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SCROLLING FOR JOBS: A LOOK AT ONLINE ACTIVITY IN REGIONAL LABOR MARKETS

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ABOUT HEARTLAND FORWARD

Heartland Forward's mission is to improve economic performance in the center of the United States by advocating for fact-based solutions to foster job creation, knowledge-based and inclusive growth and improved health outcomes. We conduct independent, data-driven research to facilitate action-oriented discussion and impactful policy recommendations.

The views expressed in this report are solely those of Heartland Forward.

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EXECUTIVE SUMMARY

Changes in technology and communications over the past 20 years have transformed labor markets around the world and made online job searches the norm for most firms and workers in the US. Just look at the growth of LinkedIn, an American business and employment-oriented online service. More than 25% of US adults are LinkedIn users today, according to Pew Research Center. It is a social media platform available in 200 countries, and LinkedIn states that "100 million job applications" are sent each month. Thus, scrolling on-line for a job has become almost expected.

Whether the labor shortage existed prior to COVID-19 or not, many employers have been beefing up their recruiting efforts amidst the "great resignation." While the answer is not crystal clear on how to close the gap, there are some trends business leaders and policymakers can consider for potential employees who are looking for jobs online.

This report looks at the rates of job ads and resumes that were posted online for 74 career paths in 98 regions of the U.S. from July 2020 to June 2021 – one full year and during the height of the COVID-19 pandemic. Occupational and geographic patterns that emerged in these job search activities were analyzed and we used additional state-level data to determine, ultimately, which features of state labor markets are most closely associated with the measures of online job search activity.

The patterns and characteristics identified in the data can help business leaders and policymakers more accurately assess their labor markets and make decisions likely to foster economic growth. Four primary conclusions were made:

1. **When predicting online job search activity in a region, occupation matters more than location.** Generally speaking, accountants in Mississippi post resumes like California accountants post resumes, and Mississippi teachers post resumes like teachers in California. The differences in rates at which job ads and resumes are posted online across occupations provides some clues about how well regional labor markets are working and which occupations may benefit from additional tools to facilitate job searches.

2. **Online postings of resumes and job ads varies by location.** Other regional differences in posting rates emerge after adjusting for the regional occupations and their online job search patterns Metro regions generally have more online job search activity than non-metro areas, but the difference is greater for resume postings than job ads. The differences in the rates at which job ads and resumes are posted provides insights into where labor markets may be out of balance – in other words, where they have more applicants than job openings, or vice versa.

3. **Not surprisingly, internet access influences how much online job search activity takes place.** States with more internet infrastructure have higher rates of online job ads, but interestingly, more resume posts show up in states where more people face challenges accessing high speed internet at home.

4. **Public health issues and policies during the pandemic also shaped online job search activities:**

   - States where cities, employers, schools, and other local institutions were free to determine the mask or vaccine policies for themselves had higher rates of job ads posted.
   - There's also a connection between vaccination statistics and online job searches. States with higher vaccination rates have higher rates of posted job ads, but states with higher vaccine utilization rates (the number of doses delivered to a state compared to the number administered) have lower rates of online resume postings. While we cannot establish a direct link with the data used in this analysis, we suspect the link between vaccinations and labor markets comes through trust in institutions. The Pew Research Center[1,2] has documented differences in institutional trust which would likely influence the perceived costs/benefits of the vaccines as well as a willingness to engage in labor markets during a pandemic.

INTRODUCTION

Recent supply chain challenges, largely attributed to labor shortages despite rising wages, have been a reminder of the importance of labor markets. Labor is a huge component of the many goods and services we rely on and earnings from labor provides necessary income for households. We have an unprecedented number of open positions, yet many potential workers remain on the sidelines.as labor force participation among 20- to 54-year-olds fell consistently from 2000 – 2015 and is still below pre-pandemic levels.[3]

Like practically all markets, labor markets have been revolutionized by the internet and the accompanying telecommunications innovations. The better we understand online job markets, the better equipped we are to help people find jobs and businesses find employees successfully. We can help people train for and secure stable employment in their chosen field, and we can help firms identify and employ the labor they need to produce their products efficiently and consistently.

The era of checking job postings on corkboards at the library, selecting just the right paper for printing resumes and taking stacks of applications and resumes to the post office has long been over. Job openings now can be identified, applied to, and interviewed for from the familiar environment of a personal laptop, home desk and even our smart devices.

While personal and professional networks still matter and not all jobs are filled through formal job applications, the process of finding a job almost always involves an online platform of one type or another –a company website that takes information on applicants digitally or a broader employment network, like LinkedIn, that offers information on the jobs available at employers across several industry sectors and regions. The lower opportunity cost of finding and pursuing jobs allows job seekers to apply for more positions, giving employers a wider range of candidates to consider and leading to better matches of people with skills and jobs in the labor market. These better matches should boost productivity and benefit everyone. But the lower cost of applying for jobs and the more beneficial matches might disproportionately benefit those with computers connected to the internet (rather than a smartphone or tablet) and the skills to manage the intricacies of an expanded online job search process, further magnifying our growing income inequality. Job application sites designed to work well on mobile devices and tech skills training targeting job search may be important factors to watch.

While the recent pandemic forced many hesitant technology adopters to get online to continue doing their jobs as they moved from the office to the Zoom screen, or to sign up for unemployment benefits and apply for new jobs, some people do not have the necessary skills to do so effectively. The persistent digital divide suggests all potential workers do not have the same access to tools needed to navigate an online job search, learn about new jobs and companies, and apply for openings – making accessibility and adoptability critical.

There are also other labor market implications of online job applications. If job seekers apply to more jobs because of the lower application costs, firms then have more applications to evaluate for each position. Even with enhanced digital tools, this can increase the complexity of the job search for employees and employers, offsetting some of the cost savings and leading to less effective labor market matches. The problem may be exacerbated if some workers are implicitly excluded by AI technologies that screen applicants by looking for specific terms on a resume or criteria that have been identified by an imperfect algorithm.[4,5]

Though it was rapidly accelerated by the recent pandemic and corresponding operational changes, the transition to online job searches has been in motion for a couple of decades and the implications of it have already been widely explored and measured. By the mid-1990s, platforms such as Monster and

Career Builder, that aggregate job ads from multiple local newspapers, made online searches valuable components of a job search.[6] By 1998 most HR professionals reported using the internet for recruiting.[7] The Census Bureau deployed the first Computer and Internet Use supplement to the Current Population Survey in 1998, and Pew began including online job search activity in surveys in 2000.[8] By the turn of the 21st century, when internet was still a capitalized, proper noun, articles advising HR recruiters on how to craft online recruiting strategies and academic research on the consequences of online job searches were already common. Employers and prospective employees quickly adapted their search strategies to include the online labor market tools.

The early research into the implications of internet job searches looked to validate the belief that low-cost applications and better information improved the matches between workers and open positions. The results found that job seekers were using more methods to find jobs and seeking more information about each job before applying. The research also found that job seekers applied to fewer jobs, rather than more. While the length of unemployment was not necessarily shortened for workers between jobs, more people were moving directly from one job to the next with fewer people experiencing periods of unemployment.[9] Also, not surprisingly, unemployed people with internet access were more likely to keep searching rather than dropping out of the labor market.[10]

Over time, online job searching has evolved to include networks such as social media platforms (LinkedIn and Facebook, for example) that were not created specifically for job searches. Workers of all ages are spending more time online in job searches.[11] Job seekers are using social media to identify open jobs and research companies. Organizations, meanwhile, are using social media to publicize job openings and to connect with job seekers,[12] although there have also been some rather notorious cases involving HR managers who used social media profiles to gather information job applicants never intended to share with potential employers.[13,14]

While job seekers find online tools to be valuable, the results on how well they work to effectively find a new job are mixed. In a Pew survey from 2015, 79% of job seekers used online resources for information, with 34% saying the internet was the most important resource used in their search.[15] Job seekers with higher education levels use different strategies and are more likely to get callbacks from online job applications.[16]

Low wage workers say they find internet resources valuable but statistics show using the internet does not necessarily increase their chances of employment.[17] Researchers in the U.K. have shown that offering job seekers information about openings for similar occupations increases the breadth of jobs they apply for and number of interviews with employers.[18] Research using National Longitudinal Survey of Youth data from the U.S. found young job seekers using the internet were able to start new jobs more quickly.[19]

ADVANCING THE RESEARCH

This report adds to what is already known about online job searches by considering occupational and regional differences in smaller labor markets in the US. We consider online resume postings, which represent the supply of labor, and ads for job openings posted by employers, which represent the demand in three stages:

- **Stage 1:** identifies the differences in online labor market activity by occupation and location.
- **Stage 2:** acknowledges the role of occupational differences and measures variation across locations after adjusting for the combination of occupations in the region.
- **Stage 3:** takes the regional variation measured in stage 2 and compares it to other attributes or policies in a state to identify attributes most closely aligned with online labor market activity. The state level attributes that align with online labor markets provide clues as to which policies are likely to influence the operational efficiency of online labor markets.

While economist may refer to the labor market as if there is one big national market for all labor, the reality is that there are hundreds of smaller labor markets- one for each specific type of labor, many of which require specific training, credentials, skills or experience. Any given job seeker is only qualified for employment in a small number of the current jobs available, and only wishes to be considered for an even smaller percentage of current openings. The mismatch between the skills and credentials held by currently unemployed workers and the skills and credentials needed for the currently available positions is the impetus for hundreds of job training programs, which are, in essence, allowing workers to move from one labor market to another.

Our interest is also in regional labor markets, rather than national, because few people cast a national net when looking for their next job. Individual counties are frequently too small for reliable employment measures and considering only metropolitan statistical areas (MSAs) excludes smaller labor markets where firms and workers may be affected differently than in the metros.

To create a set of fully inclusive regions larger than counties but smaller than states, each state is divided into two regions: metro and non-metro. The metro region consists of the counties the Office of Management and Budget (OMB) labels as part of a metropolitan statistical area. All other counties are combined to form the non-metro region. Non-metro areas include micropolitan (i.e., cities with population between 10,000 and 50,000) and more rural areas of the state.[20]

Online labor market activity in each region is measured as the number of resume and job postings provided by JobsEQ Resume Forensics and Real Time Intelligence modules for the 12-month period from July 1, 2020 – June 30, 2021.[21] The postings are categorized into 986 occupations, although no region has all occupations represented within the year. The US Bureau of Labor Statistics classifies occupations into 16 career clusters and 74 career pathways. To make analysis more manageable, the 986 occupations are grouped into the 74 career pathways, referred to simply as occupations. By looking at 74 individual occupations in 98 regional markets, the US has 7,252 smaller labor markets to consider.

STAGE 1: COMPARING ALL LABOR MARKETS TO THE NATIONAL AVERAGE

Are plumbers in rural Kentucky, accountants in urban Illinois, teachers in rural Arizona, and medical professionals in urban Oregon equally likely to post their resume online? Probably not. And are their employers equally likely to post an online ad when they need to fill an opening? Also, unlikely.

The first step in determining how occupations and regions differ from the national average is to determine rates at which resumes and job ads are posted online nationally. We do this by taking the number of resumes and dividing by the number of workers who live in the US. The resume posting rate is 0.135, meaning 13.5% of US workers had their resume posted online during the year. The job ad rate is calculated similarly, by dividing the number of online job ads by the number of jobs in the US, to get 0.237, meaning, on average, 23.7% of all jobs were posted at some point in the year. Readers interested in the technical details of the calculations in Stage 1 should see Technical Appendix I. We calculate the same posting rate for resumes and job ads for each occupation in every region and compare them to the national average and look for patterns.

When all regions and occupations are compared to the national average, it is clear that occupation has more influence on posting rates than location. This means plumbers in Kentucky post resumes at rates more similar to plumbers in Arizona, Illinois, and Oregon and less similar to accountants, teachers and medical professionals in Kentucky. It also means schools in Illinois post jobs at rates very much like schools nationwide and less like construction companies, hospitals and accounting firms in Illinois.
This is not a surprise. Some occupations, such as administrative assistants or anyone who uses a computer at work, require skills that are very similar to those needed to post a resume online. Also, some occupation-specific labor markets are geographically concentrated while others are more spread out.

Teachers may have ample opportunity to switch jobs locally and know exactly which potential employers they should check with for current openings while human resource or sales professionals may get more benefit from posting resumes online to see what opportunities they uncover through personal networks. And for some occupations, a shortage of trained workers causes firms to cast a wider net to find labor, as we saw with nurses in the recent pandemic.

We calculate the average posting rate relative to the national average for each occupation across all regions and express it as a percentage. In the table below, health informatics, a growing field that uses information technology to analyze health records, has a resume posting rate of 5.00. That means this occupation has 500% of, or five times as many, resumes as the national average. And the ratio of 0.02 for consumer services jobs (i.e., a wide variety of jobs that help people with decisions and problems such as tire service technicians, tax preparers, customer service representatives, and credit counselors) indicates there are only 2% of the expected job postings for that occupation.

The occupations with the highest and lowest rates of resumes and job ads are shown in the tables below.

MOST POSTED RESUMES	
Health Informatics	5.00
Marketing Communication & Promotions	3.31
Financial & Investment Planning	2.52
Information Support Services	2.51
Management & Entrepreneurship	2.41
Health Support Services	2.10
Family & Community Services	2.06
Interactive Media	1.87
Network Systems	1.58
Biotech R & D	1.54

LEAST POSTED RESUMES	
Agribusiness Systems	0.08
Consumer Services	0.28
Design/Pre-Construction	0.40
Law Enforcement	0.42
Construction	0.43
Quality Assurance	0.46
Management	0.47
Legislators | Govt Executives | Staff	0.47
Teaching/Training	0.50
Facility & Mobile Eqpt Maintenance	0.53

MOST ADVERTISED RESUMES	
Health Informatics	3.59
Information Support Services	3.55
Health Support Services	3.20
Financial & Investment Planning	3.14
Diagnostic Services	2.68
Network Systems	2.57
Marketing Communication & Promotions	2.54
Management & Entrepreneurship	2.00
Counseling & Mental Health	2.00
Biotech R & D	1.95

LEAST ADVERTISED RESUMES	
Consumer Services	0.02
Agribusiness Systems	0.05
Performing Arts	0.21
Management	0.32
Correction Services	0.36
Construction	0.37
Quality Assurance	0.39
Printing Tech	0.40
Visual Arts	0.41
Pub Mgmt & Admin	0.42

A quick glance at the lists of highest and lowest posting rates reveals considerable overlap between resumes and job ads. Eight of the 10 occupations on the most posted resumes list also are in the top 10 of most advertised jobs. And five occupations show up among the least posted resumes and the least advertised jobs. This indicates some occupational labor markets exhibit a high (or low) propensity to use the internet when looking for their next job or their next employee.

Labor markets with high rates of resumes and job postings online may rely less on word of mouth and more on responses to formal job ad processes. It may also reflect occupations where people tend to switch jobs frequently, leading to more searches for workers to find their new position and employers to fill recently vacated positions. They could also reflect geographically larger labor markets where people are more likely to move from one location to another when switching positions.

We identified the occupations with the highest and lowest propensities for online job searching by considering the combined rankings for online resume postings and online job ads. These are the occupations with the highest propensity for online employment activity.

HIGHEST PROPENSITY TO LOOK ONLINE	RESUME	JOB AD
Health Informatics	5.00	3.59
Information Support Services	2.51	3.55
Financial & Investment Planning	2.52	3.14
Health Support Services	2.10	3.20
Marketing Communication & Promotions	3.31	2.54
Management & Entrepreneurship	2.41	2.00
Network Systems	1.58	2.57
Biotech R & D	1.54	1.95
Family & Community Services	2.06	1.87
Interactive Media	1.87	1.77

The occupations with less than expected online labor market search activity (shown below) may rely on fewer formal mechanisms, like local word of mouth, to spread the word about openings. Positions also could be filled in a system that is not as market oriented, such as legislators and their staff members, teaching/ training and Law Enforcement are highly formalized labor markets. Positions must be posted in known forums before they are filled and only candidates who complete the official application process can be considered. Posting a resume in a public forum is not likely to be effective in those types of markets. They may also be markets where turnover is low and new positions are filled infrequently.

LOWEST PROPENSITY TO LOOK ONLINE	RESUME	JOB AD
Agribusiness Systems	0.08	0.05
Consumer Services	0.28	0.02
Construction	0.43	0.37
Management	0.47	0.32
Quality Assurance	0.46	0.39
Law Enforcement	0.42	0.49
Printing Tech	0.57	0.40
Design/ Pre-Construction	0.40	0.58
Legislators| Govt Executives | Staff	0.47	0.56
Teaching/Training	0.50	0.54

There are also some occupational labor markets where workers are highly likely to post resumes online but there are few job ads posted. And there are others where workers are less likely to post resumes but there appears to be an abundance of job ads. These may suggest labor markets with a surplus or shortage of labor, respectively.

These occupations are identified by taking the difference in rankings of the resume posting rate and job posting rate. Here are the top 10 occupations with the largest disparities in resume and job postings ranks that are ranked higher for resume posting rates (meaning more workers than jobs):

MORE RESUMES | FEWER JOBS	RESUME RANK	JOB AD RANK
Travel & Tourism	15	62
Journalism & Broadcasting	11	51
Visual Arts	27	66
Performing Arts	40	72
Correction Services	45	70
Food Products and Processing	23	42
Manufacturing Production	25	44
Logistics, Planning & Mgmt Svcs	17	35
Govt Revenue and Tax	24	40
Pub Mgmt & Admin	49	65

The top four occupations on this list reflect, at least partially, the economic consequences of the pandemic where travel and live performances were curtailed.

Some labor markets are potentially "out of balance" in the other direction. The 10 occupations with the largest disparities in job ads and resume rates with job ads being proportionally higher (meaning more available jobs than applicants):

MORE JOBS | FEWER RESUMES	RESUME RANK	JOB AD RANK
Programming & Software Dev	56	11
Buying & Merchandising	54	17
Transportation Operations	58	21
Facility & Mobile Eqpt Maintenance	65	37
Environmental Service Systems	60	33
Therapeutic Services	38	12
Diagnostic Services	26	5
Design/ Pre-Construction	72	52
Banking and Related Services	53	36
Telecommunications	33	18

Job seekers with these skills are likely to find ads to apply to without posting a resume to look for opportunities and they may represent good options for people seeking to switch into new labor markets. But of course, these occupational differences are national averages, and we also want to explore regional variation in online labor markets.

Now that we have explored occupational differences in online labor market activity, we turn our attention to regional differences.

STAGE 2: REGIONAL DIFFERENCES IN ONLINE JOB SEARCH ACTIVITY

People are free to move and work anywhere in the US, but they generally have preferences that influence the geographic area where they look for jobs. They look for jobs that allow them to stay near family, where housing is affordable and public schools are good, where they have steady employment prospects and will not have to move frequently, and jobs near cultural or recreational amenities they most enjoy.

These preferences, when combined with differences in natural resources and infrastructure built by previous generations, result in regional labor markets that pay different wages, have different combinations of occupations (or occupational mix), and offer different paths for income mobility.

While differences in regional labor markets that lead to each region's unique occupational mix are interesting and relevant research topics, considering all of them is well beyond the scope of this study. Here we assume the occupational mix is a unique feature of the region and predict the expected rate of online labor market activity. We predict the expected rate for each region by using the occupational differences estimated in Stage 1 and applying them to the local occupational mix.

This prevents Washington DC from appearing to be an outlier just because it has an unusually high rate of legislative staffers and government executives in its occupational mix. The same holds true for growing regions with many construction workers and busy ports with lots of transportation workers. The 98 region measures are fitted into a model that estimates the online labor market activity for each state and the difference between the metro and non-metro region of a state.[22,23] As expected, there is a significant difference in the posting rates for metro and non-metro regions, but the difference is much larger for resumes than for job ads. (See Technical Appendix II for a detailed description of data and calculations in Stage 2.)

EXTRA METRO POSTING RATES	
Resume posting	0.29
Job ads	0.05

Metro regions, on average, have 29% more resumes posted online than expected when compared to non-metro regions in the same state and when controlling for the size and composition of the labor force. Metro regions also have a higher rate of online job postings, but the difference is only 5% more than the non-metro region.

These results are not surprising. The differences between labor markets in metro and non-metro areas are numerous and drive much of the rural to urban migration within states. Metro residents switch jobs more often, which would explain the higher resume posting rate.[24] And people in a metro region may have a wider variety of available positions for which they are qualified. This would allow them to improve their employment situation without relocating, so a higher rate of resumes shared online is a logical result of the differences in labor market density.

The higher rate of online job ads in metro regions is also not surprising since workers switching jobs require firms to find replacement workers more frequently. The smaller difference between metro and non-metro job ads relative to resumes postings may reflect larger employers in metro regions that post one ad to fill multiple positions or run an ad continually when multiple people need to be hired for similar positions over several weeks or months. Since our dataset includes job ads with no information as to the number of people hired for the same position, this would make the difference between the metro and non-metro job ad rate estimated here to be lower than the actual difference in job posting rates.

In addition to the metro/ non-metro difference, our model estimates an average posting rate for each state. Again, the measure reported is a ratio that can be interpreted as a percentage. Georgia's rate of 1.23 indicates Georgia has 23% more resumes posted that we would expect given the occupational mix of Georgia's workforce.

These are the states with highest and lowest ratios of job ads and resumes posted online:

HIGHEST RESUME POST RATES	
District of Columbia	1.49
Georgia	1.23
Nevada	1.08
North Carolina	1.08
South Carolina	1.07
Delaware	1.06
Mississippi	1.06
Michigan	1.06
Connecticut	1.05
Louisiana	1.02

LOWEST RESUME POST RATES	
Hawaii	0.41
South Dakota	0.46
Montana	0.60
Alaska	0.61
Washington	0.63
Utah	0.64
Nebraska	0.65
Oregon	0.67
North Dakota	0.68
Minnesota	0.70

HIGHEST JOB AD RATES	
Vermont	1.51
New Hampshire	1.24
Delaware	1.20
Maine	1.19
Kansas	1.11
Idaho	1.09
Virginia	1.07
Michigan	1.06
Alaska	1.06
Iowa	1.05

LOWEST JOB AD RATES	
New York	0.61
California	0.67
Louisiana	0.72
Hawaii	0.76
Nevada	0.80
New Jersey	0.81
Florida	0.81
Mississippi	0.82
Alabama	0.84
Connecticut	0.86

Just as some careers have a higher propensity for online job search activity, some states also have higher levels of activity by both job seekers posting resumes and firms posting job ads. While the top 10 and bottom 10 do not match for resumes and job ads, some states are below average or above average on both measures.

Here are the five states with highest combined ranks of resume and job ad ratios:

HIGHEST PROPENSITY TO LOOK ONLINE	RESUME	JOB ADS
Delaware	1.062	1.199
District of Columbia	1.494	1.022
Michigan	1.056	1.060
Virginia	0.932	1.066
North Carolina	1.075	0.982

And here are the five states with the lowest combined ranks of resume and job ads:

LOWEST PROPENSITY TO LOOK ONLINE	RESUME	JOB ADS
Hawaii	0.413	0.760
California	0.701	0.672
Utah	0.636	0.860
Washington	0.625	0.887
New York	0.841	0.609

Just as some career paths seem to have mismatched levels of online activity between employers and job seekers, so do the states. Some states have relatively higher resume posting rates and lower job ad posting rates, suggesting there may be a shortage of desirable jobs. These are the top five states that may not have enough attractive jobs:

MORE RESUMES THAN JOBS	RESUMES	JOB ADS
Nevada	3	47
Louisiana	10	49
Mississippi	7	44
Georgia	2	37
Connecticut	9	42

It is worth noting that these are not necessarily the states with the highest unemployment rates. A resume posting does not indicate someone is currently unemployed, only that they are looking for and willing to consider new opportunities. This imbalance may reflect lack of upward opportunities due to skills mismatch between firms and workers, or under-employment as well as unemployment.

In other states, the rate of online job ads exceeds what would be expected given the size and composition of the labor force while the number of online resumes falls below. This could suggest firms face a larger struggle to fill openings that require general skills, or an overall labor shortage in these regions. It could also reflect ample opportunity for advancement, so workers never need to post resumes online to be able to find an improved employment opportunity. Below are the top five states in this category:

MORE JOBS THAN RESUMES	RESUMES	JOB ADS
Alaska	48	9
Vermont	37	1
Nebraska	45	11
Maine	38	4
Idaho	39	6

The variation in resume and job ad rates across the states produced some interesting geographic patterns. For instance, the states with higher propensity for online job searches tend to be on the east coast (all but Michigan) and those with lower propensity for online searches tend to be in the far west (except New York). States with higher resume rates and lower job ad rates tend to be in the south (except Connecticut) and those with higher job ad rates and lower resume rates tend to be the southern part of the country (no exceptions).

These patterns lead to several questions: What characteristics do states with high resume posting rates have in common? What patterns can be seen among states with high job ad rates? And are there state-level characteristics or policies that influence the degree to which online forums are used in regional labor markets? We address these questions with the third stage of analysis.

STAGE 3: STATE ATTRIBUTES ASSOCIATED WITH ONLINE LABOR MARKET ACTIVITY

Now that we have measured the overall posting rates for each state, we determine the features of the state labor market that contribute to the online labor market activity. To do this we capture the state posting rates estimated in Stage 2 and compare them to a variety of measures of economic activity and public policies. Our strategy is to consider many state attributes to see what fits rather than choosing only a small number of measures in advance. The attributes are discussed by category below.

1. Locations of people and jobs

Two measures are included to reflect some of the differences between metro and non-metro regions. One is the percentage of the state's population that lives in its metro counties. D.C. is nothing but a metro region, so 100% of its residents live in an urban area. California has many non-metro counties, but 95% of Californians are in a metro area. In California the urban residents are spread out across dozens of metro areas, but in Nevada, 94% of the population lives in urban areas, but the only two metropolitan areas are greater Las Vegas and Reno. More rural states such as Vermont and Maine still have most residents in non-metro counties, so the non-metro counties will reflect more weight in the state's economy and labor markets.

The second measure in this category is the average number of employees per firm. Labor markets dominated by a few large employers are likely to behave differently than those with many small employers. Additionally, many labor regulations apply only to large firms, so labor markets with many small firms may generate different levels of online labor market activity.

We also include an indicator of geography. The 20 states in the middle of the country are designated as heartland states. Historically opportunity has been more abundant on the coasts, so we allow for a difference in online labor market activity in the middle of the country.[25]

2. State labor market structure

State unemployment insurance policy and overall labor market conditions are obviously related to online job searches and therefore included in the model.

We include the percentage of the workforce that is self-employed and the average unemployment rate for the past 12 months. A labor market that relies more on self-employment may inherently have fewer job ads or resumes posted online, and when more people are unemployed more resumes and fewer job ads would be expected to be active. Both measures are likely related to observed online job searches.

State unemployment insurance policies are designed to intentionally affect how people interact with the labor market and may be reflected in online resume postings, so we include two facets of unemployment insurance. One measure is an indicator that a state requires a person to actively seek new employment to draw unemployment benefits. This is required in 41 states. Some states ask for a list or report on the employers who were contacted or applied to during the week. The second measure we included is whether a state requires claimants to submit applications through a specific online system that can be verified. This is usually a widely used online platform such as Indeed or Monster. The 25 states with this policy may have more residents with resumes posted online as a result.

Another way regional labor markets vary is the frequency with which people switch jobs. When workers switch jobs more frequently, they likely post resumes more often and firms post job ads to find new people to fill recently vacated positions. The measure we include to capture this labor market activity is the mean time in current job.[26] It is not clear that people switch jobs less frequently simply because there are fewer jobs to choose from or because of different preferences regarding careers and job expectations. Regardless of the motivations, the longer people stay in the same job, the less frequently they switch jobs, and the fewer online job ad and resume postings would be expected. In markets with a shorter time in current job, we would expect to see more online job postings and resumes because workers and employers need to look for a new match more frequently.

3. State economy

Economic growth and labor market activity go hand-in-hand, so a variety of recent economic metrics are included in the analysis. Current GDP per employee, productivity, average wages, and local employment levels are all included as potential explanatory variables.

To incorporate recent economic activity and allow for the possibility of a pre-pandemic measure, we include these measures for 2019 and the 12-month period from July 2020 through June 2021: local GDP growth, local employment growth, wage growth, total labor cost growth, and total compensation growth. Since labor is a vital part of economic activity and a significant component of production costs, these measures are all likely to correspond with labor market activity.

We include the industrial sector shares (based on employment) in the local economy as potential explanatory variables. The expected rates of resume postings and job ads were estimated based on the mix of occupations in the labor force, but not the industry sector employing them. The employment sector is also relevant because a nurse employed by a school district may have different job search behavior than a nurse employed by a hospital or medical staffing firm. An accountant employed by a manufacturing firm may engage with the labor market differently than one employed by a financial services firm and electrical contractors who need to hire electricians may recruit differently than the manufacturing firms that hire them to be on staff.

To control for the industrial sectors employing the labor force, our models include the location quotient based on employment for each of the federal government's 21 two-digit North American Industry Classification System (NAICS) codes. This measures the level of employment in a sector relative to what would be expected based on national averages and local employment overall.

4. Internet access

Obviously, reliable internet access influences how extensively individuals and firms use the internet for all things, including labor market searches. There is abundant consensus that the measures available to track internet access (specifically high-speed internet) are highly inaccurate, but little consensus as to what measure should be used instead. Thus, we use a variety of measures and compare how strongly each appears to be related to the measures of online labor market activity.

Three of the measures used come from the Digital Divide Index (DDI) created by the Purdue Center for Regional Development.[27] The DDI ranges from 0 to 100 with 0 representing the minimal digital divide and 100 representing the most extreme digital divide.

The DDI measure is the weighted average of two indices, both of which are also included in this analysis. One measures infrastructure and adoption and includes relative measures of the population without fixed broadband, no internet access, no computing devices, and median download and upload speeds. The other index includes socioeconomic factors that contribute to the digital divide: percent of population over 65, poverty rate, percent of population without a high school degree, the percent of population with a disability, and the inequality of internet access between higher and lower income households in the region.[28]

Two additional measures of county level broadband availability and use come from the FCC's form 477 filings from December 2019 and Microsoft's Airband Initiative data from 2020 as accessed through GitHub.[29] The FCC measure is the reported percentage of people in the county with access to download and upload speeds of 25 mbps/3 mbps, respectively, as of December 2019. The Microsoft measure is an estimate of the percent of people with highspeed internet service based on Microsoft customer software updates.[30]

5. COVID-19 response policies

The timeframe in which the resumes and job ads data were collected coincides with the COVID-19 pandemic and vaccine rollout in the U.S. Virus concerns undoubtedly influenced the labor market data used in this study and those effects likely varied by location.

There was surprisingly little consensus in how to best navigate the pandemic to balance health and economic concerns. Some jurisdictions focused on shared responsibility for protecting public health and mandated masks in many settings and vaccines for some segments of the population likely to represent

an exposure risk. Other places emphasized individual freedom and responsibility. Those places passed legislation banning private entities or other jurisdictions from requiring masks or vaccines.

To measure differences in the vaccine policy response we use state level data to create an index that summarizes a state's response on six different mask or vaccine policies. The index ranges from -6 for states that required vaccines and masks in every case to +6 for states that banned vaccine mandates and mask requirements in every case.[31] States with scores close to zero implemented few mandates or bans on mandate. This left smaller jurisdictions such as cities and counties and other entities such as schools, employers, and business owners free to implement and enforce the virus protection measures they deem most effective. It is possible that leaving these decisions to smaller entities who consider the costs and benefits on a more local level is preferred.

To allow for the possibility that leaving control with local entities is better than a statewide policy of either type, we include a squared index as a variable in the model building algorithm. It ranges from 0 to 36 with 0 indicating states took no action of mandating or banning vaccines or masks and allowed cities, schools, and private employers to decide what works best for their smaller communities). A value of 36 indicates a state mandated all actions or banned all actions.

Two additional measures that capture how readily vaccines were rolled out in a state are also included in the model selection process: the percentage of the population fully vaccinated as of June 30, 2021, and the state vaccine utilization rate on the same date. The utilization rate is the percent of doses sent to the state that had already been administered.

Since vaccine efforts were still in high gear when the labor market data were collected, both measures reflect a combination of public willingness to be vaccinated and how efficiently the state deployed resources and communicated vaccine availability. The willingness to be vaccinated implies a belief that the benefits exceed the costs, which may indicate a higher trust in the institutions that developed, approved, and distributed the vaccines.

Model Selection Process

With this many potential explanatory variables for 50 states (plus Washington DC), it is impossible to consider all the variables simultaneously and estimate unique effects with any degree of statistical reliability. Plus, we have multiple measures of similar information and should not expect all of them to show up in the predictive model.

To determine which variables are most closely associated with posting rates, we use model selection algorithms to help identify the "best" subset of state variables to predict posting rates for resumes and job ads separately. The details are in Technical Appendix III. We try multiple definitions of "best" and different selection algorithms and compare the results across the multiple models to minimize the likelihood of unimportant measures being identified by chance. In the discussion that follows, we discuss state characteristics that consistently show up as important predictors in the variety of models estimated.

Results for Job Ad Posting Rates

Most of the variables we consider are never included in any of the best models of job ad ratios. Only 3 of the industrial sector measures and 13 of the economic or labor market measures show up in one or more models.

Most of the results confirm what is already known about labor markets. When the unemployment rate is higher and people switch jobs less frequently, the rate of job ad postings is lower. When labor costs are higher or rising rapidly, the job ad posting rate is lower.

Some other consistent results may not be as obvious. The size of the labor market does not appear to influence the job posting rate but higher rates of urban concentration lead to lower job posting rates. The industrial sector concentration measures only show up in one model and likely do not matter.

Three remaining variables identified by the model as influencing the pandemic labor market have some potentially interesting policy implications.

1. States with higher levels of internet infrastructure as measured by the digital divide sub-index have higher job posting rates. While the model cannot determine a cause and effect between internet and job ads, the additional internet capacity gained as infrastructure funding is deployed is more likely to help than harm the availability of jobs in the regions that are targeted for expanded access.

2. States with less intervention in mask and vaccine policy have higher job ad posting rates. If only one action is taken, a ban may be better than a mandate, but having many mandates or bans on mandates is correlated with lower job ad posting rates. This means states that have more mandates on masks and vaccines and states that have more bans on private entities making mask and vaccine mandates have fewer job ads online. States where local entities were free to implement and enforce policies on virus mitigation had higher rates of job ads posted online.

3. Higher population vaccination rates are associated with more job ads. Again, the modeling process used does not allow us to determine cause and effect. It could be that people are willing to be vaccinated when they see more employment opportunities, that vaccinated people are more comfortable getting out and spending money which generates more job ads, or that there is a more complex relationship with another underlying mechanism that is influencing both measures.

Although we cannot ascertain a definite causal relationship, the data suggest that there is some relationship between differences in public pandemic management and labor market opportunities as measured by online job postings.

Results for Resume Posting Rates

The models found that most of the variables we considered are not consistently a factor in online resume posting rates for regional labor markets, reinforcing the notion that the behavior of people is more difficult to predict than that of firms.

Once again, some of what we found confirms what we would expect to see according to economic theory if resume postings represent workers looking for new or improved employment: states with higher wages have higher resume posting rates but states with faster employment growth recently have lower resume posting rates.

Higher wages attract more people to the labor market and high rates of recent job growth suggests much of the labor force may have recently moved into a new position and is not currently interested in other opportunities.

The industrial sector measures show up more regularly in the resume models and one sector –agriculture, forestry, and mining – shows up in every model. The larger the employment share in the agriculture sector the lower the rate of resume postings a region is predicted to have. This is consistent with the agribusiness services sector having the lowest rates of resume postings in the occupational analysis. There is something about the skills needed for jobs in that sector or the employment processes used that cause workers to conclude the benefits of posting a resume online are not worth the effort.

The resume posting models also consistently reveal a couple of patterns with interesting policy implications.

1. Internet access matters. Here, again, internet access shows up as an important characteristic, but this time it is the socioeconomic risk factor of the digital divide index. This index measures people at risk of not being able to access or adopt high speed internet in a state. When this risk is higher, a state has slightly higher resume posting rate. This may reflect the effective job libraries and job centers have done with filling the internet gap for job seekers. Or it may reflect people who are seeking better employment for long periods of time without successfully finding a new job.

   Understanding the exact mechanism by which resume postings and internet access are related is an important topic for future research. It may be that those at risk of not having internet at home are able to post resumes elsewhere, but the materials they post are less effective and it's not just internet access but also targeted training on job search skills that will be needed to better address income inequality as we close the digital divide.

2. Public health policy matters. At least one of the vaccine measures was identified in every model as a relevant predictor negatively correlated with resume posting rates. In some models it was the percent of population fully vaccinated and in others it was the vaccine utilization rate where the utilization rate is the percentage of vaccine doses allocated to the state that have been used rather than wasted.

   States with higher dose administration rates have lower rates of resume postings. This relationship is less obvious at first glance but may be measuring a couple of different phenomena simultaneously which would explain the consistently strong results in a variety of model specifications. For a state to use a higher percentage of its vaccine doses requires that the state have an effective strategy to deploy the doses, that it communicates the plan well, and that residents are willing to offer their arm to receive the vaccine. Residents are only willing to receive the vaccine when they believe the benefits exceed the costs or potential risks. We suspect these differences in willingness to be vaccinated are closely aligned with differences in institutional trust documented by the Pew Research Center.[32] Again, the methodology used here does not allow us make conclusions regarding cause and effect, but we can say that the degree to which the vaccine utilization rate reflects a combination of institutional efficiency and trust in those institutions, it is capturing important information that provides insight into how local labor markets operate and suggests efficient, trustworthy institutions may confer valuable benefits beyond those economists have already recognized and explored.

CONCLUSIONS

Labor markets matter to Americans. Wages or salaries received from employment is the largest source of income for US households. In fact, for many working- and middle-class households, wages are the only source of income. Data from the Bureau of Economic Analysis, however, shows labor's share of gross national income has fallen from about 67.0% to 63.8% since 2000.

During the same time, labor market participation rates have generally declined, and labor markets have become more reliant on new communication technologies to advertise openings and screen applicants. Even positions filled by word of mouth through personal networks are more likely to be communicated through a digital platform or social media than a random conversation at the coffee shop.

Occupational choice currently plays a large role in determining how crucial online job searches are to finding the best employment options. There's nothing inherently wrong or inefficient with labor markets for different occupations having different processes. But if workers in some occupations post fewer resumes because there is little overlap in the skills needed to do the job and those needed to apply for a job, it could limit job seekers' ability to find and secure better employment options. This is an issue we should address with more focused training related to online job searches.

Differences across states unrelated to the occupational mix also provide insight into what policies may contribute to vibrant online labor markets. Online job ads are more abundant where there is also good internet infrastructure and access. Plus, pandemic public health strategies are related to online labor market activity. Too little local ability to implement and enforce public health policies and low vaccination rates are associated with lower job ad rates and high vaccine utilization rates are associated with lower resume posting rates.

If we have evidence to suggest public policies are related to the rates at which people and firms engage in online markets to facilitate employment, the heartland needs us to pay attention, understand the broader and more nuanced implications, and craft policies that allow everyone to benefit from the new and improved economy we want to build together.

TECHNICAL APPENDIX I: CALCULATING RESUME AND JOB AD POSTING RATES

The resume and job listings counts are based on the eight-digit O*NET-SOC codes utilizing the new taxonomy introduced in 2019. There are 1,016 occupations possible, but only 986 are included in this analysis.[33] The actual employment data for each region are reported using the SOC 2018 framework using six-digit SOC codes and the two are merged using the crosswalk produced by the BLS which can be found here.[34]

The number of postings and resumes for each occupation in each region come from JobsEQ as part of their Real Time Intelligence and Resume Forensics packages. They use web scraping algorithms and code all job ads and resumes to a location and occupation based on job titles and other information in the posting. Duplicate posts for the same position or resumes by the same person are deleted.
The national average posting rate is calculated as

$$PostRate_{national} = \frac{\sum post_{ir}}{\sum employ_{ir}} \quad (1)$$

Where $post_{ir}$ measures the number of postings (job ads or resumes) for occupation i in region r and $employ_{ir}$ is employment. For job ads, employment is tied to the location of the employer and for resumes the location is tied to the residential location of the person. Across regions the number of workers does not equal the number of jobs since many people commute or work remotely. The national total of employees and jobs is not equal as some people hold multiple part time jobs, and other people work in the US remotely while living abroad.

For each occupation and region, the posting rate is calculated as

$$PostRate_{ir} = \frac{post_{ir}}{employ_{ir}} \quad (2)$$

We then estimate the following models using ordinary least squares with robust standard errors and no constant:

$$Postrate_{ir} = \beta_{3i} * Occupation + \beta_{3r} * Region + \varepsilon_{ir} \quad (3)$$

$$Postrate_{ir} = \beta_4 * Occupation + \varepsilon_{ir} \quad (4)$$

$$Postrate_{ir} = \beta_5 * Region + \varepsilon_{ir} \quad (5)$$

where Occupation is a vector of 74 indicator variables for the occupations and Region is a vector of 98 indicator variables for the regions, and ε_{ir} is a normally distributed error term. The predictive accuracy of models (3) and (4) are qualitatively similar, so for ease of interpretation of the coefficients we use (4) to estimate occupational effects. The values in β_4 as estimated by (4) are the effects reported as the occupational posting rates for job ads and resumes in Stage 1.

TECHNICAL APPENDIX II: STAGE 2 CALCULATIONS

In this stage we want to estimate regional effects independent of the occupational effects of online labor market activity. To do this we predict the posts (resumes or job ads) we expect in a market if each occupation has a unique posting rate but the rate for an occupation is consistent across all regions.

The expected number of posts for region r is calculated as

$$ExpectedPosts_r = \sum_{i=1}^{74} employ_{ir} * rate_i \quad (6)$$

where i indexes the 74 occupations, $employ_{ir}$ is the number of people employed in occupation i in region r, and $rate_i$ is the average rate of online job activity for occupation i nationwide.

We then calculate the ratio of job ads and resumes relative to the number expected to come up with a regional posting rate that can be interpreted as percentage of posts expected given the occupational mix of the regional labor market.

We then use regression techniques with robust standard errors to estimate

$$PostRate_{ir} = \beta_{7s} * State + \beta_{7m} * Metro + \varepsilon_{ir} \quad (7)$$

where State is a vector of indicator variables for each state, Metro is an indicator of whether it's the metro or non-metro region of a state, and e is a normally distributed error term. The coefficient estimates in β_{7s} and β_{7m} are reported in Stage 2 as the state and metro effects.

TECHNICAL APPENDIX III: STAGE 3 DETAILS

The state level effects estimated in stage 2 (β_{7m}) are the dependent variables and a wide selection of potential state level characteristics are evaluated to determine which factors may be likely to influence online labor market activity. With the large number of potential explanatory variables, we use model selection algorithms in steps to guide the analysis.

The first step in stage 3 is to consider industrial employment patterns. The Furnival-Wilson Leaps and Bounds Algorithm (hereafter FW) is used first to identify which, if any industries, effectively predict the state level effects. To come up with an estimable model, the FW technique is run using only the 21 sector shares for industrial sectors. For the job ad ratio model considering only LQ measures, the algorithm is optimized with 5 or 6 industries, depending on which optimization statistic you consider. The top 6 LQs are added into the model with the remainder of the explanatory variables to determine the best model from the larger variable set.

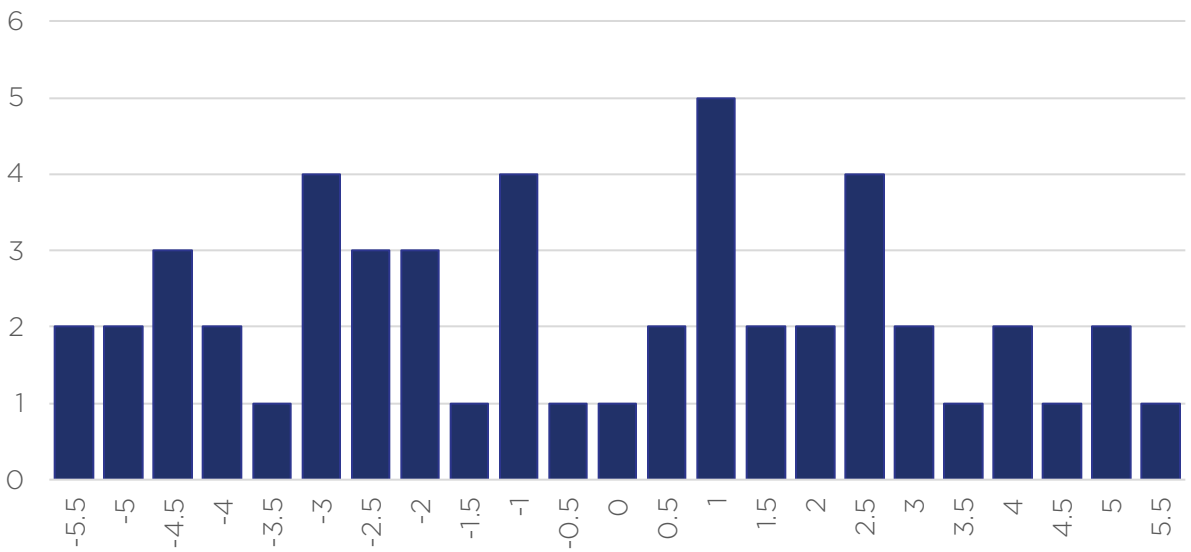
For the resume posting rates, the initial FW estimation identifies 7 industry sector measures that are included with the remaining variables to identify the best overall model.

At this point in the analysis the FW is replaced with lasso model identification techniques since many of the economic variables are highly correlated and FW is known to be less effective with highly correlated data. Lasso models are estimated using several different statistical options and assumptions as robustness checks to confirm the estimation choices are not driving the results. For the characteristics identified we consider the direction (positive or negative) and the consistency of the direction and magnitude of the estimated effects. Variables consistently identified as good predictors with consistently estimated relationships with posting rates are noted in the discussion.

REGION	JOB AD RATE	RESUME RATE
Alabama	0.843	0.822
Alaska	1.057	0.608
Arizona	0.926	0.906
Arkansas	0.931	0.928
California	0.672	0.701
Colorado	0.996	0.881
Connecticut	0.858	1.051
Delaware	1.199	1.062
District of Columbia	1.022	1.494
Florida	0.814	0.936
Georgia	0.891	1.227
Hawaii	0.760	0.413
Idaho	1.092	0.709
Illinois	0.881	0.943
Indiana	0.951	0.871
Iowa	1.045	0.701

Kansas	1.108	0.795
Kentucky	0.977	0.878
Louisiana	0.722	1.016
Maine	1.194	0.720
Maryland	0.914	0.973
Massachusetts	0.964	0.791
Michigan	1.060	1.056
Minnesota	0.984	0.700
Mississippi	0.822	1.059
Missouri	0.953	0.890
Montana	0.976	0.603
Nebraska	1.043	0.653
Nevada	0.804	1.077
New Hampshire	1.236	0.886
New Jersey	0.806	0.873
New Mexico	0.926	0.746
New York	0.609	0.841
North Carolina	0.982	1.075
North Dakota	0.993	0.675
Ohio	0.914	0.890
Oklahoma	0.915	0.888
Oregon	0.934	0.668
Pennsylvania	0.978	0.884
Rhode Island	1.033	0.909
South Carolina	0.956	1.072
South Dakota	0.967	0.463
Tennessee	0.908	0.894
Texas	0.878	0.936
Utah	0.860	0.636
Vermont	1.505	0.744
Virginia	1.066	0.932
Washington	0.887	0.625
West Virginia	0.948	0.978
Wisconsin	1.027	0.751
Wyoming	0.994	0.792

PANDEMIC POLICY INDEX SCORES



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[20] Three states: Delaware, New Jersey, and Rhode Island, do not have non-metropolitan counties, for a total of 98 regions in the analysis.

[21] http://www.chmuraecon.com/jobseq

[22] District of Columbia is treated as a state throughout the analysis.

[23] The model was also estimated with a unique effect for each region, but it did not improve the explanatory power, so the model controlling for state and metro regions is the preferred set of results presented here.

[24] Author calculations from ACS data. Metro residents have average time on current job of 7.56 years while non-metro residents have 8.53 years at current job.

[25] The Heartland is the region of 20 states in the US that includes Alabama, Arkansas, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Michigan, Minnesota, Mississippi, Missouri, Nebraska, North Dakota, Ohio, Oklahoma, South Dakota, Tennessee, Texas, and Wisconsin.

[26] This is measured using Current Population Survey data downloaded from IPUMS from the January 2018 and 2020 surveys that asks about jobs and employers. The measure used in this analysis was created from the question that asks respondents how long they have worked in their current job.The responses are weighted by the job tenure supplement weight to be representative of the population overall. Based on the sample sizes, we can estimate the average job tenure for a region overall but must assume the same rate applies to all occupations since there is not enough data to estimate occupation specific rates within a region.

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[30] For a detailed description of FCC and Microsoft data comparisons go to https://github.com/microsoft/USBroadbandUsagePercentages/commit/44bb4ab09a0b04b1ed1fd0a981abf873b3c18571.

[31] The six metrics combined into the index are statewide school masks, school vaccine requirements for students, school vaccine requirements for teachers, private employer vaccine requirements, state agency vaccine requirements, and facilitating an app for private entities that wish to require vaccines. On some measures states were given a score of -0.5 or 0.5 if a mandate or ban was passed, but then declared unenforceable by the courts or explicitly announced that it would not be enforced.

[32] https://www.pewresearch.org/politics/2019/07/22/trust-and-distrust-in-america/

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