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Historic narrowing of employment gap post-pandemic, especially for people with cognitive disabilities

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Abstract

BACKGROUND: People with disabilities are underemployed. This improved recently. Under federal law, employers with 14(c) certificates can pay people with disabilities far below minimum wage, typically in segregated settings (sheltered workshops). Almost everyone in 14(c) employment has an intellectual/developmental disability. Some states have eliminated sheltered workshops, but phase-out is controversial.

OBJECTIVE: To examine pre- and post-pandemic trends in employment rates and subminimum wage prevalence among people with disabilities, especially cognitive disabilities, differences among states, and what national and state-by-state data reveal about associations between employment rate and subminimum wage.

METHOD: I analyzed 2010-2023 U.S. Census American Community Survey data on employment rate by presence of disability and presence of cognitive disability, 2010-2024 Department of Labor (DOL) data on subminimum wage certificates in Community Rehabilitation Programs (CRPs), and 2015-2024 DOL data on number of CRP workers paid subminimum wage. I assessed trends in employment and subminimum wage prevalence graphically. With linear regressions, I assessed state-by-state patterns in employment of people with cognitive disabilities and subminimum wage prevalence.

RESULTS: Disability employment gap narrowed long-term, especially post-pandemic—more so for people with cognitive disabilities. Long-term, every state's employment gap for people with cognitive disabilities narrowed while 14(c) enrollment decreased. States with higher subminimum wage prevalence showed much larger drops in such prevalence, but the association between employment rate and subminimum wage prevalence was modest.

CONCLUSION: Employment improvements parallel nationwide initiatives. Research informing public policy and hiring and retention practices should take advantage of the further post-pandemic improvement, and marketing investments should promote these practices.

Keywords: Employment, Intellectual Disability, Developmental Disabilities, Sheltered

5 Workshops, Disabled Persons, Community Rehabilitation Programs

1 Introduction

1.1 *Employment Among People with Disabilities Through Economic Shocks*

People with disabilities are employed at far lower rates than people without disabilities. During recessions occur, their employment typically declines more sharply, and during recoveries, their employment typically recovers more slowly (Burkhauser et al., 2001; Burkhauser & Stapleton, 2003; Fogg et al., 2011; Kaye, 2010; Schur et al., 2023). This phenomenon was important enough that it was called out specifically by the National Institute for Disability and Rehabilitation Research (now the National Institute for Disability Independent Living and Innovation Research) in the first long-range plan they issued after the 2008 Great Recession (U.S. Department of Education Office of Special Education and Rehabilitative Services, 2013). Recent analyses, however, have indicated that the covid recession and recovery were different: employment among people with disabilities declined only proportionately when covid hit and recovered faster than among people without disabilities (Ne’eman & Maestas, 2023). Employment opportunities differ by type of disability both in the U.S. and internationally (Boman et al., 2015; Pettinicchio & Maroto, 2017). Differences persist even when accounting for other variables (Boman et al., 2015). This sets the stage to examine trends specifically in people with cognitive disabilities, who have traditionally faced deep stigma and substantial barriers.

1.2 *Subminimum Wage Among People with Disabilities*

The Fair Labor Standards Act of 1938 (Fair Labor Standards Act of 1938, n.d.) establishes the federal minimum wage—currently \$7.25 per hour—but Section 14(c) of the act authorizes employers to pay subminimum wage to people with disabilities (“individuals...whose earning or productive capacity is impaired by age, physical or mental deficiency, or injury”) when employers are issued a certificate by the U.S. Department of Labor. Such an authorization

to pay subminimum wage is called a “14(c) certificate” (U.S. Department of Labor Wage and Hour Division, 2025). The purpose of subminimum wage under the act is “to prevent curtailment of opportunities for employment”.

People with intellectual disabilities have long faced deep stigma. Attitudes have improved since many state institutions closed that had segregated people with intellectual disabilities (Dell’Armo & Tassé, 2021). Nevertheless, even though the initial idea beyond 14(c) was that subminimum wage would apply across a wide variety of disability type, including physical disabilities (Employment of Workers with Disabilities Under Section 14(c), 2024), today almost everyone in a 14(c) program has an intellectual/developmental disability (Government Accountability Office, 2023a).

The Workforce Innovation and Opportunity Act (WIOA) of 2014 (Workforce Innovation and Opportunity Act, 2014) amended the Rehabilitation Act of 1973 to call for maximizing opportunities for subminimum wage earners to achieve competitive integrated employment (CIE) at least at minimum wage. Segregated vocational services reduce the potential for future positive outcomes toward competitive integrated employment, and integrated vocational service models incorporating strategies such as supported and customized employment lead to improved outcomes in economics, quality of life, and mental health (Taylor et al., 2023).

Subminimum wage programs have been extremely controversial. Their promoters typically argue that they provide productive work and socialization for people who could not otherwise work. Their detractors typically decry the segregation experienced by people employed at subminimum wage in 14(c) programs and note that people typically work for years in 14(c) without an opportunity to transition to competitive integrated employment (possibly with support) notwithstanding WIOA’s expectation of such a goal.

In one state (Maine) that closed its last sheltered workshop in 2010, employment of people with intellectual disabilities and autism supported by that state's Home and Community Based Services program through Medicaid did not increase for several years (indeed decreased over the time frame analyzed in the study) (Phoenix & Bysshe, 2015).

5 The Supreme Court has ruled that that unjustified segregation of persons with disabilities constitutes discrimination under the ADA (*Olmstead v. L.C.*, 1999). A federal district court has applied this ruling to sheltered workshops, holding that participation "must be a choice, not a requirement" (*Lane v. Kitzhaber*, 2012). But the Government Accountability Office (GAO) has identified structural and policy barriers preventing people from transitioning from 14(c)
10 programs to competitive integrated employment (Government Accountability Office, 2023a), and the U.S. Commission on Civil Rights has recommended repealing 14(c) (U.S. Commission on Civil Rights, 2000). However, some groups have opposed repeal. They argue that repeal would hurt people with intellectual/developmental disabilities (Coalition for the Preservation of Employment Choice, 2022; Voice of Reason, 2021). Fifteen states have enacted legislation since
15 2015 to phase out subminimum wage and sheltered workshops (J. Christensen, 2024). The most recent substantive update to federal regulation of 14(c) programs was issued in 1989, but the U.S. Department of Labor proposed a new rule in December 2024 that would phase out issuance of 14(c) certificates (Employment of Workers with Disabilities Under Section 14(c), 2024).

1.3 Research Questions

20 In an effort to go beyond case studies of experiences by an individual state, this paper poses and answers five research questions about the overall patterns and long-term trends in the landscape of disability employment and subminimum wage across the nation and the broader patterns among states. Research questions 3, 4, and 5 focus on sheltered workshops, whose

workers overwhelmingly have intellectual/developmental disabilities. The U.S. Census American Community Survey does not collect data on intellectual/developmental disability, but it does collect data on cognitive disability. Research questions 2, 4, and 5 therefore focus on cognitive disability. The five research questions are:

- 5 1. What are the nationwide trends—both long-term and post-pandemic—in employment of people with any disability, relative to employment people without a disability?
2. What are these trends for people with a cognitive disability?
3. What are the nationwide trends—both long-term and post-pandemic—in prevalence of sheltered workshops?
- 10 4. How similar or different are states from one another, and from the nationwide trends, in employment of people with a cognitive disability and in the use of sheltered workshops?
5. What is the relationship, seen from comparisons among states, between employment of people with a cognitive disability and the use of sheltered workshops?

2 Materials and Methods

15 To answer the research questions, this paper describes systematic analysis of time series from two data sources: U.S. Census American Community Survey (ACS) data on employment by disability status since the 2010 census and U.S. Department of Labor data about 14(c) sheltered workshops (more formally known as Community Rehabilitation Programs or CRPs (U.S. Department of Labor Wage and Hour Division, n.d.). The Department of Labor data
20 included both the number of CRP programs (available since 2011) and number of people employed at subminimum wages in such programs (available since 2015). Data from the U.S. Census Bureau helped answer Research Questions 1, 2, 4, and 5, and data from the U.S. Department of Labor helped answer Research Questions 3, 4, and 5.

All analyses used R 4.2.1 (R Core Team, 2024), with code and data at

<https://github.com/acobolew/disability-employment>

2.1 *American Community Survey Employment by Disability Status*

2.1.1 Description of ACS

5 Annually, the U.S. Census Bureau conducts the American Community Survey (ACS) through random sampling (U.S. Census Bureau, 2024). The ACS includes the Puerto Rico Community Survey (PRCS), which is the ACS customized for Puerto Rico (US Census Bureau, 2025).

10 Responses are collected online, by mail, or by a field representative by computer-assisted interviewing (and were previously also collected by telephone). The ACS is the largest household survey that the Census Bureau conducts. It is sent to about 3.5 million addresses each year and includes processes to collect data from individual households (U.S. Census Bureau, 2024) as well as institutional and noninstitutional group quarters (U.S. Census Bureau, 2024, 2025a). If a person or household is selected into the sample, responding to the ACS is required
15 by law (Gamboa, 2002). In addition, the census engages in statistical and other methodological efforts to both minimize nonresponse bias and to correct for it (U.S. Census Bureau, 2024) and annually publishes sample size and other data quality measures (U.S. Census Bureau, n.d.-b).

20 For households, there are 3-4 modes of data collection, depending on year: mail, personal visit, internet (starting in January 2013), and computer-assisted telephone interview (until September 2017) (U.S. Census Bureau, 2023). For group quarters the Census Bureau makes an appointment with a manager, director, administrator, or other contact person for the group quarter, interviews that person to collect information about the group quarter and compile a list

of people staying there, and then conducts interviews with a sample of residents randomly selected from that list (U.S. Census Bureau, 2025a).

The ACS data reported in this paper are specific to the civilian noninstitutionalized population of people age 18-64 (“working age”), including both people living in households and people living in noninstitutional group quarters. The category of noninstitutional group quarters includes people in college/university student housing and other noninstitutional facilities including group homes intended for adults, emergency and transitional shelters for people experiencing homelessness, residential treatment centers for adults, workers’ group living quarters and job corps centers, and other noninstitutional group quarters (Gamble et al., 2022).

2.1.2 ACS Sample Size

Because the ACS has procedures to reach both people in households and people in group quarters, the Census Bureau describes sample size separately in terms of number of household units (for people not in group quarters) and in terms of number of “group quarters people” for people in group quarters. For both groups (households and group quarters), the Census Bureau reports number of “final interviews” across all modes of data collection. For households, ACS final interview sample size for the years in the present paper ranged from 1,917,799 household interviews (in 2010) to 2,322,722 household interviews (in 2014) (U.S. Census Bureau, n.d.-b). For people in group quarters, ACS final interview sample size for the years in the present paper ranged from 119,144 interviews with people in group quarters (in 2021) to 165,116 interviews with people in group quarters (in 2014) (U.S. Census Bureau, n.d.-b).

The Census Bureau does not publish total sample size of persons per se, because the sampling unit of the larger survey is household rather than person. However, a *lower bound* to the number of noninstitutionalized working-age people in the full ACS sample can be calculated

by analyzing the ACS Public Use Microdata Sample (PUMS). Whereas the full ACS has reliable aggregate estimates, the PUMS has redacted person-level information—but the PUMS is only a sub-sample in order to preserve respondent confidentiality. This is why sample sizes calculated from PUMS are only a lower bound on the full ACS sample sizes. To calculate these lower

5 bounds on the sample size, I analyzed PUMS data downloaded from IPUMS (Ruggles et al., 2025). Based on this analysis, Table 1 presents number of noninstitutionalized working-age persons in each annual PUMS sample (total, by whether the person had any disability, and by whether the person had a cognitive disability). It can be seen that, in an annual PUMS sample, the total number of such persons was never less than 1,869,759, the number of such persons with

10 a disability was never less than 193,231, and the number of such persons with a cognitive disability was never less than 77,663.

The PUMS sample sizes are about two-thirds of the ACS sample sizes (U.S. Census Bureau, 2021a). The total number of persons in the ACS analyses in this paper were therefore generally about 1.5 times the PUMS sample sizes. The ACS sample in this paper thus had

15 upwards of 2.8 million noninstitutionalized working-age persons per year, upwards of 290,000 such persons with a disability per year, and upwards of 116,000 such persons with a cognitive disability per year.

2.1.3 Disability Status

Since 2008, ACS has collected data from respondents about whether they have each of

20 six “disability types”: hearing difficulty, vision difficulty, cognitive disability, ambulatory disability, self-care disability, and independent living difficulty; respondents who report any one of the six disability types are considered to have a disability (U.S. Census Bureau, 2021b). This set of six questions was designed with from the point of view of the social model of disability

and has also been selected as the standard for all U.S. Department of Health and Human Services sponsored data collection, per amendments to the Public Health Service Act enacted by Section 4302 of the Affordable Care Act (U.S. Census Bureau, 2025c; Data Collection, Analysis, and Quality, n.d.).

5 This paper analyzes data by three categories of disability status, two of which overlap: people with no disability (not in any of the ACS “disability type” categories), people with any disability (in at least one of the six ACS “disability type” categories), and people with a cognitive disability (in the ACS “cognitive disability” category, regardless of whether they were also in another “disability type” category).

10 2.1.4 Employment Status as Defined by ACS

ACS categories respondents into one of these categories: “employed” (has a job), “unemployed” (does not have a job and has actively looked for work in the past four weeks), or “not in the labor force” (does not have a job and has not actively looked for work in the past four weeks) (Shepard et al., 2023).

15 2.1.5 Accessing and Processing ACS Data

ACS data can be accessed efficiently in computer code via the Census Bureau’s Application Programming Interface (API) (U.S. Census Bureau, 2025b). Data can be accessed by year, by geography, and by sub-population. Because this is a survey from a broader population, the ACS API provides not just best estimates for each of the quantities downloaded for this paper but also the margin of error of these quantities.

20 Using the R package `tidycensus` (Walker & Herman, 2024) to interface with the Census Bureau’s API, I downloaded employment data, by disability status and state (including DC and Puerto Rico), from the year of the 2010 decennial census through the most recent data available

(2023), except that, due to low response rate at the beginning of the pandemic, the Census Bureau did not publish data on the target variables for 2020. All such ACS data came from Census table B18120 (“Employment Status by Disability Status and Type”), which is specific to the civilian non-institutionalized working age population, where “working age” is defined as 18-64 years old (U.S. Census Bureau, n.d.-a). For each group and year, ACS data provides both point estimates and margins of error for number of people employed, number of people unemployed, and number of people not in labor force. This detailed breakdown provides the raw data for computing employment rate and employment ratio, as described in the next paragraph.

For each combination of year, disability status, and state, I calculated *employment rate* as the number of people employed divided by the sum of people employed, unemployed, and not in labor force. To control for broader trends in the overall labor market, I also calculated *employment ratio* as employment rate for that disability status divided by employment rate for people with no disability. (For each disability status, an employment ratio of 1 would indicate that people with that disability status are employed at a rate equal to that of people without a disability, an employment ratio of 0.5 would indicate that people with that disability status are employed at a rate one-half that of people without a disability, and an employment ratio of 0.25 would indicate that people with that disability status are employed at a rate one-quarter that of people without a disability.)

Because employment rates and employment ratios are calculated by combining information across downloaded quantities, they are known as *derived quantities*. For every such derived quantity I calculated standard errors using the margin-of-errors for a derived quantity as recommended by the Census Bureau and implemented by tidycensus (Walker & Herman, 2024).

I then plotted the national ACS employment data, by year, for the *employment rate* for each disability status and for people without a disability and the national data for the *employment ratio* for each disability status (except that the plots omit employment ratio for people with no disability because that employment ratio is 1 by construction).

5 2.2 *Department of Labor 14(c) Subminimum Wage Data*

For data on 14(c) Community Rehabilitation Programs, I downloaded all data directly available from the U.S. Department of Labor Wage and Hour Division website, with availability starting October 2021. To access data from before this date I also downloaded all unique data releases from the “Wayback Machine” at archive.org. The Wayback Machine is a digital archive
10 of web pages that allows users to “go back in time” to see how websites looked in the past (“Wayback Machine,” 2025), which enabled me to access historical data (before October 2021) that the Wage and Hour Division had previously publicly posted, in order to augment the data currently posted online with data that were previously posted by the same authoritative source. The URLs for all downloaded Department of Education data are at
15 <https://github.com/acobolew/disability-employment>, as are Excel files containing the downloaded data. Number of programs was available starting in January 2010, and number of people employed at subminimum wage was available starting in October 2015. (Because there were periods when the Department of Labor processed applications particularly slowly, I calculated number of programs as the sum of current and pending.) Department of Labor data
20 includes the geography included in the ACS as well as Guam. To calculate per-capita rate of people paid subminimum wage I divided the number of such people by census population estimates (which excluded Guam). Because census population estimates by state were available only through 2023, I also used 2023 estimates in 2024. (Given population trends by state, this would be expected to introduce error of less than 1.8%.)

I then plotted the national Department of Labor data, by year, for the number of workers paid subminimum wage in CRP programs and for the number of such programs. Because the changes over time in these quantities (especially in number of workers paid subminimum wage) did not follow a straight line, I added curvilinear fits to the graphs to highlight the trends over time, using the `geom_smooth()` function in the R package `ggplot2` (Wickham, 2016).

2.3 *State-by-State Data*

To examine state-by-state patterns over time (Research Question 4), I applied curvilinear fits (generalized additive models) to the state-by-state data on employment ratio and on workers per capita paid subminimum wages in 14(c) CRP programs, using the `mgecv` package in R (Wood, 2011). Generalized additive models are a generalization of linear regression models in statistics that can naturally model curvilinear changes (Wood, 2017). The fits incorporated “random effects” that allowed the specific shape of the change over time to vary by states. This facilitated graphical assessment of trends over time, by state.

To explore the potential for covariation state-by-state between employment ratio and workers paid subminimum wages (Research Question 5), I conducted an additional analysis in which I restricted attention to 2015-2023 (the years that ACS and per-capita rate of people paid 14(c) subminimum wage were both available). In this additional analysis for each of the 50 states, DC, and Puerto Rico, I linearly regressed the cognitive disability employment ratio and the per-capita rate of people earning subminimum wage in 14(c) programs against year (centered on 2019, as that is the middle of the 2015-2023 time window). In order for both regressions to weight year equally (except that 2020 was absent from ACS dataset), I inversely weighted the per-capita 14(c) data by number of time points per year. These regressions produced four parameters for each state: an intercept and a slope for cognitive disability employment ratio (for

the average value of a state's cognitive disability employment ratio and the broad change over time in the state's cognitive disability employment ratio), and an intercept and a slope for numbers of workers per capita paid subminimum wage in CRP programs (for the average value of a state's prevalence of subminimum wage and the broad change over time in the state's prevalence of subminimum wage). I then examined the covariation of these four parameters across states.

3 Results

3.1 *Demographics of Research Population by Year and Disability Status*

Tables 2 and 3 present demographic characteristics of the research population by year and disability status.

All but the rightmost portion of Table 2 presents the sex and age characteristics, both by whether a person has any disability and by whether a person has a cognitive disability. Sex distribution was stable over time: for every year, 49-51% of the population was female, regardless of disability status.

Table 2 dichotomizes age according to how it is reported in the ACS aggregate tables (age 18-34 versus 35-64). For people with no disability and for people with no cognitive disability, age distribution on this coarse scale was fairly stable, with 37-39% younger than 35. In contrast, for people with any disability, the population shifted younger over time, with 20% younger than 35 in 2010 versus 29% younger by 2023. For people with a cognitive disability there was a parallel trend: 28% younger than 35 in 2010 versus 40% younger by 2023.

The rightmost portion of Table 2 presents ethnic status (percent Hispanic or Latino versus White non-Hispanic/Latino). This is reported only by presence of disability because the ACS aggregate data do not report this characteristic by cognitive disability status. The population

shifted more Hispanic/Latino over time: Among people without a disability, the shift was from 21% Hispanic/Latino in 2010 to 27% by 2023. There was a similar though slightly steeper trend among people with a disability: 18% Hispanic/Latino in 2010 to 24% by 2023. Thus, people with a disability were disproportionately not Hispanic/Latino, but this disproportionality narrowed over time.

Table 3 presents race of the research population by year and by whether a respondent had any disability, as the ACS aggregate data do not report these characteristics by cognitive disability status. The population became more racially diverse over time, regardless of presence of disability: Among people with a disability it went from 74% White alone in 2010 to 72% White alone in 2019. This was almost identical among people without a disability, for whom it went from 75% White alone in 2010 to 71% White alone in 2019. In 2021 the percentage White alone dropped about 10%, regardless of presence of disability, as the Census Bureau made major changes to how it collected and coded information about race (Marks & Rios-Vargas, 2021). This is reflected as well in the simultaneous jump of about 10% in “Two or More Races”, from 2-3% in 2010-2019 to 12% in 2021-2023, regardless of disability status.

People with a disability were disproportionately Black: regardless of year, 15-17% of people with a disability were Black alone versus only 12-13% of people without a disability being Black alone. The percentage American Indian or Alaska Native was constant at 1% regardless of year or disability status. People with a disability were disproportionately not Asian: among people with a disability, 2-3% were Asian alone, whereas among people without a disability 6-7% were Asian alone. Native Hawaiian or Other Pacific Islander was less than 0.5% of the research population regardless of year or presence of disability.

3.2 *Research Questions 1 and 2 Answered with American Community Survey Employment Data*

From 2010 to 2023, employment increased for all groups (Fig. 1A). It rose especially steeply among people with any disability. It rose even more steeply among people with a cognitive disability. This resulted in a long-term narrowing of the employment gap, as seen in Fig. 1B: since 2010 employment ratio grew for people with any disability—but grew even more steeply for people with a cognitive disability. Since the pandemic, these trends only accelerated.

From 2010 to 2023, employment among people without disabilities rose from 72.8% to 79.4%, employment among people with any disability rose from 33.3% to 46.2%, and employment among people with cognitive disabilities rose from 23.4% to 40.6%. The employment ratio for people with any disability thus rose from 0.46 to 0.58 (a 1.3-fold increase), and the employment ratio for people with a cognitive disability thus rose from 0.32 to 0.51 (a 1.6-fold increase).

In other words, the employment rate for people with a cognitive disability rose from about one-third the employment rate for people without a disability to about one-half the employment rate of people with a disability.

For further context, applying the employment rates from 2010 and 2023 to the estimates 2023 population of people with cognitive disabilities reveals a large shift: the employment gap for people with a cognitive disability narrowed by 1.8 million people. This employment gap narrowed especially in 2021 and 2022.

3.3 *Research Question 3 Answered with Department of Labor 14(c) Subminimum Wage Data*

The number of people earning subminimum wages in 14(c) community rehabilitation programs dropped by about 70% from 2015 (the first year that such data were available online)

through roughly the end of 2020 (Fig. 1C) during a time when employment ratio among people with cognitive disabilities was rising. The number of people earning subminimum wage in such programs has since plateaued. The number of 14(c) certificates to operate such programs has fallen since 2011 (the first year that data on number of certificates were available online) and has continued to fall—down three-quarters from 2011 to 2024 (Fig. 1D).

3.4 *Research Question 4 Answered with State-by-State ACS and Department of Labor Data*

Fig. 3 presents state-by-state data on employment ratio for people with cognitive disabilities and number of 14(c) CRP subminimum wage earners in programs per capita, with curvilinear fits. All states experienced an increase in employment ratio among people with cognitive disabilities, and the number of such subminimum wage earners fell in all states (except in New Hampshire, which had already eliminated subminimum wage jobs by the time the time series began in October 2015).

3.5 *Research Question 5 Answered with Further Analysis of State-by-State Data*

To further explore the potential relationship between number of 14(c) subminimum wage earners per capita and employment ratio for people with a cognitive disability, linear regressions were performed, separately for the 50 states, DC, and Puerto Rico, for the time interval where those time series overlapped (2015-2023, a period immediately after WIOA's passage that also captures most of the national trend for rising employment ratios and falling subminimum wage jobs). Fig. 3 presents a scatterplot matrix of the parameters of those state-by-state regressions.

The first cell on the principal diagonal (that is, the upper left cell in the scatterplot matrix) displays the distribution of the intercept of subminimum wage workers per 100k—that is, the number of such workers per capita by state, averaged across the years 2015-2023. The distribution is not symmetrical, instead being right-skewed (having a sharp peak on the left and a

long tail on the right). This reflects that most states have few if any subminimum wage workers (peaking below 25 per 100k population) while there is a long tail of states with proportionately more (approaching 150 per 150k population).

The second cell on principal diagonal shows the distribution of the slope (change over time) for subminimum wage workers per 100k. The most important feature of this cell is that every state has slope ≤ 0 (note that the x -axis labels at the bottom of the second column are all zero or negative. This reflects that number of subminimum wage earners fell in every state (except in New Hampshire where there were already zero).

The fourth cell on principal diagonal shows the distribution of the slope (change over time) for employment ratio for people with cognitive disabilities. The most important feature of this cell is that every state has slope > 0 (note that the x -axis labels at the bottom of the fourth column are all positive) for cognitive disability employment ratio, reflecting that employment ratio for people with cognitive disabilities rose in every state.

The few states that, pre-pandemic, already had many subminimum wage earners per capita (for example, Minnesota in first column second row of Fig. 3) had a strong tendency to experience the largest decrease in subminimum wage earners per capita. This is seen in the tight scatterplot in the first column second row of Fig. 3 and the very negative Pearson correlation of -0.90. Other correlations among regression parameters are weak (all other correlation magnitudes ≤ 0.35). There was a slight tendency (correlation = 0.35) for states that, pre-pandemic, had many subminimum wage earners per capita to have higher cognitive disability employment ratio midway through the interval (for example Minnesota in first column third row of Fig. 3). There was an even slighter tendency (correlation = -0.27) for such states to experience only modest

improvements over time in employment ratio for cognitive disabilities (for example, Minnesota in first column bottom row of Fig. 3).

4 Discussion

Employment ratio has improved for people with any disability, but has improved even more for people with a cognitive disability. While employment rate remains lower among people with a cognitive disability than among people with any disability, that gap is also narrowing. For the first time in the data record, employment ratio for people with cognitive disabilities has exceeded 0.5. This is unprecedented. It means that people with cognitive disabilities are now employed at more than half the rate of people with no disability.

Interpreting these results requires attention to two distinct timeframes. The first involves long-term improvements in employment ratio, coinciding with dramatic decline in sheltered workshops. The second reflects the post-pandemic acceleration in employment ratio after most sheltered workshops had closed.

4.1 Longer-Term Employment Increases Coincide with Increased Resources and Supports for Competitive Integrated Employment

The post-pandemic improvement in employment is superimposed on a longer-term improvement, dating back to at least 2011—a period during which employment ratio for people with cognitive disabilities increased 1.6-fold while number of sheltered workshops decreased 3.9-fold. These sustained trends across more than a decade likely reflect the combined impact of a series of policy changes and federal initiatives undertaken during the same period of time that have shifted the landscape away from segregated settings and toward competitive integrated employment. Indeed, since the most recent substantive changes in federal 14(c) regulations, there have been many strategies and resources developed for competitive integrated employment of

persons with disabilities. They represent a combination of actions by Congress, the federal executive branch, and states. They also span five policy domains that correspond to five distinct titles of the federal code: Labor (Title 29), Health & Welfare (Title 42), Tax (Title 26), Public Contracts (Title 41), and Education (Title 20). Table 4 itemizes key initiatives at the federal level, along with their specific domains and timing. They are described below, including links to the evidence base in the scientific literature.

For example, under the national Employment First framework (U.S. Department of Labor Office of Disability Employment Policy, n.d.-c), publicly financed systems are urged to pursue policies and practices to promote competitive integrated employment. Indeed, as of September 2023, all states have taken some action promoting Employment First: 31 have passed Employment First legislation, 16 have issued Employment First executive orders, and 32 have administrative policies or regulations supporting Employment First (Association of People Supporting Employment First, 2023). There is an evidence base for practices that promote competitive integrated employment: Supported Employment and Individual Placement and Supports have demonstrated positive employment outcomes and cost effectiveness for people with severe mental illness (Bush et al., 2009; T. N. Christensen et al., 2021; Drake et al., 1999; Kinoshita et al., 2013), and cognitive rehabilitation has been shown to lead to substantial improvements in cognitive functioning and quality of life (McGurk & Wykes, 2008). Customized Employment has also emerged as a promising practice, with evidence from model descriptions and project evaluations that it that may produce quality employment outcomes for persons with disabilities, though studies of Customized Employment to date have typically lacked comprehensive fidelity measurement and random assignment (Riesen et al., 2023). Supported Employment has been part of the Rehabilitation Act since 1986 (Rehabilitation Act

Amendments of 1986, 1986), and Supported Employment and Customized Employment are both specifically included in WIOA.

The U.S. Department of Labor’s Office of Disability Employment Policy (ODEP) has engaged in several efforts to promote competitive integrated employment, such as the Campaign for Disability Employment (U.S. Department of Labor Office of Disability Employment Policy, n.d.-a), the Disability Employment Initiative to fund expanded employment opportunities for people with disabilities to California, Connecticut, Idaho, Massachusetts, Minnesota, and Maryland (U.S. Department of Labor Office of Disability Employment Policy, 2016), the Employment First State Leadership Mentoring Program (U.S. Department of Labor Office of Disability Employment Policy, n.d.-c), an Employment First Community of Practice (U.S. Department of Labor Office of Disability Employment Policy, n.d.-c), and the online CIE Transformation Hub (U.S. Department of Labor Office of Disability Employment Policy, n.d.-b). In addition, ODEP’s National Expansion of Employment Opportunities Network (NEON) works with sheltered workshops to extend competitive integrated employment opportunities to people in segregated settings or paid subminimum wages (U.S. Department of Labor Office of Disability Employment Policy, n.d.-d).

Competitive integrated employment is also promoted by the Home and Community Based Services (HCBS) Final Rule (the “settings rule”), which passed in 2014 with compliance deadline extended to 2023 (Lynch, 2020). The settings rule promotes competitive integrated employment by requiring that such settings be integrated into the greater community and that the settings include opportunities for people with disabilities supported by HCBS to seek and engage in competitive integrated employment (Home and Community-Based Setting, n.d.). By requiring that people supported by HCBS have a choice of service providers, the settings rule also effectively creates more choice in supports, including decoupling the choice of work supports

from who provides other supports. Empirically, HCBS investment is related to employment of people with disabilities: state-by-state, greater allocation of long-term services and supports expenditures to HCBS is powerful predictor of employment among people with disabilities (Bixby, 2025).

5 Competitive integrated employment is also related to the Achieving a Better Life Experience Act (ABLE Act), which Congress passed in 2014 in Division B of Public Law 113-295 (Public Law 113-295, 2014), with the Internal Revenue Service (IRS) releasing final regulations in 2020 (Guidance Under Section 529A: Qualified ABLE Programs, 2020). Under the ABLE Act, people with disabilities can establish tax-advantaged savings accounts (“ABLE
10 accounts”) without jeopardizing access to public benefits. The ABLE Act promotes competitive integrated employment because workers can save more without jeopardizing access to means-tested public benefits like SSI and Medicaid (ABLE National Resource Center, 2025).

In addition, in 2022 the U.S. Department of Education’s Rehabilitation Services Administration (RSA) awarded five-year grants for the federal fiscal year 2022 Disability
15 Innovation Fund demonstration project to provide 14 state vocational rehabilitation agencies with funding to implement Subminimum Wage to Competitive Integrated Employment (SWTCIE) Innovative Model Demonstration projects, informed by a systematic review of the evidence base (U.S. Department of Education, 2022).

Indirect and direct federal contractors have also been required not to pay subminimum
20 wage. The AbilityOne Program, operated by an independent federal agency, is a large source of employment for people who are blind or who have significant disabilities (U.S. AbilityOne Commission, 2025a). More than 420 nonprofits employ people through the program (U.S. AbilityOne Commission, 2025b). In 2022 the AbilityOne Commission issued a rule prohibiting

payment of subminimum wages under 14(c) through the AbilityOne Program (Prohibition on the Payment of Subminimum Wages Under 14(c) Certificates, 2022). In addition, by executive order, federal agencies have been directed since 2014 to contract only with entities paying at least minimum wage (Executive Order 13658, 2014). While a subsequent executive order raising that minimum wage for people employed by federal contractors (Executive Order 14026, 2021) has been rescinded (Executive Order 14236, 2025), the 2014 executive order remains in effect.

The overwhelming long-term trend, nationally and in every state, for employment ratio to increase while sheltered workshops decrease suggests that these extensive coordinated policy efforts and initiatives to promote competitive integrated employment have been effective over the long haul.

4.2 *Post-pandemic Employment Increase*

As encouraging as the long-term trend is in employment ratio for people with cognitive disabilities, it accelerated dramatically post-pandemic. In the 7-year span from 2012 to 2019, employment ratio for people with a cognitive disability increased by a factor of 1.25 (equivalent to 3.3% per year compounded over those 7 years). In the 4-year span from 2019 to 2023, the employment ratio increased by a factor of 1.32 (equivalent to 7.2% per year compounded over those 4 years). In other words, post-pandemic the employment ratio for people with a cognitive disability increased at *more than double the rate* that it increased pre-pandemic.

This finding contrasts with historic trends where this population experiences a slower recovery following economic downturns. The swift and substantial improvement in the employment ratio for people with any disability—and especially for people with a cognitive disability—suggests that the dynamics of the post-pandemic labor market may have created unique opportunities for competitive integrated employment. The increased availability of

telework opportunities during the pandemic may have reduced some traditional barriers to employment for people with disabilities, offering more flexible and accessible work arrangements. This finding validates previous calls from the National Institute for Disability and Rehabilitation Research to identify effective strategies for enhancing employment opportunities through telecommuting—calls dating back to 2013, long before the pandemic. During the pandemic, the World Health Organization endorsed flexible working arrangements allowing people with disabilities to telework (World Health Organization, 2020). Practice followed policy recommendations: Prevalence of telework in the U.S. tripled during the pandemic (Government Accountability Office, 2023b). There was a positive link to employment of people with a disability, as gains in overall disability employment post-pandemic have been concentrated in teleworkable, essential, and non-frontline occupations (Ne’eman & Maestas, 2023). The link to employment of people with a cognitive disability was even stronger, as workers with cognitive disabilities were especially likely to telework during the pandemic (Ameri et al., 2023).

Accommodations (which can include telework but need not be limited to telework) also increased during the pandemic, especially for people with cognitive disabilities. In 2021, 19% of employees with cognitive disabilities enjoyed a full or partial fulfillment of an accommodation request. This was the highest rate among any of the six ACS disability categories that year and represented more than a doubling of the rate that employees with cognitive disabilities experienced nine years earlier (Kruse et al., 2024).

4.3 Employer Practice

The public sector is not alone in promoting employment of people with disabilities. Shortly before the pandemic, the Society for Human Resource Management (2019) issued a research report on employment of people with disabilities with a number of findings and

recommendations. Among the findings was that 60% of surveyed HR professionals, 49% of employees, and 40% of managers felt at least moderately comfortable working with colleague with intellectual disabilities (rates that were higher than for colleagues with physical disabilities but lower than for colleagues with mental health disabilities). But the survey also found

5 significant barriers rooted in attitudes and in concerns about costs of accommodations. Informed by the report, the society launched an Employing Abilities @Work Certificate as the pandemic was hitting (Society for Human Resource Management, n.d.). The certificate is just one part of a broader initiative promoting recruitment, hiring, and retention of people with disabilities that has persisted into the post-pandemic era (Society for Human Resource Management, 2025). A recent

10 analysis of longitudinal employer survey data (Houston & Kruse, 2025) indicates that (1) accessibility practices are associated with increased employment through both increased hiring and decreased exits, (2) self-identification encouragement practices and promotion of disability initiatives are associated with increased employment of people with disabilities specifically through increased hiring, and (3) disability training and education and accommodation practices

15 are associated with increased employment through decreased exits.

4.4 *Tightening Labor Market*

The data in Fig. 1B show the employment ratio for people with cognitive disability increasing through a long period when Fig. 1A shows the employment rate for people with no disability was also increasing (with the exception of the transient pandemic shock). This is

20 consistent with the interpretation that the tightening labor market is driving improved employment outcomes among people with cognitive disabilities. However, note that an analysis of Current Population Survey data indicated that, among people with disabilities overall, the employment ratio was essentially constant at 0.42 when employment cratered from February 2020 to April 2020 (Houtenville et al., 2021). This suggests that employment of people with

disabilities may no longer be as pro-cyclic as it was years earlier (see also Ne’eman & Maestas, 2023). This further suggests that there may be genuine change in policy, culture, and practice promoting employment of people with disabilities. It is an open question, however, whether this conclusion applies as well to people with a cognitive disability.

5 4.5 *State-by-State Patterns*

Viewed across almost a decade, every state exhibited an increased employment ratio for people with cognitive disabilities—even including Maine, where employment for people with cognitive disabilities had not initially increased immediately after Maine closed its last sheltered workshop in 2010 (Phoenix & Bysshe, 2015). In addition, no state increased subminimum wage jobs over the long-term. By far the biggest co-variation state-by-state (correlation -0.90 in Fig. 3 between subminimum wage intercept and subminimum wage slope) is that states with the most subminimum wage jobs per capita saw the largest per-capita decrease in such jobs.

The long-term decline in the number of people paid subminimum wage occurred even in states that saw recent increases in number of people paid subminimum wage. For example, in Missouri the number of people per 100k population paid subminimum wages in 14(c) CRP programs fell from about 130 in 2015 down to about 25 in 2021 before rebounding and then plateauing around 55. Similar patterns occurred in Arkansas (about 110 in 2015, down to about 20, rebounding to about 50), Kansas (about 110 in 2015, down to below 10, rebounding to about 25), Ohio (about 140 in 2015, down to below 10, rebounding to about 25), Pennsylvania (about 95 in 2015, down to about 20, rebounding to about 30), and Indiana (about 80 in 2015, down to about 10, rebounding to about 15). There was a modest tendency, however, for employment ratio to rise more steeply in states where subminimum wage employment fell less (the 0.28 correlation between slopes in Fig. 3)—but employment ratio nevertheless improved in every state.

4.6 Recommendations

It seems likely that the post-pandemic labor market may have created significant opportunities for competitive integrated employment of all people with disabilities, especially for people with cognitive disabilities. As labor market conditions shift, it will be important to consolidate these gains and use successful work placement settings as a model for future initiatives to promote competitive integrated employment. The following recommendations are supported:

- RSA and the SWTCIE model demonstration projects should consider engaging in a mid-point review to ensure they are taking advantage of the opportunities provided by the post-pandemic rise in employment ratio for people with cognitive disabilities.
- Research funders such as NIDILRR should encourage proposals that identify post-pandemic hires of people with disabilities—especially people with cognitive disabilities—to identify successful practices that can be sustained regardless of future changes in the labor market. For example, to what extent can the post-pandemic rise in employment ratio be attributed to factors beyond telework?
- NIDILRR should also encourage proposals that propose to grow the evidence base on the extent to which telework options and accommodations could benefit specifically people who might otherwise be employed in sheltered workshops.
- ODEP’s Campaign for Disability Employment should promote the promising practices identified as being responsible for the dramatic post-pandemic improvement in employment ratio. Taking advantage of these opportunities is

especially important to ensure that transition to competitive integrated employment is successful.

4.7 *Limitations*

Assessing the presence of a disability solely through the six “disability type” questions in the American Community Survey may fail to identify some people with a disability when they are enrolled in income support programs like Social Security Disability Insurance (SSDI) or Supplemental Security Income (SSI) (Burkhauser et al., 2014), thus biasing upward the estimates of employment rate for people with disabilities reported in this paper and biasing upward the employment ratios reported in this paper. While this paper may thus overestimate employment ratio, however, such bias would be unlikely to change systematically over time in a way to affect the trends reported in the present paper. The result about the historic increase in employment ratio is thus likely to be robust, even if the result about the absolute level of employment by people with a disability may be optimistic.

Another limitation is that, although this paper documents changes in employment ratio and in subminimum wage prevalence, it does not follow trajectories of individual people currently or previously paid subminimum wage.

In addition, this study considers variation among states but does not analyze differences within states, such as urban versus rural contexts. Including such analyses in future work could clarify whether the association between sheltered workshops and employment might differ by local labor market.

4.8 *Conclusion*

While there remains a large employment gap for persons with any disability, the gap has narrowed over the long term and especially post-pandemic. Improvements over both of these

timeframes are even more pronounced for people with a cognitive disability. Research to inform public policy and hiring and retention practices by all employers should take advantage of this.

The long range plan of the National Institute on Disability, Independent Living, and

Rehabilitation Research continues a focus on building the evidence base for employers to

5 successfully hire, retain, and promote people with disabilities (National Institute on Disability, Independent Living, and Rehabilitation Research, 2024). Research and other investments should identify post-pandemic hires of people with disabilities—especially people with cognitive disabilities—to identify successful practices that can be sustained regardless of future changes in the labor market, potentially going beyond telework, but also including the extent to which

10 telework could benefit people who might otherwise be in sheltered workshops, and there should be a marketing investment to promote those practices.

Data sharing

All code and data (including code to access data from Census API) are available at <https://github.com/acobolew/disability-employment>

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Conflict of interest

The author declares that he has no conflict of interest.

Ethics statement

10 This was an analysis of publicly available aggregate data that did not involve the collection or analysis of human subjects data as defined in Federal Policy for the Protection of Human Subjects (“Common Rule”), so ethical approval from an Institutional Review Board was not needed.

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Informed consent

20 This was an analysis of publicly available aggregate data that did not involve the collection or analysis of human subjects data as defined in Federal Policy for the Protection of Human Subjects (“Common Rule”), so informed consent was not needed.

Diversity, equity, ethics, and inclusion

The author is the parent of two adults, one of whom has an intellectual/developmental disability.

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Table 1

Number of Noninstitutionalized Working-age Persons in PUMS Sample (Total and by Disability Status).

Year	Total	No Disability	Has Disability	No Cognitive	Has Cognitive
				Disability	Disability
2023	1,946,501	1,719,045	227,456	1,835,737	110,764
2022	1,940,959	1,715,895	225,064	1,833,427	107,532
2021	1,878,823	1,667,859	210,964	1,782,168	96,655
2019	1,895,667	1,691,049	204,618	1,804,468	91,199
2018	1,897,181	1,693,890	203,291	1,809,325	87,856
2017	1,891,167	1,685,174	205,993	1,802,802	88,365
2016	1,878,698	1,668,855	209,843	1,789,858	88,840
2015	1,884,038	1,674,764	209,274	1,795,293	88,745
2014	1,880,566	1,669,009	211,557	1,791,506	89,060
2013	1,891,325	1,680,211	211,114	1,804,102	87,223
2012	1,877,392	1,671,764	205,628	1,790,490	86,902
2011	1,882,313	1,672,070	210,243	1,793,894	88,419
2010	1,869,759	1,676,528	193,231	1,792,096	77,663

Table 2

Sex, Age, and Ethnic Characteristics of Working-Age Noninstitutionalized Population, by Year and Disability Status.

	% Female				% Younger Than 35				% Hispanic or Latino	
	With Disability	No Disability	With Cog Disability	No Cog Disability	With Disability	No Disability	With Cog Disability	No Cog Disability	With Disability	No Disability
Year	Disability	Disability	Disability	Disability	Disability	Disability	Disability	Disability	Disability	Disability
2023	51%	50%	50%	51%	29%	38%	40%	37%	24%	27%
2022	51%	50%	50%	50%	28%	39%	40%	37%	24%	27%
2021	51%	51%	50%	51%	26%	38%	38%	37%	23%	26%
2019	50%	51%	49%	51%	24%	39%	35%	38%	20%	25%
2018	51%	51%	49%	51%	23%	39%	34%	38%	20%	25%
2017	50%	51%	49%	51%	23%	39%	34%	38%	20%	24%
2016	50%	51%	49%	51%	22%	39%	33%	38%	20%	24%
2015	50%	51%	49%	51%	22%	39%	31%	38%	19%	23%
2014	50%	51%	49%	51%	21%	39%	31%	38%	19%	23%

2013	50%	51%	49%	51%	21%	39%	31%	37%	19%	22%
2012	50%	51%	49%	51%	21%	39%	30%	37%	19%	22%
2011	50%	51%	49%	51%	20%	39%	30%	37%	18%	22%
2010	50%	51%	49%	51%	20%	38%	28%	37%	18%	21%

Table 3

Racial Characteristics of Working-Age Noninstitutionalized Population, by Year and Disability Status.

		% American Indian or Alaska Native								% Native Hawaiian or Other Pacific Islander Alone						% Some Other Race Alone		% Two or More Races	
		% White Alone		% Black Alone		Alone		% Asian Alone		Islander Alone		Race Alone		Races					
Year		With	No	With	No	With	No	With	No	With	No	With	No	With	No				
		Disab	Disab	Disab	Disab	Disab	Disab	Disab	Disab	Disab	Disab	Disab	Disab	Disab	Disab	Disab			
2023		61%	59%	15%	12%	1%	1%	3%	7%	0%	0%	7%	8%	12%	12%				
2022		61%	60%	16%	12%	1%	1%	3%	7%	0%	0%	7%	8%	12%	12%				
2021		62%	60%	15%	12%	1%	1%	3%	7%	0%	0%	6%	8%	12%	12%				
2019		72%	71%	17%	13%	1%	1%	3%	7%	0%	0%	4%	5%	3%	3%				
2018		72%	72%	16%	12%	1%	1%	3%	7%	0%	0%	4%	5%	3%	3%				

2017	72%	72%	16%	12%	1%	1%	3%	7%	0%	0%	4%	5%	3%	3%
2016	73%	72%	16%	12%	1%	1%	3%	6%	0%	0%	4%	5%	3%	2%
2015	73%	73%	16%	12%	1%	1%	3%	6%	0%	0%	4%	5%	3%	2%
2014	73%	73%	16%	12%	1%	1%	2%	6%	0%	0%	4%	5%	3%	2%
2013	73%	74%	16%	12%	1%	1%	2%	6%	0%	0%	4%	5%	3%	2%
2012	73%	74%	17%	12%	1%	1%	2%	6%	0%	0%	4%	5%	3%	2%
2011	73%	74%	17%	12%	1%	1%	2%	6%	0%	0%	4%	5%	3%	2%
2010	74%	75%	16%	12%	1%	1%	2%	6%	0%	0%	4%	5%	3%	2%

Note: 0% indicates < 0.5%.

Table 4

Timing and Domain of Federal Initiatives Supporting Competitive Integrated Employment.

Initiative	Domain	Year
Supported Employment added to Rehabilitation Act	Labor	1986
Campaign for Disability Employment – First Public Service Announcement	Labor	2010
Employment First State Leadership Mentoring Program	Labor	2012
Employment First Community of Practice	Labor	2012
Workforce Innovation and Opportunity Act (WIOA)	Labor	2014
Home and Community Based Settings Final Rule Adopted	Health & Welfare	2014
ABLE Act	Tax	2014
Executive Order 13658 Prohibiting Subminimum Wage by Federal Contractors	Public Contracts	2014
Disability Employment Initiative	Labor	2016
National Expansion of Employment Opportunities Network (NEON)	Labor	2019
ABLE Act Final Regulations	Tax	2020
Subminimum Wage to Competitive Integrated Employment (SWTCIE) model demonstration programs funded by Disability Innovation Fund	Education	2022

AbilityOne Commission Rule Prohibiting Subminimum Wage	Public	2022
	Contracts	
Home and Community Based Settings Final Rule Compliance Deadline	Health &	2023
	Welfare	
Online CIE Transformation Hub	Labor	2024

Figure Captions

Fig. 1. National trends over time. (A) Employment rate by type of disability status (with each annual data point from American Community Survey analysis aligned with July 1). In 2020 (when employment cratered), the Census Bureau did not publish data on the variables feeding this panel because of low response rate to the American Community Survey. Error bars (calculated from ACS margin of error estimates) not visible because 95% confidence intervals are smaller than symbol size. **(B)** Employment ratio of people with any disability and people with cognitive disability relative to people with no disability. (By construction, people with no disability have an employment ratio of 1.) Error bars smaller than symbol size. **(C)** Number of workers in community rehabilitation programs paid minimum wage, starting from first date that data were posted online. Time sampling is monthly starting in April 2023, quarterly from October 2021 through April 2023, and increasingly irregular farther in the past depending on when Department of Labor posted data and when archive.org crawled the site. Curve is a “loess smoother” with 95% confidence region (to highlight the overall trend in the data). **(D)** Number of community rehabilitation programs, starting from first date that data were posted online, after which time sampling is as in (C). Overall trend highlighted with loess smoother as in (C).

Fig. 2. State-by-state trends for employment ratio for people with cognitive disabilities (referenced to left axis) and number of workers per 100k population paid subminimum wage in 14(c) Community Rehabilitation Program (referenced to right axis). Error bars show 95% confidence intervals. Curves show generalized additive model fits and 95% confidence regions.

Fig. 3. Scatterplot matrix showing patterns among states in linear regressions coefficients of CRP subminimum wage workers per 100k population and cognitive

disability employment ratio on year. In the lower triangle are scatterplots showing the shape and strength of the association among state-by-state regression parameters, and in the upper triangle are correlation coefficients showing the strength of those associations. Principal diagonals show estimated univariate probability densities for the regression coefficients.

- 5 Underlying data are from 2015 through 2023 (with ACS employment ratio missing for 2020), and year is centered on 2019 (the middle of the time interval). Linear regressions of 14(c) data inversely weighted by number of time samples per year so each year would be weighted equally.

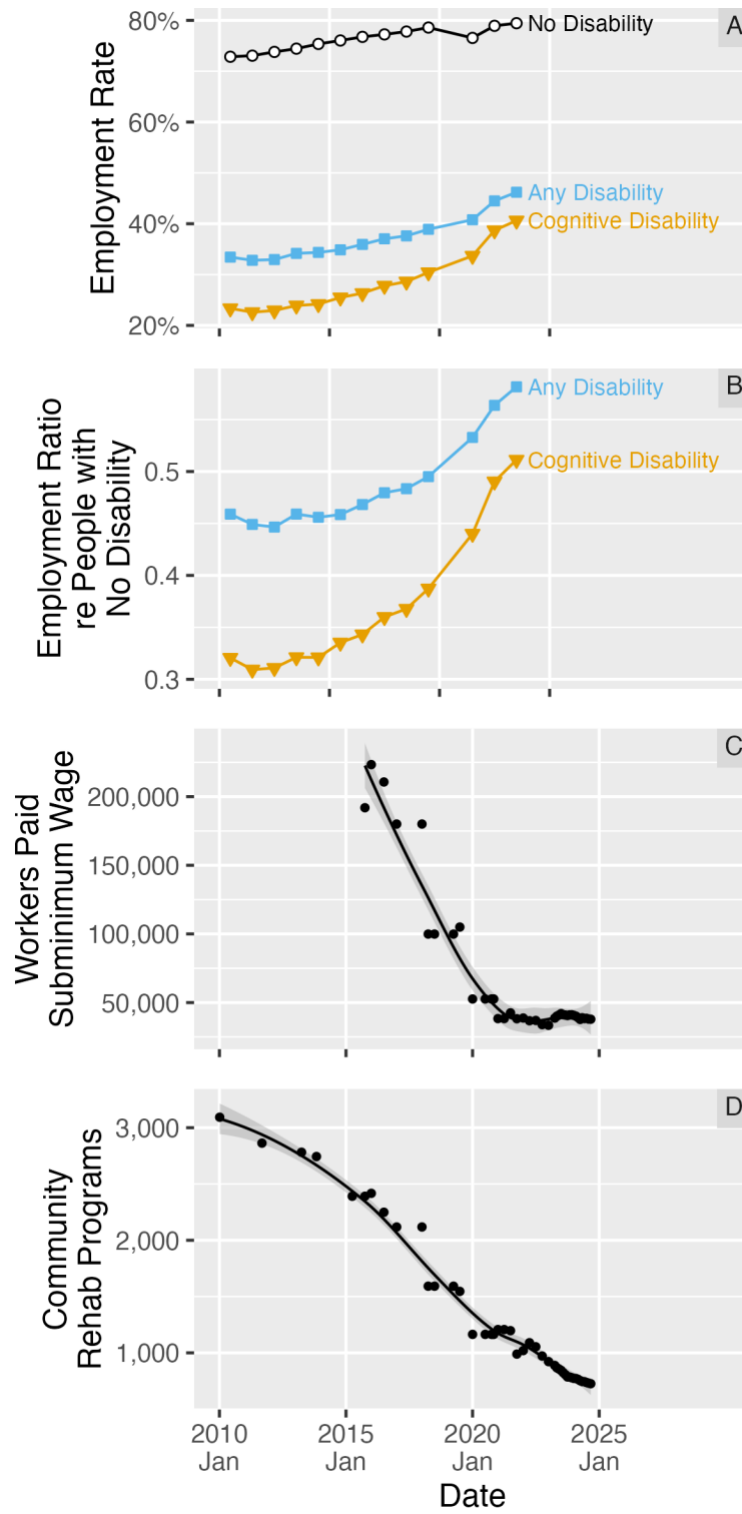
Figure 1

Figure 2

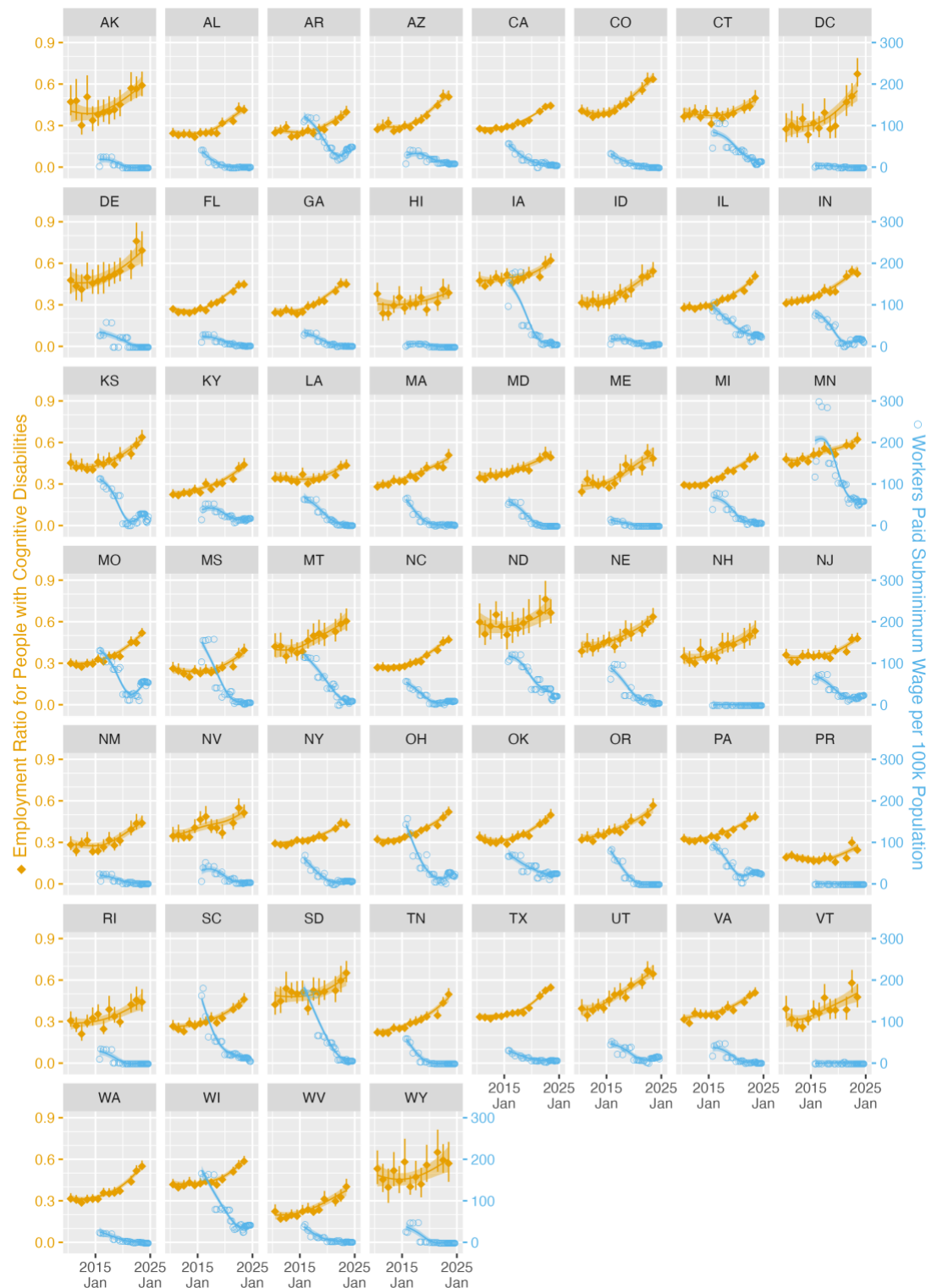


Figure 3

