Regional Economies in Transition:
Methodology

This document provides more detail on the data and methodology used for the analyses presented in *Regional Economies in Transition: Analyzing Trends in Advanced Industries, Manufacturing, and the Service Sector to Inform Inclusive Growth Strategies*. The report presents a typology of regions by three key trends: the decline in manufacturing, the rise in advanced industries, and the quality of accessible service-sector jobs. While we include broad information on the sources and methods used in the body of that report, this document provides more information on some of the finer details of the analyses.

Data Sources and Regional Definitions

The primary data source used for the analyses is the "Detailed Estimates of County Employment and Output" data produced by Moody's Analytics. The dataset provided estimates of employment, wage and salary disbursements, and output (gross domestic product, or GDP) for each county in the United States, by industry. Data by industry was reported according to the North American Industrial Classification System (NAICS) at the two-, three-, and four-digit NAICS levels of industry aggregation. Data at the most detailed, four-digit NAICS level was used for the analyses as it provided enough detail to reasonably define advanced industries and accessible service industries (i.e., service industries deemed to be accessible to workers with lower levels of educational attainment). Data for the month of December in the years 2005 and 2015 were used in our analysis. Manufacturing was defined to include all four-digit NAICS codes falling within the two-digit NAICS codes of 31, 32, and 33. More detail on the definitions of advanced industries and accessible service industries is included below. As noted in the main report, for some analyses we show data for both all manufacturing and what we refer to as "traditional manufacturing," which was defined to exclude all advanced industries in the manufacturing sector.

Other datasets used include typical entry-level educational requirement data (by four-digit NAICS code) for May 2016 from the U.S. Bureau of Labor Statistics (BLS)[1] and Regional Price Parity (RPP) index data for 2015 from the U.S. Bureau of Economic Analysis.[2] The entry-level education requirements data by four-digit NAICS code was used to define accessible service industries while the RPP index data was used to adjust average annual wages in those industries for regional differences in the cost of living (see "Defining Accessible Service Industries" and "Constructing an Index of Job Quality for Accessible Service Industries" sections below for details). Finally, we also relied on 2015 American Community Survey (ACS) 5-year microdata from the Integrated Public Use Microdata Series (IPUMS)[3] to examine the educational attainment of workers, and the 2015 ACS 5-year summary file data from the U.S. Census Bureau[4] to calculate measures of residential segregation and diversity by race/ethnicity at the regional level.

We aggregated all data to the regional level prior to analysis for the 150 largest regions in terms of 2010 population counts. Unless otherwise noted, regions were defined as metropolitan statistical areas (MSAs) based on the U.S. Office of Management and Budget's December 2003 definitions. We used the December 2003 MSA definitions to be consistent with data on the National Equity Atlas and the regional database that undergirds it.

Defining Advanced Industries

The definition of advanced industries we employed comes directly from the Brookings Institution's report, *America's Advanced Industries*.[5] The report identified "individual advanced industries" based on two criteria: research and development (R&D) spending and the proportion of science, technology, engineering and math (STEM) and STEM-related occupations in an industry. The report argued that R&D expenditures indicate the "centrality of innovation to an industry" and that R&D is a driver of innovation, economic growth, and spillover benefits. STEM employment indicates both an industry's ability to innovate, and to "realize the full value of innovations." High proportions of STEM employment indicate that a large amount of staff, including technical and even management and service staff, understand the technical aspects of the product and the needs of consumers, suppliers, and the market.

To measure R&D spending, the Brookings report used data from the National Science Foundation's 2009 Business R&D and Innovation Survey.[6] It defined the threshold for advanced industries at $450 in R&D expenditures per worker, or roughly the 80th percentile in terms of R&D spending per worker at the four-digit NAICS industry level. The report argues that expenditures per worker is a better measure than expenditures by revenue, as R&D spending per worker is more highly correlated with average income and patents per worker. The report identifies 50 industries at the four-digit NAICS level as "advanced industries"—35 are manufacturing industries, three are energy industries, and 12 are service industries.

Defining Accessible Service Industries

One unique aspect of our analysis is the attempt to gauge the quality of service jobs that are accessible to the economically insecure population, defined as people with family income below 200 percent of the federal poverty level. To do so, we examined ACS microdata on the educational attainment of the economically insecure population of working age (25–64 years) across the 150 largest regions, as well as BLS data on entry-level education requirements by four-digit NAICS industries for the entire United States. While entry-level education requirements for a broad industry, such as the entire manufacturing sector, were likely to vary from region to region, we expected there to be much less regional variation within the rather detailed four-digit NAICS industries, suggesting that they were reasonably valid for each of the 150 largest metropolitan statistical areas.

We found that the vast majority (86 percent) of working-age economically insecure adults in the 150 largest metro areas had educational attainment less than a BA degree. We also examined how much the share of the population with less than a BA degree varied across regions, and found little variation: in 141 regions, the share was at least 80 percent, while in the remaining nine regions, it only varied from 68 to 79 percent. Thus, our findings suggest that, in general, jobs requiring a BA degree are not accessible to the economically insecure population while jobs that do not require this level of education are accessible.

In examining the national BLS data on typical entry-level job requirements in four-digit NAICS service industries, we found that the level of industry specificity led to reasonably homogeneous education requirements. That is, while each four-digit industry included some entry-level jobs that required very high levels of education and others that required little-to-no education, the bulk of jobs in each industry tended to fall on one end or the other of the educational spectrum. For example, while 12 percent of jobs in the software publishing industry (NAICS 5112) require a high school diploma or less, nearly 80 percent require at least a BA degree or higher, suggesting that the industry is generally not accessible to those without a BA degree. Also, while about 7 percent of jobs in the consumer goods rental industry (NAICS 5322) require a BA degree or higher, 93 percent require less than a BA, making the industry as a whole appear quite accessible to those without a BA degree.

Taking information on the educational attainment of economically insecure working-age adults and the education requirements of entry-level service industries together, we defined accessible service industries as all four-digit NAICS industries in which at least 80 percent of entry-level jobs required less than a BA degree. This definition is not perfect; some jobs in the industries we included are not likely to be accessible to those without a BA and some we excluded are. However, we believe this definition provides a good sample of industries that are broadly accessible to economically insecure adults, and the differences in job quality in these industries we found when looking across the 150 largest regions were valid. In total, we identified 104 four-digit NAICS codes as accessible service industries (Figure 1).

Figure 1.
Accessible service industries by four-digit NAICS code

NAICS code	Description
2213	Water; sewage and other systems
4231	Motor vehicle and motor vehicle parts and supplies merchant wholesalers
4232	Furniture and home furnishing merchant wholesalers
4233	Lumber and other construction materials merchant wholesalers
4235	Metal and mineral (except petroleum) merchant wholesalers
4237	Hardware; and plumbing and heating equipment and supplies merchant wholesalers
4238	Machinery; equipment; and supplies merchant wholesalers
4239	Miscellaneous durable goods merchant wholesalers
4241	Paper and paper product merchant wholesalers
4244	Grocery and related product merchant wholesalers
4245	Farm product raw material merchant wholesalers
4247	Petroleum and petroleum products merchant wholesalers
4248	Beer; wine; and distilled alcoholic beverage merchant wholesalers
4249	Miscellaneous nondurable goods merchant wholesalers
4411	Automobile dealers
4412	Other motor vehicle dealers
4413	Automotive parts; accessories; and tire stores
4421	Furniture stores
4422	Home furnishings stores
4431	Electronics and appliance stores

4441	Building material and supplies dealers
4442	Lawn and garden equipment and supplies stores
4451	Grocery stores
4452	Specialty food stores
4453	Beer; wine; and liquor stores
4461	Health and personal care stores
4471	Gasoline stations
4481	Clothing stores
4482	Shoe stores
4483	Jewelry; luggage; and leather goods stores
4511	Sporting goods; hobby; and musical instrument stores
4512	Book stores and news dealers
4521	Department stores
4529	Other general merchandise stores
4531	Florists
4532	Office supplies; stationery; and gift stores
4533	Used merchandise stores
4539	Other miscellaneous store retailers
4542	Vending machine operators
4543	Direct selling establishments
4812	Nonscheduled air transportation
4821	Rail transportation
4831	Deep sea; coastal; and great lakes water transportation
4832	Inland water transportation
4841	General freight trucking
4842	Specialized freight trucking
4851	Urban transit systems
4852	Interurban and rural bus transportation
4853	Taxi and limousine service
4854	School and employee bus transportation
4855	Charter bus industry
4859	Other transit and ground passenger transportation
4870	Scenic and sightseeing transportation
4881	Support activities for air transportation
4882	Support activities for rail transportation
4883	Support activities for water transportation
4884	Support activities for road transportation
4885	Freight transportation arrangement
4889	Other support activities for transportation
4921	Couriers and express delivery services
4922	Local messengers and local delivery
4931	Warehousing and storage
5242	Agencies; brokerages; and other insurance related activities
5311	Lessors of real estate
5312	Offices of real estate agents and brokers
5313	Activities related to real estate

5321	Automotive equipment rental and leasing
5322	Consumer goods rental
5323	General rental centers
5324	Commercial and industrial machinery and equipment rental and leasing
5612	Facilities support services
5613	Employment services
5614	Business support services
5615	Travel arrangement and reservation services
5616	Investigation and security services
5617	Services to buildings and dwellings
5619	Other support services
5621	Waste collection
5622	Waste treatment and disposal
5629	Remediation and other waste management services
6212	Offices of dentists
6219	Other ambulatory health care services
6231	Nursing care facilities
6233	Community care facilities for the elderly
6244	Child day care services
7112	Spectator sports
7131	Amusement parks and arcades
7132	Gambling industries
7139	Other amusement and recreation industries
7211	Traveler accommodation
7212	RV (recreational vehicle) parks and recreational camps
7213	Rooming and boarding houses
7223	Special food services
7224	Drinking places (alcoholic beverages)
7225	Restaurants and other eating places
8111	Automotive repair and maintenance
8112	Electronic and precision equipment repair and maintenance
8113	Commercial and industrial machinery and equipment (except automotive and electronic) repair and maintenance
8114	Personal and household goods repair and maintenance
8121	Personal care services
8122	Death care services
8123	Dry cleaning and laundry services
8129	Other personal services
8134	Civic and social organizations

Source: PolicyLink/PERE analysis of data from the U.S. Bureau of Labor Statistics.

Constructing an Index of Job Quality for Accessible Service Industries

To create an index of job quality for accessible service industries, we relied upon information available in the industry dataset from Moody's Analytics. As noted above, the dataset is limited to information on total employment, wage and salary disbursements, and output (gross domestic product, or GDP). Thus, the most useful measure of job quality available was clearly wage levels, and we divided total wages by total employment in each industry to get average annual wages. In addition to wage levels, we derived measures of growth in average annual wages and employment between 2005 and 2015 to include in the index as well, as they are often used as indicators of industry job quality. Total employment and total wages in 2005 and 2015 were summed up across all accessible service industries in each region, and average annual wages, average annual wage growth, and employment growth measures were calculated for all accessible service industries combined. Wage growth was calculated in real terms, using the Consumer Price Index for All Urban Consumers from the U.S. BLS to adjust wage measures to December 2015 dollars before deriving growth rates.

While average annual wages were clearly the most important indicator of job quality available in the data, the cost of living differs greatly across the 150 largest regions. To construct a more comparable measure of wage levels, we adjusted average annual wages for each of the 104 accessible service industries in each region for cost of living. To do so, we relied upon the RPP index for 2015 from the U.S. Bureau of Economic Analysis. The RPP is a price index that measures regional prices relative to the nation as a whole. For example, an RPP value of 125 for a region means that prices in that region are, on average, 25 percent higher than the U.S. average.

Given that our objective is to measure prices faced by the economically insecure population, we adjusted the RPP to account for the fact that economically insecure households are likely to spend a larger than average share of their income on rent and housing costs. To make this adjustment, we took advantage of the fact that the RPP is reported, for each region, both as an overall index, and by three different expenditure categories: goods, rent services, and other services. We first confirmed that we could closely approximate the overall index in each region by taking a weighted average of the indices across the three expenditure categories (using personal consumption expenditure-based weights found in a methodology document for RPP index, published in July 2016, of 41.5 percent of total weight for goods, 20.6 percent for rent services, and 37.9 percent for other services).[7]

Next, we constructed a cost-of-living–adjusted index calibrated to the prices faced by economically insecure households by increasing the weight of the rent services expenditure category, and decreasing the weights of the goods and other services categories proportionally. To estimate how much to increase the weight assigned to the rental services expenditure category, we calculated from the 2015 ACS 1-year microdata (from IPUMS-USA), for all renter-occupied households in the 150 largest metros, the share of household income spent on rent for economically insecure renter households versus all renter households combined. We found that economically insecure renter households spent an average of 50.02 percent of their income on rent, while the average for all renter households combined was 34.85 percent.

This suggests that the share of income spent on rent is 43.5 percent higher (50.02/34.85) for economically insecure renter households than for all households combined. Therefore, we increased the weight on the index for rent services by 43.5 percent, and reduced the weights on the indices

for goods and other services such that their relative size (compared with each other) remained the same and the weights of the three indices summed to one. The resulting weighting scheme for the adjusted RPP index ascribes 36.8 percent of total weight to goods, 29.6 percent to rent services, and 33.6 percent for other services. Figure 2 shows the original and adjusted RPP index and their components for the San Jose, California metropolitan statistical area. As can be seen, given the high cost of rents in the region (with an RPP for rent services of 207.4), the cost-of-living–adjusted RPP index for the economically insecure is higher than the original RPP index (132.6 vs. 124.1). Figure 3 depicts the RPP index and adjusted RPP index for the 150 largest metro areas, with labels for selected regions, to provide a sense of how much the adjusted index differs from the original.

The RPP index, adjusted to reflect costs faced by economically insecure households, was used to derive cost-of-living–adjusted average annual earnings for the 104 accessible service industries in each region. With the three metrics for our index of job quality for accessible service industries in place (cost-of-living–adjusted average annual wages in 2015, real growth in average annual wages from 2005 to 2015, and employment growth from 2005 to 2015), we normalized each measure by calculating z-scores for the 150 largest metros. Finally, we took a weighted average of the three z-scores for each region, attributing two-thirds of total weight (66.67 percent) to average annual wages, one-sixth of total weight (16.67 percent) to real wage growth, and one-sixth of total weight (16.67 percent) to employment growth. While the weighting scheme was admittedly somewhat arbitrary, our goal was to weight average annual wages much more heavily than the growth measures based on our judgement that it is the most meaningful measure of job quality of the three. The final index of job quality for accessible service industries ranges from -1.65 to 3.22, with an average value of zero. Thus, positive values reflects better-than-average job quality and negative values reflect worse-than-average job quality across the 150 largest metro areas.

Figure 2.
Regional Price Parity (RPP) index and cost-of-living (COL)–adjusted RPP index for the economically insecure in the San Jose, California metropolitan statistical area

Category	Expenditure weight	RPP	Adjusted expenditure weight	COL-Adjusted RPP
All items		124.1		132.6
Goods	0.415	108.8	0.368	108.8
Services: Rents	0.206	207.4	0.296	207.4
Services: Other	0.379	109	0.336	109

Source: PolicyLink/PERE analysis of data from the U.S. Bureau of Economic Analysis and the IPUMS 2015 1-year American Community Survey.

Figure 3.
Regional Price Parity (RPP) index and cost-of-living (COL)–adjusted RPP index for the 150 largest metropolitan statistical areas
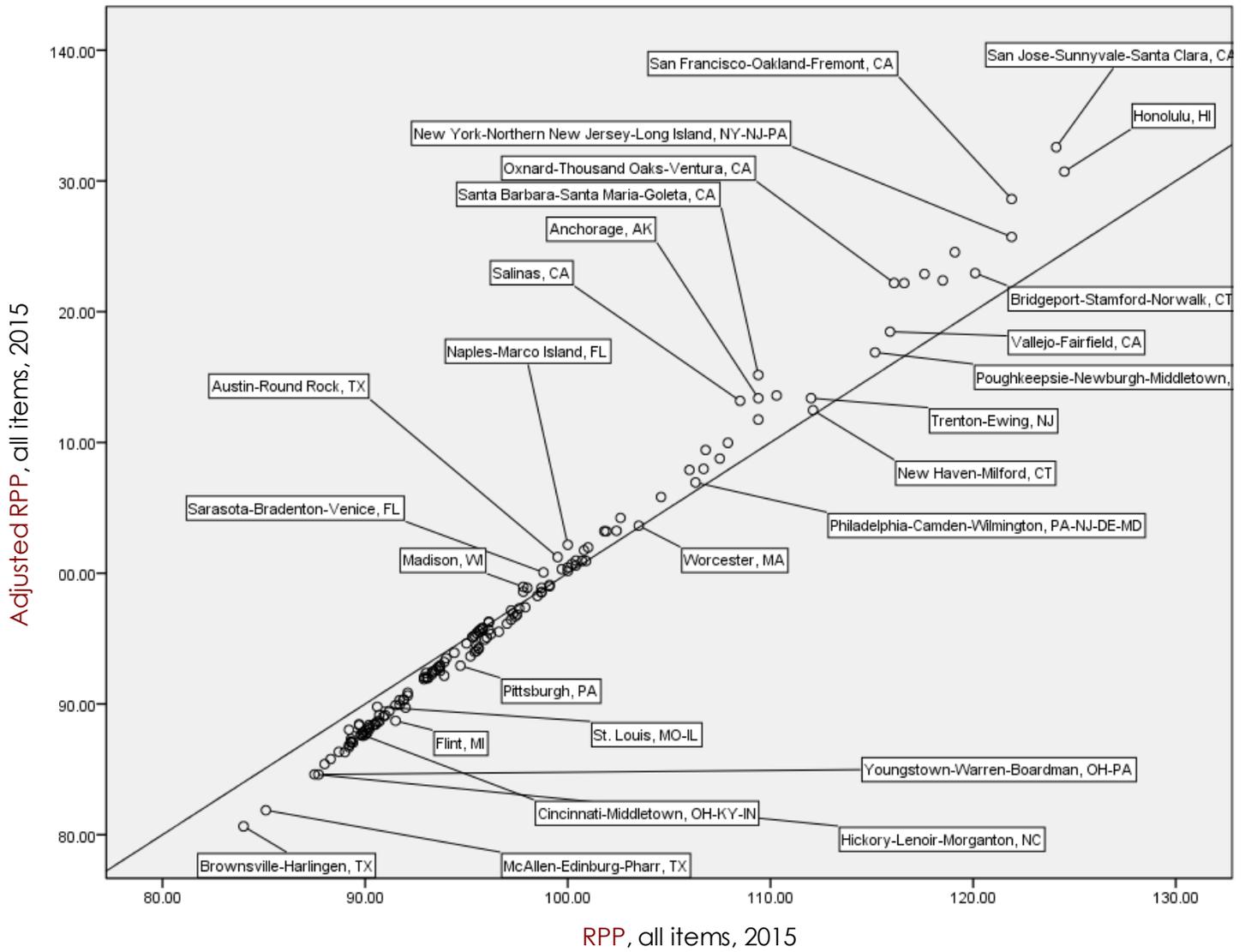
Source: PolicyLink/PERE analysis of data from the U.S. Bureau of Economic Analysis and the IPUMS 2015 1-year American Community Survey.

Creating the Regional Typology

We relied upon three basic measures to create the regional typology presented in the *Regional Economies in Transition* report: percent change in manufacturing employment (2005–2015), percent change in advanced industry employment (2005–2015), and the index of job quality in accessible service industries. The basic approach was to place the 150 metros into three groups based on the number of standard deviations from the mean by each measure, and then cross-tabulate the results. Initially, this led to 27 different groups of regions (three cubed). However, given that many of the 27 resulting groups contained very few metros and had similar values for the three factors as other groups, we collapsed them into seven groups (or "types" of regions).

We began by grouping the 150 largest metros into three groups (low, middle, and high) by the percent change in manufacturing employment. The low group included all metros with values more than one standard deviation below the mean, the middle group included all with values within one standard deviation of the mean, and the high group included all with values more than one standard deviation above the mean. We then further parsed each group of regions into three more groups by growth in advanced industry employment, again using the mean and standard deviation calculated across all 150 metros with the same relative cuts (one standard deviation above and below the mean). The result was nine distinct groups of regions, with an uneven number of regions in each group. Finally, we incorporated the third factor of the typology—the index of job quality for accessible service industries—in the same fashion by placing the 150 regions into three groups and again applying the same relative cuts (one standard deviation above and below the mean). The procedure is illustrated in Figures 4 and 5. Figure 4 depicts the largest 150 regions classified into three groups by each of the three factors, while Figure 5 depicts how they were reduced into the seven regional types included in the final typology.

Recall that we measured the decline in manufacturing and growth in advanced industries as the percent change in employment in these sectors between 2005 and 2015. Because a large share of manufacturing jobs (49 percent among the 150 largest metros) are advanced industry jobs, some may wonder why we did not exclude the advanced manufacturing industries when deriving growth in manufacturing employment. After all, this would make the two measures independent of one another, and reduce the extent of the positive correlation that is visible in Figures 4 and 5. While we did consider deriving the index in this way, we found in sensitivity testing that it would make very little difference in the final categorization of regions, and so we opted for the more parsimonious and straightforward definition of "manufacturing decline" that includes all manufacturing industries. The implication here is that regions with strong growth in what we refer to as "traditional manufacturing" in the report (i.e., all manufacturing industries other than advanced manufacturing), tend to be the same as those with strong growth in advanced manufacturing.

Figure 4.

Grouping regions by manufacturing decline, advanced industry growth, and quality of accessible service industries, 150 largest metropolitan statistical areas

Quality of accessible service industries: ● High ● Middle ● Low

% change in advanced industry employment, 2005–2015

% change in manufacturing employment, 2005–2015

Within 1 std. dev. of mean

Within 1 std. dev. of mean

Source: PolicyLink/PERE analysis of data from Moody's Analytics.

Figure 5.

Grouping regions into final regional typology, 150 largest metropolitan statistical areas

Final regional typology:

○ Leading Tech Hub   ○ High Prospects   ○ Steady, Looking Up   ○ Steady, Average   ○ Steady, Struggling   ○ Passed Over   ○ Hardest Hit
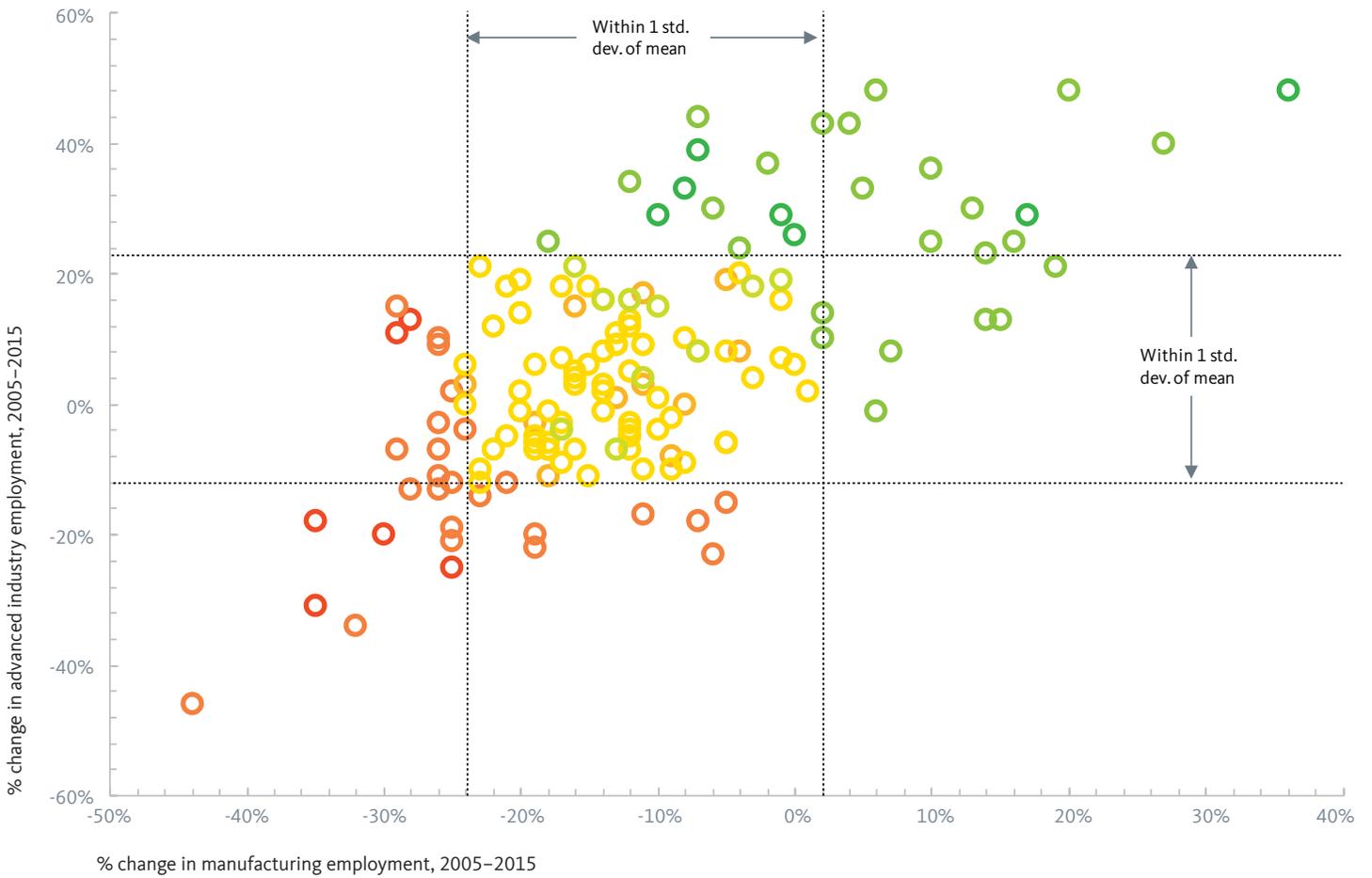
Source: PolicyLink/PERE analysis of data from Moody's Analytics.

Notes

1   "Occupational Employment Statistics," Bureau of Labor Statistics, U.S. Department of Labor, last modified April 4, 2019, https://www.bls.gov/oes/additional.htm.

2   "Regional Price Parities by State and Metro Area," Bureau of Economic Analysis, last modified May 16, 2019, https://www.bea.gov/data/prices-inflation/regional-price-parities-state-and-metro-area.

3   "U.S. Census Data for Social, Economic, and Health Research," IPUMS USA, accessed April 12, 2019, https://usa.ipums.org/usa/.

4   "Summary File Data, 2015," American Community Survey (ACS), U.S. Census Bureau, accessed April 12, 2019, https://www.census.gov/programs-surveys/acs/data/summary-file.2015.html.

5   Mark Muro, Jonathan Rothwell, Scott Andes, Kenan Fikri and Siddharth Kulkarni, *America's Advanced Industries: What They Are, Where They Are, and Why They Matter* (Washington, DC, The Brookings Institution, 2015), https://www.brookings.edu/research/americas-advanced-industries-what-they-are-where-they-are-and-why-they-matter/.

6   "Business R&D and Innovation Survey," National Science Foundation, accessed April 12, 2019, https://www.nsf.gov/statistics/srvyindustry/about/brdis/.

7   "Real Personal Income and Regional Price Parities," BEA Resources: Methodologies (Suitland, MD: Bureau of Economic Analysis, July 2016), https://www.bea.gov/sites/default/files/methodologies/RPP2016_methodology.pdf.

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