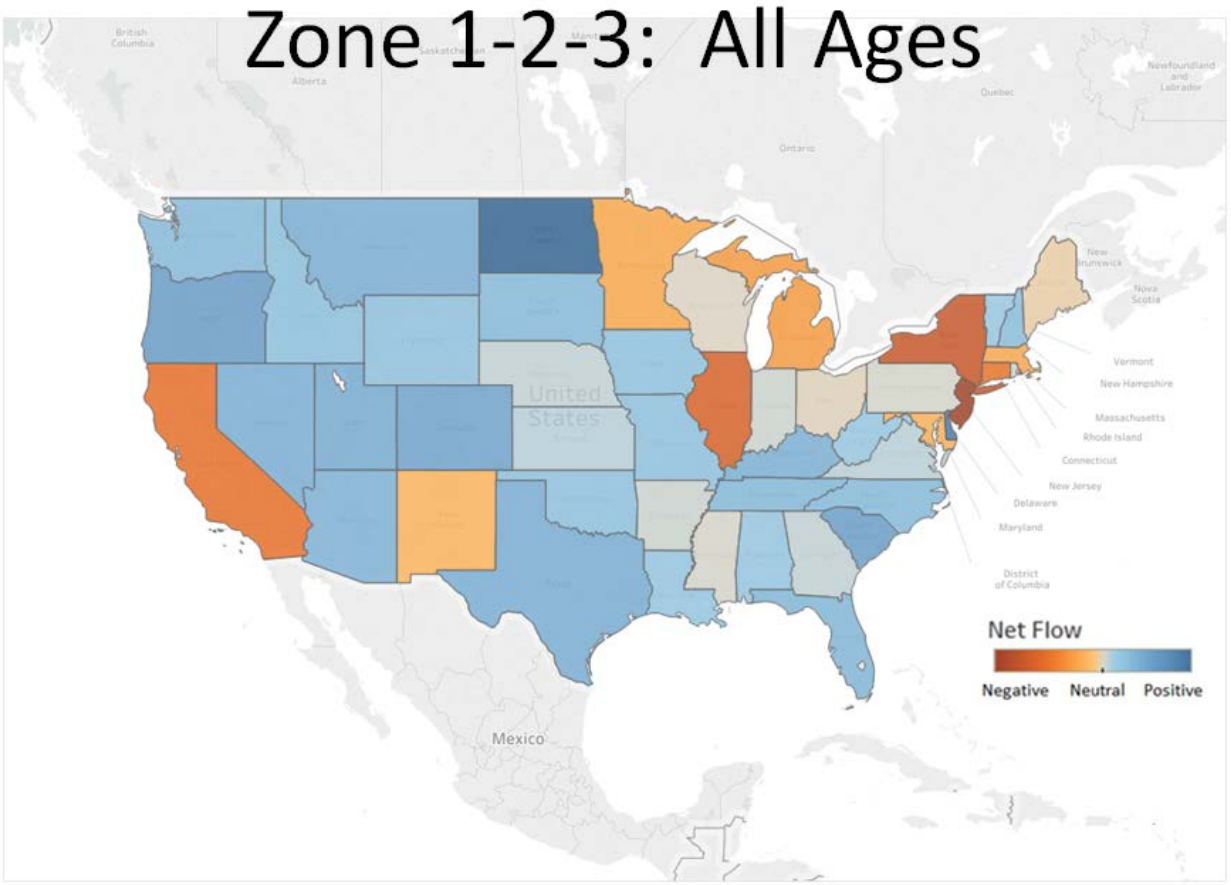


Figure 13

Net flows of persons with bachelor's degrees or higher are displayed in Figure 14. Using this measure, the higher rate of outflow states include South Dakota, Iowa, Illinois, Ohio, Michigan, West Virginia, New Jersey, Rhode Island, and Mississippi. Comparatively stronger inflow rates are evident in Texas, Colorado, Nevada, Oregon, and Washington.

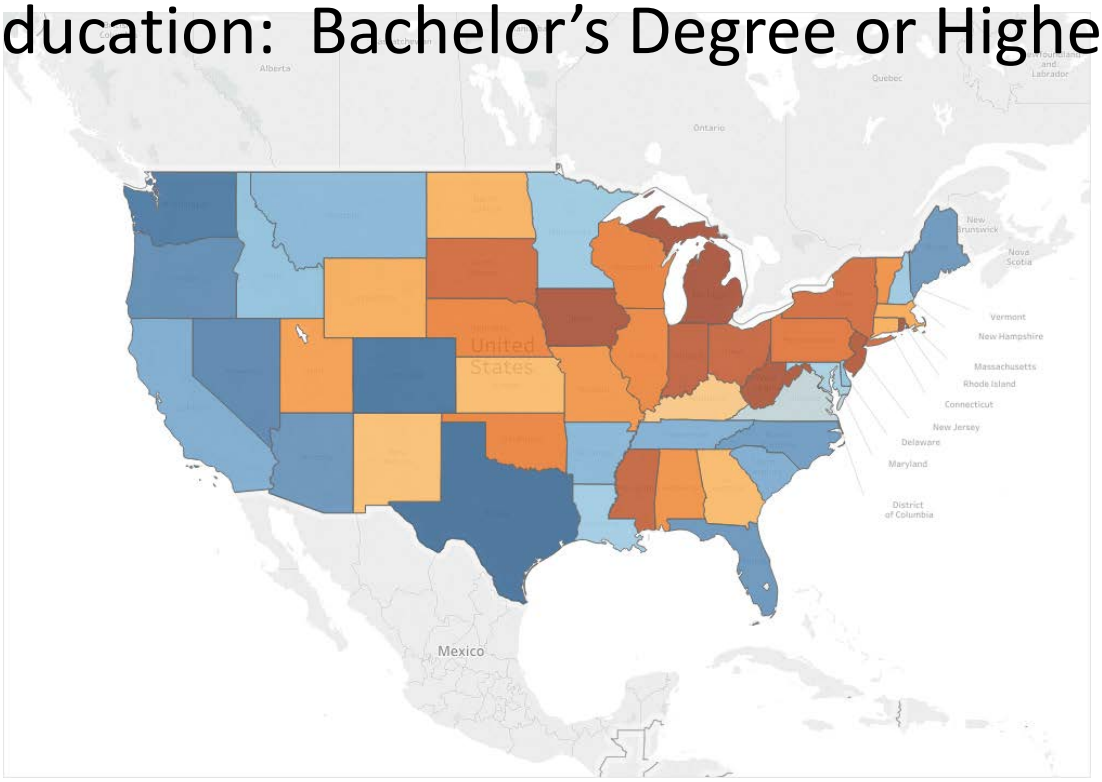


Figure 14

Last, Figure 15 shows the net positive and negative migration flows of persons with at least a high school diploma, but without a bachelor's degree or higher. Though it differs in intensity, the pattern matches the results for Figure 13 where Zones 1-3 were measured. Of the lower 48 states, ten posted outflows of what would generally be classified as persons who would be likely to work in middle skill positions.

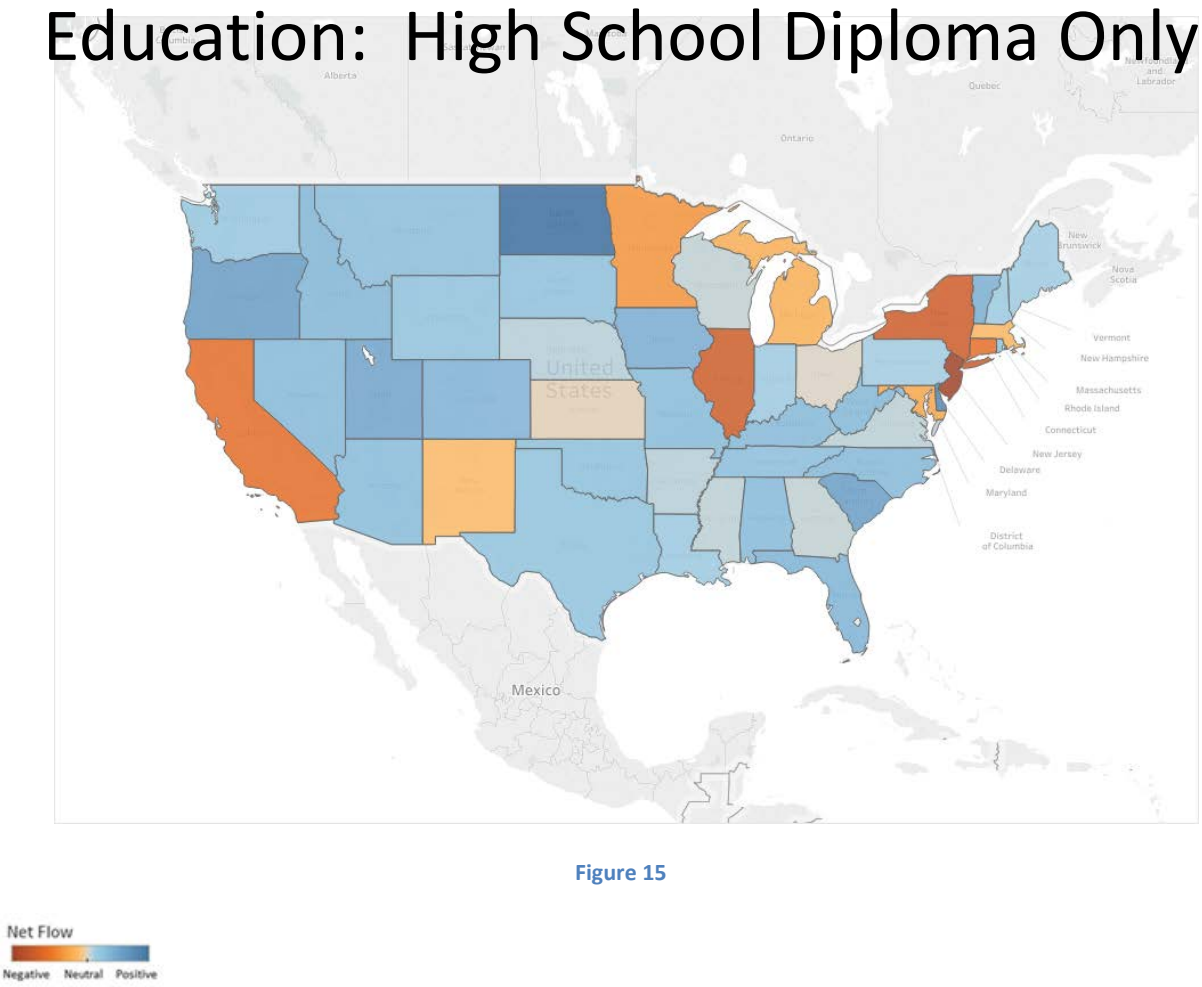


Figure 15

Conclusions

This study looked at several education, preparation, and skill-based characteristics of Iowa's and the nation's occupational structure. The assessment sheds light on the skill and preparation levels demanded by Iowa's industries, how those levels differ from the nation, and projections of future needs.

Further, this evaluation considered three specific skill dimensions of U.S. occupations: critical basic skills, problem solving skills, and high-level technical skills. Skills ratings from the O*NET database were utilized to identify groups of high-scoring occupations in the targeted skill sets. The selected occupations were matched with the Standard Occupational Codes attached to respondents in the U.S. PUMS, 2011 – 2015 rolling sample of workers who indicated that they had moved from one state to another over that time period. This allowed for a calculation of the gross inflows and outflows of specific occupations among the states and the District of Columbia with an eye towards isolating the set of higher skill occupational flows.

The purpose of that analysis was to initially test the utility of the O*NET skills measures in order to detect variation across the states. The investigation found that there were generally high correlations in state performance along the three targeted skill dimensions, but that there were unique variations as well across the range of skill, preparation, education, and age variables assessed. While most of the absolute state level variations were displayed in Table 9 and Table 10, magnitudes of change were also calculated and mapped to demonstrate the relative intensity of change by the skill categories, as well as the preparation zone values and the overall education level of the migrating sample.

There has been widespread discussion of middle skills gaps or shortages as well as expressed concerns that some areas of the U.S., especially in much of the Midwest, are realizing noticeable skill or workforce capacity losses, or more accurately, negative exchanges when looking at the kinds of workers who flow into these areas as measured by their occupational characteristics versus the kinds that flow out. This analysis allowed us to generalize the characteristics of migrants across multiple dimensions and to describe migration flows in absolute terms and in relative terms. Though these are simple measures, they do allow us to quantify the states' abilities to attract workers considering different skill types, preparation zones, or education levels. The analysis also controlled for younger versus older migrants to further assist in compiling the states' competitive advantages in that desirable younger demographic subgroup.

This analysis is exploratory and preliminary. Because the data are sample based, there are measurement parameters to the results that allow us to state with more or less confidence whether differences between in-migrants versus out-migrants among the states are statistically significant. We have not done those calculations. That means that differences declared in this analysis may not in fact be the case in some instances, especially where the differences by the variables measured are relatively small or the number of migrants in the sample categories themselves are relatively small.

Appendix: Data Sources, Transformations, and Methods

The initial step for scoring Iowa's workforce involved tapping into the Occupational Information Network (O*NET) system of the Education and Training Administration (ETA) of the BLS to establish sets of higher-skill metrics to use to score the occupations of the migrants in our study. The O*NET system has scores assigned to a wide array of occupational attributes to include abilities, interests, knowledge, skills, work activities, work levels, and work values. Those attributes are scored separately in terms of their importance in the occupation and level of development one typically needs to do the job. Example scores are displayed in Table A1.

Table A1 Example of O*NET Skill Scores

Skills — Critical Thinking Save Table (XLS/CSV)

Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems.

Sort by:

Importance ▲	Level	Code	Occupation
94	80	23-1023.00	Judges, Magistrate Judges, and Magistrates
88	71	15-2091.00	Mathematical Technicians

For the purposes of this study, sets of skills were chosen that were indicative of higher levels of occupational preparation and performance. The chosen higher skill categories and their constituent skills are contained in Table A2. For each occupation and for each skill grouping, individual "Importance" scores were obtained from O*NET resources and then summed to get composite values for the three high skill categories. The O*NET data set had 974 occupations. Every occupation received an overall critical basic skills score, a problem solving skills score, and a high-level technical skills score.

Table A2 Targeted Higher Skill Category Groupings

Critical Basic
Critical Thinking
Mathematics
Science
Writing

Problem Solving
Complex Problem Solving
Judgement and Decision Making
Systems Analysis
Systems Evaluation

High Level Technical
Operations Analysis
Programming
Quality Control Analysis

The skill categories and their constituent components were designated such because

- critical basic skills represented core higher-level skills that one would expect in the management, supervisory, and technical occupations of industries,
- problem solving skills represented skills required to evaluate and solve problems as well as adapt to a changing economic environment, and
- high-level technical skills were considered those most able to maintain technological competitiveness across a wide range of industries.

O*NET also scores all occupations according to job zones, which are composite indicators ranging from one to five that are based on levels of education, experience, and training needed to perform a particular occupation. Those job zones are

1. Little or no preparation required
2. Some preparation needed
3. Medium preparation needed
4. Considerable preparation needed
5. Extensive preparation required

Job zone scores were assigned to every occupation in the data set as a complement to our three higher skills categories, and these scores were then matched up with U.S. and Iowa OES data for 2016. These two sets of workforce skill and preparation data can be used to compare Iowa to the U.S.

For analysis of the net flow of occupations among the states, the O*NET data set was also matched up with the Standard Occupation Codes (SOC) used in the PUMS data base. That very large data base contained summaries of all net inflows and outflows of workers in the 2011 through 2015 American Community Survey (ACS) period. That data set had 474 occupational categories, which required averaging many of the more highly detailed O*NET scores into the SOC aggregations used for the PUMS sample. This procedure allowed for an analysis of the state's comparative exchange of skilled workers, or more accurately, our competitiveness with regard to sets of higher skilled occupations.

Analysis of the original O*NET scores across the occupations indicated that there was a normal distribution for the critical basic and the problem solving subgroup of skills. The high-level technical group, however, was skewed: a large fraction of occupations had low scores, or zeros, while a much more discrete set of occupations had moderate to very high scores. These same distribution patterns were evident after reducing the original scores to align with the PUMS occupational codes.

Given that there were normal distributions for the first two skills groups and there was a pronounced skew to the left of the higher level technical skills group, it was decided that an occupation had a "high" score in a category if the z-score for that occupation was greater than 0.5. A z-score of 0.5 means that score is in the upper 30 percent of values, which was the case with the first two skill categories. Because of the skewing, the cut-off for the high-level technical skills was a z-score of 1.0, which accounted for about 12 percent of all occupations. These cutoffs are certainly arbitrary, but felt to be reasonable given the higher-skill dimensions evaluated here.

In addition, in the instances where collapsing occupational classifications to align with the SOC data set produced job preparation zone values that were not whole numbers, results were rounded to the nearest integer.

The results of the higher skill groupings chosen for analysis were plotted against the job zone data to see how well the scores clustered along the levels of preparation. A comparison with the critical basic skills category is displayed in Figure A1. In the highest job zone (5), occupational scores ranged from 231 to 407, in the middle zone (3), the scores ranged from 151 to 319, and in the bottom zone, the range was 88 to 198. Though there is a definite linear pattern in that higher preparation yields, on average, higher critical basic scores, there is also substantial dispersion of the critical basic scores that overlaps succeeding job zones. This same type of pattern was evident for the problem solving category and for the high-level skills classification.

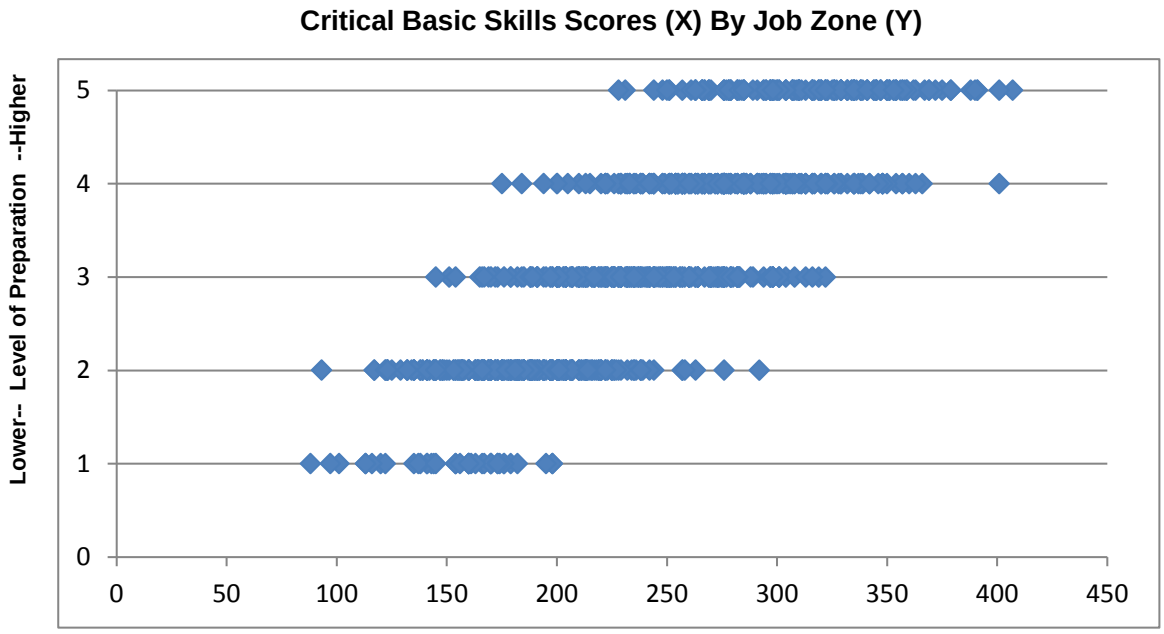


Figure A1