Impact of COVID-19 on the Diversity of the Construction Workforce

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Abstract

Construction industry employment has been severely impacted by the coronavirus disease 2019 (COVID-19) pandemic. This paper examines the impact of the COVID-19 pandemic in the United States (U.S.) construction labor market. This study contributes to the state of knowledge by (1) revealing how the COVID-19 pandemic impacted the construction employment across different demographic groups and geographic regions in the U.S. and (2) identifying vulnerable demographic groups (e.g., minorities, women, older workers) in the construction workforce that are disproportionally impacted by the pandemic. Employment data from the Current Population Survey (CPS) and Current Employment Statistics (CES) program, which are administered by the Bureau of Labor Statistics (BLS), are used to assess the impact of the COVID-19 on construction employment. The impact of the COVID-19 is defined as a change in 12-month employment from 2019 to 2020; the study mostly focuses on April and September of 2020. Analyzing CES survey data reveals that the women workforce in construction declined by 11.9 percent in April 2020, when the COVID-19 caused a 15.6 percent decline in the U.S. construction labor market. The study also reveals that Black or African American communities are disproportionately impacted by job loss in the U.S. construction industry. In September 2020, the 12-month decline in construction employment among Black or African Americans was 29.6 percent compared to 5.8 percent for the overall decline in construction employment. It is observed that states in the north of the U.S. suffered a rapid decline in construction employment during the initial stage of the COVID-19 pandemic. Thirty states suffered a higher 12-month decline in construction average weekly earnings in September compared to April, which reveals the persistent impact of the pandemic on the industry. This study contributes to the state of practice by helping policymakers understand the pandemic's disproportionate impact across different demographic groups and geographic regions. It is expected that this study assists policymakers draft equitable recovery policies to overcome the setbacks caused by the pandemic.

Introduction

The coronavirus disease 2019 (COVID-19) has caused an unprecedented impact on the U.S. labor market. To curb the spread of the COVID-19, which easily transfers when a healthy individual comes in contact with small droplets or small particles produced by infected individuals, businesses were shut down, educational institutions were moved

online, and employees were forced to work remotely when possible. While the risk of contracting the COVID-19 forced some employees with an underlying condition to quit their jobs, the COVID-19-induced recession also caused significant job loss in the U.S. labor market. The COVID-19 recession caused a 15 percent employment decline in April 2020 compared to a maximum of 6 percent employment decline during the Great Recession of 2007-2009 (Groshen 2020). In addition to job losses, the COVID-19 also impacted workforce diversity across industries (Krumenauer 2020). The COVID-19 induced job losses have been disproportionate among gender, race and ethnicity, and age groups in the U.S. labor market (Couch et al. 2020; Ellingrud et al. 2020; Oppel 2020; Saenz and Sparks 2020). This paper presents the impact of the COVID-19 on the U.S. construction workforce demographics and states' construction employment.

The construction industry is one of the major contributors to the economy and jobs in the United States. The construction industry contributed $887 billion to the U.S. gross domestic product (GDP) in 2019, which corresponds to 4.1% of the total U.S. GDP in 2019 (Simonson 2020). The employment in the U.S. construction industry ranged from a low of about 4.6 million in the 1990s to a high of 7.7 million during the 2006 housing boom and was about 7.6 million in early 2020 (Kirchhoff 2011; BLS 2020b). The COVID-19 pandemic in 2020 has caused severe job loss in construction due to project cancellation, disruption in the supply chain, and worksite safety concerns (Coronavirus-AGC Survey 2020).

The construction industry has consistently been a male-dominant industry and has lower participation of women and minorities. According to the Labor Force Statistics from the Current Population Survey (CPS), women represented only 10.3 % of the total construction workforce in 2019. Similarly, Whites, Black or African Americans, Asians, and Hispanic or Latino ethnicity represented 88.1%, 6.4 %, 1.9%, and 30.4% of the U.S. construction workforce in 2019 (BLS 2020a). The lower participation of minorities and women is due to numerous reasons. First, as construction trade has been portrayed as a masculine industry dominated by white males, the culture entrenched within the industry undermines the women and minority workforce (Fielden et al. 2000; Gurjao 2017). The women had to deal with the attitude of not belonging to the trade. There is lower involvement of women in construction-related federal apprenticeship programs. Only 10 % of participants in construction-related federal

apprenticeship programs were women in 2019 (Soto 2020). The women and minority apprentices also have lower retention and recruitment rates (Kelly et al. 2015). Second, women, minorities, and people of color have consistently been victims of subtle and unconscious biases that manifest within the construction industry. The apprentices from minorities are assigned menial works preventing them from developing skills and techniques required for the construction trade (Bousquin 2020). The racial slurs, racist graffiti, and nooses are pervasive in construction sites (Phillips 2020). Also, the minorities face significant challenges with interpersonal interaction limiting their capability to develop strong professional relationships (Kelly et al. 2015). Networking among the minority workers is not as robust as workers from the majority group; this creates difficulty finding jobs when work on one construction site is over. Third, low access to health insurance is another reason discouraging the participants of minorities in the construction sector. Nearly 24 percent of workers in construction and nearly 48 percent of Hispanic construction workers had no health insurance coverage in 2018 (Brown 2020). The health insurance among the certain categories (e.g., construction trade helpers, roofers, plasterers, tile and floor installers, fence installers) of construction workers is significantly lower than other white-collar construction works (Slowey 2018). Lastly, the educational attainment in STEM (i.e., science, technology, engineering, and mathematics) has been difficult and elusive for women and minorities, creating barriers in qualifying for jobs requiring higher technical as well as managerial skills (Funk and Parker 2020). In addition to all these reasons lowering participation of minorities and women in construction, the COVID-19 pandemic has additionally impacted the women and minorities in construction.

The increasing evidence suggests that minorities are at high risk of the COVID-19 (Ford 2020; Pasco et al. 2020). Also, the overall job loss among women is significantly higher than men in the U.S. labor market (Kashen et al. 2020). More women than men exited from work to take care of children who had to stay in homes due to the closure of schools and daycare facilities (Alon et al. 2020). Also, the minorities experienced a significant decline in employment during the COVID-19 because of their involvement in jobs that has a high risk of contracting the COVID-19 (Goldman et al. 2021). The disproportionate effect of the COVID-19 on women and minorities is likely to hurt the diversity and inclusion goals within different industries in the United States. Diversity in the workforce

has been recognized as one of the crucial factors for companies' financial gain and profitability (Hunt et al. 2018). The diverse workforce with varying perspectives and approaches has a better understanding of diverse consumer needs and would be more competitive in a globalized economy (Olbrich et al. 2015; Hunt et al. 2018; AGC Diversity and Inclusion Council 2018). The companies in the top quartile of gender or racial and ethnic diversity are more likely to have financial returns above their national industry medians (Hunt et al. 2015). Despite several advantages of having a diverse workforce, the participation of women and minorities has been historically low in the construction industry and may now be further worsened by the impact of the COVID-19. Therefore, in this study, the impact of the COVID-19 pandemic on the diversity of the construction workforce is examined to provide a context for policy development that would help to promote the participation of women, minorities, and underrepresented groups in the construction industry. The authors also reviewed the impact of the COVID-19 on construction jobs and average weekly earnings across different states in the U.S.

This study is organized as follows. First, the data sources used to measure the impacts on construction employment are explained. Then, the main result is presented in the form of descriptive analysis by comparing employment change in April and September of 2020 compared to the same month of the previous year. Finally, the discussion of the findings is presented to help understand the impact of the COVID-19 across the U.S. construction workforce demographic.

Measuring the impact of the COVID-19 on construction workforce diversity

The data from the Bureau of Labor Statistics (BLS) is used to assess the impact of the COVID-19 on the construction workforce. The employment statistics for the construction industry are obtained from two surveys: The Current Employment Statistics (CES) survey and the Current Population Survey (CPS).

The BLS estimates nonfarm employment, hours, and earnings through Current Employment Statistics (CES) on a monthly basis. The CES survey covers approximately 697,000 individual worksites from about 145,000 businesses and government agencies derived from a sampling frame of Unemployment Insurance (UI) tax accounts, including nearly 10.2 million establishments. The current CES sample includes roughly one-third of all nonfarm

establishment payroll employees across the United States. The CES produces employment data based on industry and geographic area. Data for the nation is produced by CES National Estimate, while CES State and Metro Area produces data for all 50 States and about 450 metropolitan areas and divisions.

The CPS is administered by BLS on a monthly basis to 60,000 eligible households to obtain information on labor force status in the United States. The CPS survey provides labor force data with several demographic characteristics, such as age, educational attainment, and race and Hispanic ethnicity. As the data is available for different demographic groups, the CPS data is most suitable to access the impact of the COVID-19 on minorities and workers of different age groups in the construction industry. The CPS includes wage and salary workers, self-employed people, unpaid family workers, persons employed by households, farmworkers, and workers temporarily absent from work without pay. The CPS survey also measures unemployment in the United States. The unemployed measured in the CPS survey are those who are jobless and actively seeking employment during the survey reference week. The CPS survey only includes the population who are 16 years and older.

CES is the most reliable gauge to measure monthly employment change, whereas the CPS survey is designed to provide a highly accurate rate of labor force participation and unemployment rate (Bowler 2006). This study uses CES survey data to review the impact of the COVID-19 on the overall construction workforce and women workforce in different construction sectors and subsectors. The CPS data are used to evaluate the impact of the COVID-19 pandemic on minorities and across different age groups in the U.S. construction labor market. The CES survey also provides employment data on different states and metro areas, which is used to assess the impact of the COVID-19 on construction employment across different states.

The impact of the COVID-19 for any month is defined as a change in employment from 2019 to 2020. This study considered the month of April and September to study the impact of the COVID-19 on construction employment. The April 2020 employment data is used to study the initial impact of the COVID-19 on construction employment for three reasons. First, the U.S. labor market in April experienced the most job loss since the great recession of 2007-2009 (Tappe 2020). Second, the COVID-19 was declared a national emergency on March 13, 2020, and most of the lockdown measures were effective in April, closing most non-essential businesses across the United States.

Third, the CPS data collection reference period is a week that includes the 12th of the month, and for the CES survey, the reference period is a pay period that includes the 12th of the month (Bowler 2006). Thus, April's employment data could more accurately portray the initial impact on construction jobs as the lockdown measures were strictly implemented from the mid of March 2020. The September data is used to examine the recovery of construction jobs that were lost from the initial shock of the COVID-19 in April of 2020. The September data is used to study the recovery as it is the latest available employment data for assessing the impact on construction employment at the time of this study. Equation 1 is used to study the impact of the COVID-19 on construction employment.

$$COVID-19\ Impact_{month} = \frac{Y_{month\ 2020} - Y_{month\ 2019}}{Y_{month\ 2019}} - \frac{Y_{month\ 2019} - Y_{month\ 2018}}{Y_{month\ 2018}} \quad (1)$$

The *COVID-19 impact* for any month in 2020 is represented as the percentage change in employment from the same month of the previous year. The double difference in Equation 1 is used to represent the 12-month percentage change in employment that is over and above the 2020-2019 change that would be expected to occur during normal conditions as proxied by employment change in 2018-2019. Two sample hypothesis test is also performed to determine if the decline in employment between April and September of 2020 was significantly different across different demographics and geographic regions.

Results

The simplest way to quantify the impact of the COVID-19 on the construction industry is to examine the impact on construction employment across the United States. Figure 1 shows the number of construction jobs from 1984 to September of 2020 in the U.S. construction industry from CPS and CES survey. It can be seen that CPS reports a higher number for construction employment than the CES survey. That is because CPS includes self-employed people, unpaid family workers, and workers on leave without pay. Further reasons for the difference in employment data from the two surveys are discussed in Bowler (2006). Figure 1 shows that there has been gradual and significant job loss in two previous recessions (1990s Recession and Great Recession of 2007-2009). However, the COVID-19 recession has a sudden and abrupt impact on the construction labor market, costing thousands of jobs in just a few months. Table 1 summarizes the impact of the COVID-19 in the construction labor market using the

employment data from the CES survey. Comparing the change in employment from April 2019 to April 2020, it is observed that construction employment was reduced by 12.2 percent. Table 1 also provides the percentage change from April 2018 to April 2019 that would be used to adjust the changes occurring during the normal condition. After the adjustment, there was a 15.6 percent decline in construction employment. Also, it is worthy to note that the employment level started to raise immediately after reaching the lowest point in April 2020. In September 2020, the impact of the COVID-19 was a 5.8 percentage decline in construction employment compared to a 15.6 percent decline in April. Table 1 also summarizes the impact of the COVID-19 across three different sectors of construction and their subsectors defined according to the CES program (BLS 2015). The three construction sectors include the construction of buildings, heavy and civil engineering construction, and specialty trade contractors. The heavy and civil engineering construction sector experienced the least decline in employment in April 2020; however, in September, this sector suffered a 7.8 percent decline in employment compared to a 3.8 percent and 6 percent declines for construction of building and specialty trade contractor sectors, respectively.

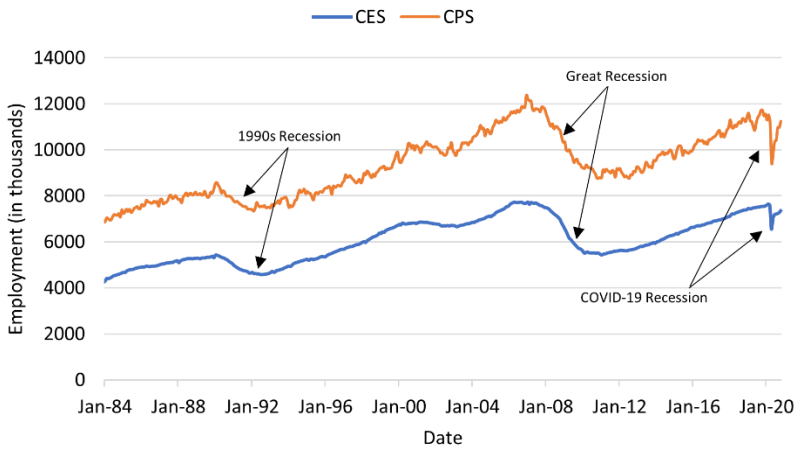

Figure 1. Construction employment in the United States (Source: Authors' tabulation using BLS surveys)

Table 1. COVID-19 impact on construction employment (CES survey)

Industry	Total Employment (in thousands)						% change 2018-2019		% change 2019-2020		COVID-19 Impact (%)	
	2018		2019		2020							
	Apr	Sep	Apr	Sep	Apr	Sep	Apr	Sep	Apr	Sep	Apr	Sep
Construction	7223.0	7355.0	7469.0	7524.0	6556.0	7261.0	3.4	2.3	-12.2	-3.5	-15.6	-5.8
Construction of buildings	1616.3	1640.9	1649.4	1664.6	1456.7	1625.1	2.0	1.4	-11.7	-2.4	-13.7	-3.8
Residential building	793.5	802.7	811.6	825.4	712.8	828.9	2.3	2.8	-12.2	0.4	-14.5	-2.4
Nonresidential building	822.8	838.2	837.8	839.2	743.9	796.2	1.8	0.1	-11.2	-5.1	-13.0	-5.2
Heavy and civil engineering construction	1034.8	1065.4	1078.8	1079.1	992.9	1008.7	4.3	1.3	-8.0	-6.5	-12.2	-7.8
Utility System Construction	541.3	568.7	570.3	563.0	508.3	511.8	5.4	-1.0	-10.9	-9.1	-16.2	-8.1
Land Subdivision	38.9	37.7	38.2	40.6	34.8	34.9	-1.8	7.7	-8.9	-14.0	-7.1	-21.7
Highway, Street, and Bridge Construction	337.2	343.5	349.2	354.0	331.1	348.3	3.6	3.1	-5.2	-1.6	-8.7	-4.7
Other Heavy and Civil Engineering Construction	117.8	117.0	122.0	123.0	112.7	119.6	3.6	5.1	-7.6	-2.8	-11.2	-7.9
Specialty trade contractors	4571.8	4648.7	4741.0	4780.1	4106.6	4627.3	3.7	2.8	-13.4	-3.2	-17.1	-6.0
Building foundation and exterior contractors	906.2	916.0	936.6	943.5	786.2	910.0	3.4	3.0	-16.1	-3.6	-19.4	-6.6
Building equipment contractors	2156.7	2206.2	2254.1	2285.0	2004.5	2240.0	4.5	3.6	-11.1	-2.0	-15.6	-5.5
Building finishing contractors	830.8	845.8	847.7	842.6	691.5	790.9	2.0	-0.4	-18.4	-6.1	-20.5	-5.8
Other specialty trade contractors	678.3	680.0	701.6	707.8	618.5	682.3	3.4	4.1	-11.8	-3.6	-15.3	-7.7

Source: Authors' tabulation using CES survey

Table 2 summarizes the impact of the COVID-19 on the average weekly earnings of construction employees using data from the CES survey. In general, the average weekly earnings of construction employees saw a 1.2 percent drop in April 2020 compared to April 2019. After adjustment, the actual drawdown as a result of the pandemic on construction earnings was 3.7 percent in April 2020; it is worth noting that the earnings remained 3.4 percent below the pre-coronavirus level in September. Among the various construction sectors, construction of buildings had the least decrease in average weekly earnings in both April and September 2020. Despite the recovery in construction jobs, the construction earnings decreased for all three sectors in September 2020 compared to April 2020. The seemingly contradictory observations reflected the extensive job loss among low-paid workers as an immediate result of the economic shutdown, while the lagging effect of the coronavirus on construction earnings indicated the shortage of skilled workers. As the pandemic hit hard on the industry labor market, a majority of contractors expressed concern over the labor market. A survey by Dodge Data and Analytics on 99 contractors across the U.S. reported a higher level of need for skilled workers (Dodge Data and Analytics 2020).

Table 2. COVID-19 impact on construction average weekly earnings (CES survey)

Industry	Average weekly earnings (in dollars)						% change 2018-2019		% change 2019-2020		COVID-19 Impact (%)	
	2018		2019		2020							
	Apr	Sep	Apr	Sep	Apr	Sep	Apr	Sep	Apr	Sep	Apr	Sep
Construction	1171.57	1177.02	1200.7	1225.54	1185.79	1234.62	2.5	4.1	-1.2	0.7	-3.7	-3.4
Construction of buildings	1238.01	1239.01	1255.68	1285.44	1270.01	1319.42	1.4	3.7	1.1	2.6	-0.3	-1.1
Residential building	1080.8	1092.08	1099.64	1118.25	1118.61	1166.19	1.7	2.4	1.7	4.3	0.0	1.9
Nonresidential building	1383.9	1373.36	1404.86	1442.41	1409.99	1484.65	1.5	5.0	0.4	2.9	-1.1	-2.1
Heavy and civil engineering construction	1369.31	1372.99	1400.7	1434.12	1372.99	1405.68	2.3	4.5	-2.0	-2.0	-4.3	-6.4
Utility System Construction	1385.66	1422.03	1430.57	1458.7	1376.25	1393.44	3.2	2.6	-3.8	-4.5	-7.0	-7.1
Land Subdivision	1405.24	1327.14	1314.72	1350.98	1517.27	1597.93	-6.4	1.8	15.4	18.3	21.8	16.5
Highway, Street, and Bridge Construction	1287.88	1278.36	1336.44	1383.02	1365.55	1375.46	3.8	8.2	2.2	-0.5	-1.6	-8.7
Other Heavy and Civil Engineering Construction	1500.15	1405.89	1433.65	1424.18	1342.75	1390.91	-4.4	1.3	-6.3	-2.3	-1.9	-3.6
Specialty trade contractors	1105.41	1104.9	1138.7	1154.69	1113.7	1140.63	3.0	4.5	-2.2	-1.2	-5.2	-5.7
Building foundation and exterior contractors	1027.1	1006.77	1049.63	1091.14	1047.55	1105.06	2.2	8.4	-0.2	1.3	-2.4	-7.1
Building equipment contractors	1172.45	1187.7	1215.98	1221.09	1176.81	1248.46	3.7	2.8	-3.2	2.2	-6.9	-0.6
Building finishing contractors	1034.7	1019.45	1051.65	1046.22	993.17	1048.43	1.6	2.6	-5.6	0.2	-7.2	-2.4
Other specialty trade contractors	1092.14	1082.3	1123.16	1165.74	1112.15	1140.76	2.8	7.7	-1.0	-2.1	-3.8	-9.9

Source: Authors' tabulation using CES survey

Impact of the COVID-19 on Women Workforce

The employment data from the CES survey is used to determine the impact of the COVID-19 on the women's workforce in the construction industry. Table 3 summarizes the impact of the COVID-19 on the women's workforce. The change in women's employment is obtained for April 2020 and September 2020 from the same month in 2019. When the COVID-19 pandemic forced the closure of businesses in April 2020, the number of women employed in construction payroll jobs reduced by 11.9 percent. However, the gain of employment among women workforce in construction payroll job was rapid. As of September 2020, the 12-month percentage decline in payroll jobs for women in construction was only 3.6 percent compared to 5.8 percent (Table 1) for overall payroll jobs in construction.

The impact on the employment of women across different construction sectors has also varied during the COVID-19 pandemic. Table 3 also summarizes the impact of the COVID-19 on women's employment in three construction sectors. In April 2020, the impact of the COVID-19 caused more than an 11 percent decline in the women workforce in all three sectors. However, the women workforce regained significant jobs that were lost in the initial stages of

the COVID-19 by September 2020. The 12-month employment decline for women in September 2020 in the construction of buildings and specialty trade contractors was 2.6 percent and 3.9 percent, respectively. Heavy and civil engineering construction has the slowest recovery among the three construction industry sectors for the women workforce. As of September 2020, the heavy and civil engineering sector still experienced a 6.9 percent decline in women's employment, which is 3 points higher than the overall employment decline for women in September 2020.

Table 3. COVID-19 impact on women workforce in construction

Industry	Women Employment (in thousands)						% change 2018-2019		% change 2019-2020		COVID-19 Impact (%)	
	2018		2019		2020							
	Apr	Sep	Apr	Sep	Apr	Sep	Apr	Sep	Apr	Sep	Apr	Sep
Construction	924.0	945.0	962.0	974.0	887.0	969.0	4.1	3.1	-7.8	-0.5	-11.9	-3.6
Construction of buildings	290.1	300.8	303.7	304.7	281.8	300.7	4.7	1.3	-7.2	-1.3	-11.9	-2.6
Residential building	172.9	180.7	177.1	179.0	163.3	178.9	2.4	-0.9	-7.8	-0.1	-10.2	0.9
Nonresidential building	117.1	120.7	126.4	126.2	117.6	121.7	7.9	4.6	-7.0	-3.6	-14.9	-8.1
Heavy and civil engineering construction	111.8	113.3	114.6	113.6	104.8	106.1	2.5	0.3	-8.6	-6.6	-11.1	-6.9
Utility System Construction	50.9	52.5	52.5	51.9	49.6	49.3	3.1	-1.1	-5.5	-5.0	-8.7	-3.9
Land Subdivision	15.8	14.8	14.6	14.7	12.9	13.1	-7.6	-0.7	-11.6	-10.9	-4.0	-10.2
Highway, Street, and Bridge Construction	31.7	32.1	32.7	33.1	29.6	31.5	3.2	3.1	-9.5	-4.8	-12.6	-7.9
Other Heavy and Civil Engineering Construction	13.6	13.9	14.8	14.0	13.0	11.7	8.8	0.7	-12.2	-16.4	-21.0	-17.1
Specialty trade contractors	522.3	531.0	543.3	556.8	501.5	562.4	4.0	4.9	-7.7	1.0	-11.7	-3.9
Building foundation and exterior contractors	82.1	84.5	89.4	89.6	77.6	90.9	8.9	6.0	-13.2	1.5	-22.1	-4.6
Building equipment contractors	263.9	269.1	276.7	285.3	258.2	282.2	4.9	6.0	-6.7	-1.1	-11.5	-7.1
Building finishing contractors	100.8	100.9	99.1	102.7	94.7	106.4	-1.7	1.8	-4.4	3.6	-2.8	1.8
Other specialty trade contractors	75.1	76.4	77.6	79.0	70.3	81.9	3.3	3.4	-9.4	3.7	-12.7	0.3

Source: Authors' tabulation using BLS surveys

Impact of the COVID-19 on Race and Hispanic Ethnicity

The impact of the COVID-19 on construction employment across different races and Hispanic ethnicity is assessed using the employment data from the CPS. Table 4 shows the 12-month percentage change in employment for Whites, Black and African American, Asian, and Hispanic or Latino ethnicity for April and September of 2020. Hispanic and Asian communities suffered the most job loss in April 2020 in the construction industry. The 12-month decline in employment for the Hispanic and Asian communities in April 2020 was 20.3 percent and 19 percent, respectively. Most of the job losses among Asians and Hispanics in April 2020 were recovered by September 2020. However, the impact of the COVID-19 in September 2020 was sustained and more severe among

Black or African Americans. In September 2020, the 12-month decline in construction employment among Black or African Americans was 29.6 percent. Figure 2 shows the impact of the COVID-19 on construction employment from March to September of 2020. The impact of the COVID-19 for different months shown in Figure 2 is calculated according to Equation 1. Figure 2 shows that the construction employment decline is significant among the African American community compared to other races since July 2020. The COVID-19 impacts (as measured by Equation 1) for seven months from April 2020 were used in a two-sample t-test to determine if there were statistically significant differences in the average impact on employment across the racial category of construction workers. The result of the t-test reveals that there is a statistically significant difference among African Americans and White construction workers in terms of job loss during the COVID-19 (p=0.03).

Table 4. COVID-19 impact on construction employment (CPS)

RACE	Total Employment (in thousands)						% change 2018-2019		% change 2019-2020		COVID-19 Impact (%)	
	2018		2019		2020							
	Apr	Sep	Apr	Sep	Apr	Sep	Apr	Sep	Apr	Sep	Apr	Sep
Whites	9749.0	10270.0	9628.0	10498.0	8296.0	9946.0	-1.2	2.2	-13.8	-5.3	-12.6	-7.5
Hispanic And Latino	3474.0	3524.0	3446.0	3494.0	2717.0	3300.0	-0.8	-0.9	-21.2	-5.6	-20.3	-4.7
Black or African American	646.0	717.0	627.0	814.0	544.0	683.0	-2.9	13.5	-13.2	-16.1	-10.3	-29.6
Asian	206.0	249.0	221.0	224.0	195.0	227.0	7.3	-10.0	-11.8	1.3	-19.0	11.4

Source: Authors' tabulation using BLS surveys

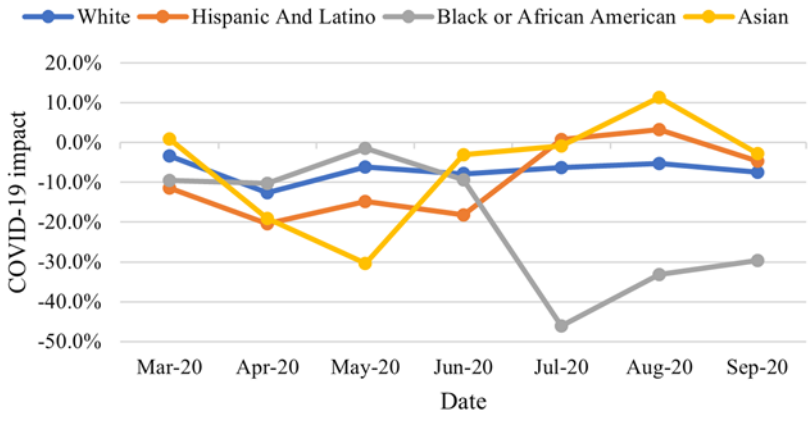

Figure 2. COVID-19 impact for different race and Hispanic ethnicity (Source: Authors' tabulation using BLS surveys)

Impact of the COVID-19 across different age group

The impact on employment across different age groups of construction workers during the COVID-19 pandemic is studied using CPS data. Table 5 shows the 12-month percentage change in construction employment for different age groups from March to September of 2020. Construction workers in the age group of 16-54 years were most impacted by job loss in April 2020. The 12-month percentage decline in employment for the age group of 16-54 years in April 2020 was 14.9 percent. Despite the high risk of the COVID-19 in the age group of 55 years and older, the 12-month employment decreased among this age group was 8.8 percent in April 2020, 6 points less than the age group of 16-54 years. However, the job loss among the construction workers of the age group 55 years and older was high in September 2020. In September 2020, a 12-month percentage reduction in construction employment was 13.3 percent for the age group of 55 years and over, 5 points more than the age group 16-54 years. The COVID-19 impacts (measured by Equation 1) from April 2020 to September 2020 were used to determine if there were statistically significant differences in the average impact on employment across the construction workers of different age groups. The result from the two-sample t-test reveals that there is no statistically significant difference between the age group of 16-55 years and the age group of 55 years and over in terms of job loss during the COVID-19 ($p=0.065$).

Table 5. COVID-19 impact on construction workers of different age group

COVID-19 Impact	Total Employment (in thousands)						% change 2018-2019		% change 2019-2020		COVID-19 Impact (%)	
	2018		2019		2020							
	16-54 years	over 55 years	16-54 years	over 55 years	16-54 years	over 55 years	16-54 years	over 55 years	16-54 years	over 55 years	16-54 years	over 55 years
COVID-19 Impact $_{\text{March}}$	8559.0	2163.0	8676.0	2328.0	8533.0	2394.0	1.4	7.6	-1.6	2.8	-3.0	-4.8
COVID-19 Impact $_{\text{April}}$	8655.0	2295.0	8486.0	2372.0	7062.0	2242.0	-2.0	3.4	-16.8	-5.5	-14.8	-8.8
COVID-19 Impact $_{\text{May}}$	8725.0	2326.0	8506.0	2359.0	7633.0	2231.0	-2.5	1.4	-10.3	-5.4	-7.8	-6.8
COVID-19 Impact $_{\text{June}}$	8820.0	2523.0	8951.0	2434.0	7974.0	2597.0	1.5	-3.5	-10.9	6.7	-12.4	10.2
COVID-19 Impact $_{\text{July}}$	8916.0	2637.0	9081.0	2659.0	8101.0	2651.0	1.9	0.8	-10.8	-0.3	-12.6	-1.1
COVID-19 Impact $_{\text{August}}$	8760.0	2615.0	9104.0	2622.0	8585.0	2577.0	3.9	0.3	-5.7	-1.7	-9.6	-2.0
COVID-19 Impact $_{\text{September}}$	9021.0	2564.0	9230.0	2726.0	8692.0	2535.0	2.3	6.3	-5.8	-7.0	-8.1	-13.3

Source: Authors' tabulation using CPS employment data

Impact of the COVID-19 across different states

The CES survey data is used to evaluate the impact of the COVID-19 on construction employment across the states in the U.S. Table 6 summarizes the impact of the COVID-19 on employment across different states for April and September of 2020. Figure 3 and Figure 4 show the color-coded maps to visualize the impact of the COVID-19 on construction employment across the states. It can be observed that some states on the Northeastern coast and the West coast of the United States suffered a disproportionate decline in construction employment in April 2020. Massachusetts, Michigan, New York, Pennsylvania, Washington, and Vermont lost more than 30 percent of construction jobs in April. However, the drastic job loss in these states was overcome to some extent by September 2020. The decline of construction employment in these states was below 20 percent in September 2020 except for Vermont, which still had an employment decline of 27 percent in September 2020. The two-sample t-tests were performed to examine if the COVID-19 impact (as measured by equation 1) on each state of the U.S. was significantly different from the COVID-19 impact in the overall United States. The COVID-19 impacts from April to September of 2020 were used to perform two-sample hypothesis testing. The results of the t-tests are shown in Figure 5. The average employment decline in states shown in red and green in Figure 5 are significantly different from the average employment decline in the overall U.S. construction industry. The states shown in red have a higher average COVID-19 impact (between April 2020 to September 2020) compared to the average COVID-19 impact on the U.S. construction employment. The states shown in green have a lower average COVID-19 impact compared to the average COVID-19 impact on the U.S. construction employment.

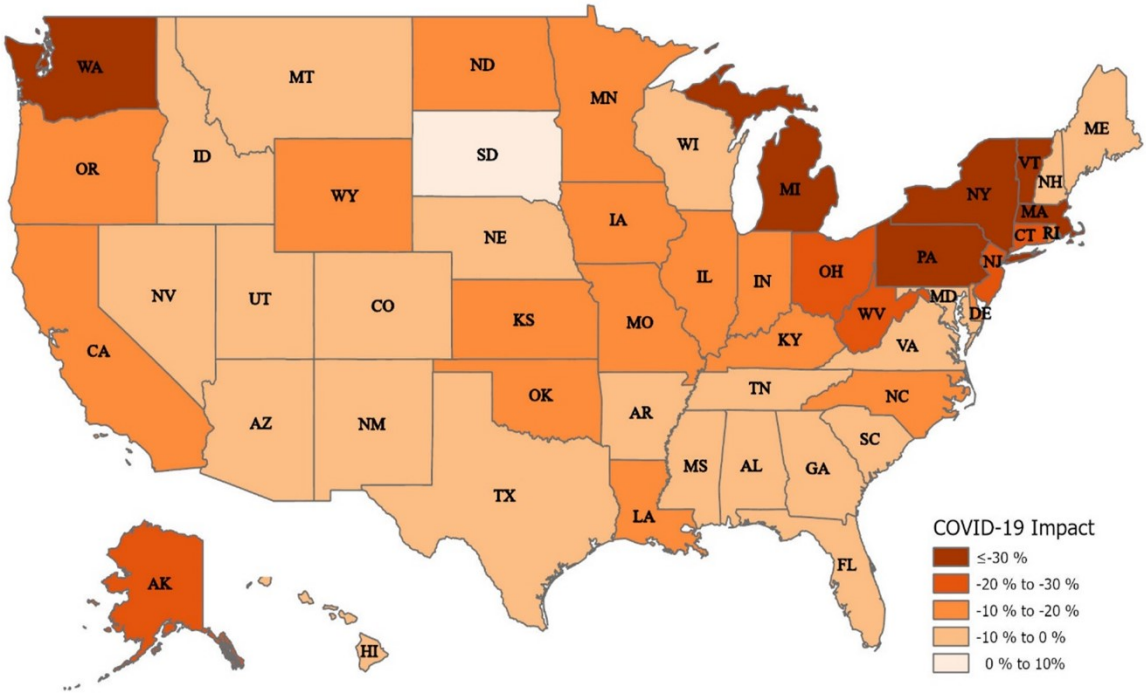

Figure 3: COVID-19 impact on construction employment across different states in April 2020 (Source: Authors' tabulation using BLS surveys (CES State and Metro Area))

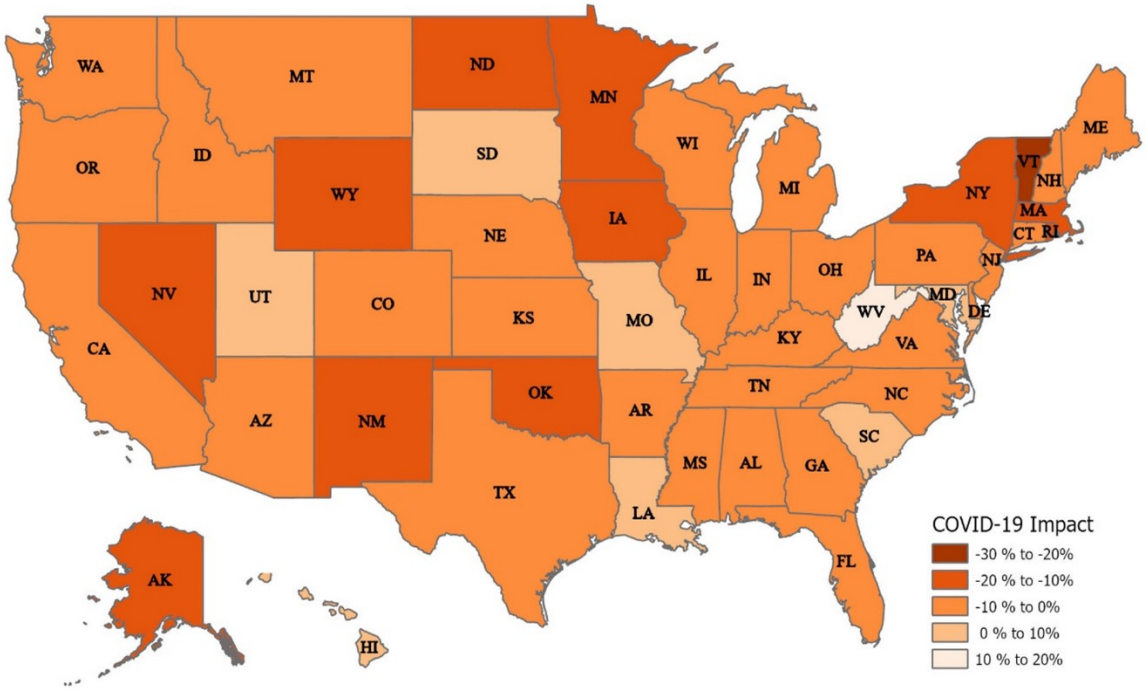

Figure 4. COVID-19 impact on construction employment across different states in September 2020 (Source: Authors' tabulation using BLS surveys (CES State and Metro Area))

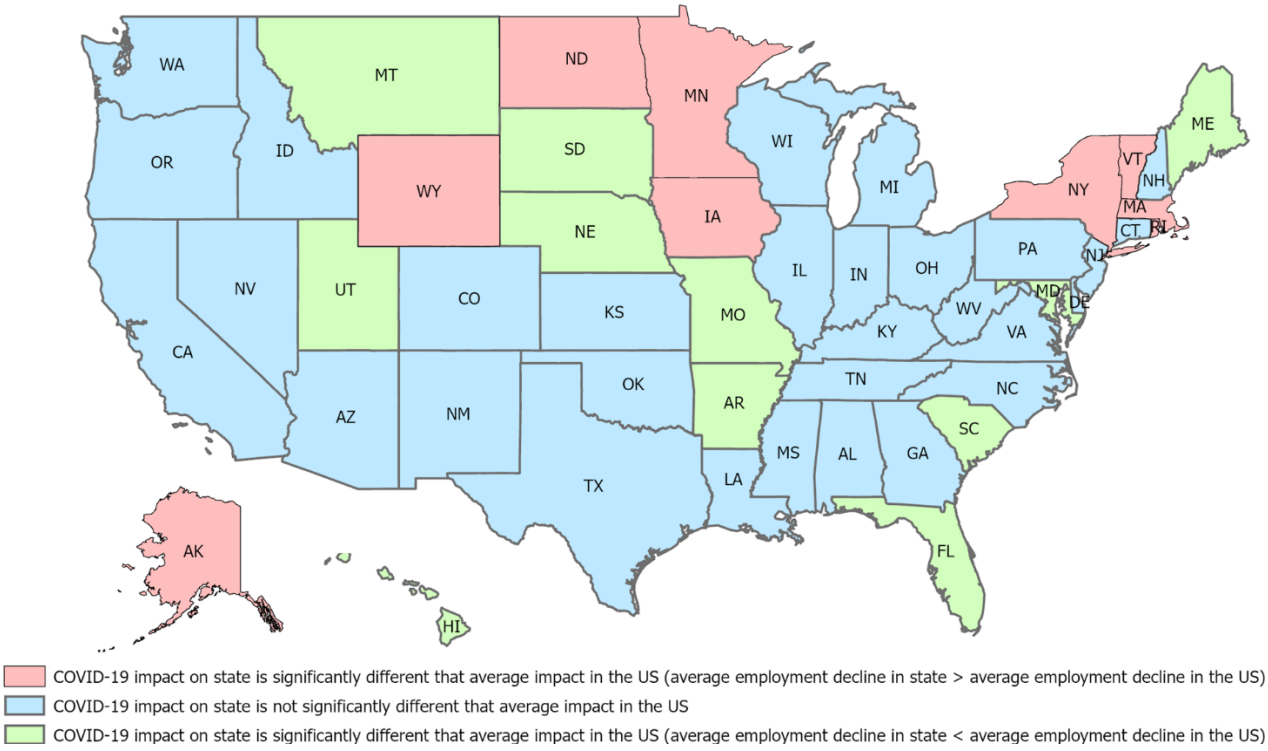

Figure 5. States with impact on construction employment significantly different than impact on construction employment in the U.S. (Source: Authors' tabulation using BLS surveys)

Table 6. COVID-19 impact on construction employment in different states of the U.S.

State	Total Employment (in thousands)						% change 2018-2019		% change 2019-2020		COVID-19 Impact (%)	
	2018		2019		2020							
	Apr	Sep	Apr	Sep	Apr	Sep	Apr	Sep	Apr	Sep	Apr	Sep
Alabama	88.0	90.6	93.1	94.8	89.4	93.3	5.8	4.6	-4.0	-1.6	-9.8	-6.2
Alaska	15.4	16.0	16.5	16.3	13.3	14.9	7.1	1.9	-19.4	-8.6	-26.5	-10.5
Arizona	155.7	161.3	169.1	173.1	169.4	169.6	8.6	7.3	0.2	-2.0	-8.4	-9.3
Arkansas	50.5	50.8	52.8	52.4	52.9	53.1	4.6	3.1	0.2	1.3	-4.4	-1.8
California	854.3	868.4	879.5	892.1	746.9	842.0	2.9	2.7	-15.1	-5.6	-18.0	-8.3
Colorado	172.2	174.8	177.7	180.3	166.0	171.5	3.2	3.1	-6.6	-4.9	-9.8	-8.0
Connecticut	58.0	59.2	60.7	59.4	50.2	57.1	4.7	0.3	-17.3	-3.9	-22.0	-4.2
Delaware*	22.0	22.4	22.9	22.7	20.2	21.4	4.1	1.3	-11.8	-5.7	-15.9	-7.1
Florida	538.2	550.4	560.2	568.9	559.7	559.8	4.1	3.4	-0.1	-1.6	-4.2	-5.0
Georgia	194.7	198.0	202.9	204.1	193.1	203.6	4.2	3.1	-4.8	-0.2	-9.0	-3.3
Hawaii*	37.3	37.4	37.4	36.7	37.2	37.4	0.3	-1.9	-0.5	1.9	-0.8	3.8
Idaho	48.2	50.1	52.0	53.9	52.3	54.6	7.9	7.6	0.6	1.3	-7.3	-6.3
Illinois	224.9	226.7	229.4	228.6	200.3	209.2	2.0	0.8	-12.7	-8.5	-14.7	-9.3
Indiana	139.7	141.9	145.7	145.5	134.8	146.5	4.3	2.5	-7.5	0.7	-11.8	-1.8
Iowa	76.3	77.6	78.0	78.2	70.1	66.6	2.2	0.8	-10.1	-14.8	-12.4	-15.6
Kansas	59.9	62.5	65.5	63.0	61.4	62.5	9.3	0.8	-6.3	-0.8	-15.6	-1.6
Kentucky	77.9	78.1	79.9	80.6	73.5	81.6	2.6	3.2	-8.0	1.2	-10.6	-2.0
Louisiana	152.3	152.3	145.2	138.1	119.8	126.9	-4.7	-9.3	-17.5	-8.1	-12.8	1.2
Maine	29.3	29.5	29.5	30.0	28.7	30.3	0.7	1.7	-2.7	1.0	-3.4	-0.7
Maryland*	163.9	165.0	166.8	166.9	159.2	171.5	1.8	1.2	-4.6	2.8	-6.3	1.6
Massachusetts	158.2	159.5	162.5	163.2	105.4	143.9	2.7	2.3	-35.1	-11.8	-37.9	-14.1
Michigan	167.5	169.3	171.2	174.5	98.2	174.6	2.2	3.1	-42.6	0.1	-44.8	-3.0
Minnesota	115.3	123.7	123.7	130.3	114.5	121.0	7.3	5.3	-7.4	-7.1	-14.7	-12.5
Mississippi	45.0	43.6	43.5	44.3	41.1	41.9	-3.3	1.6	-5.5	-5.4	-2.2	-7.0
Missouri	122.9	123.2	126.9	127.1	117.3	132.0	3.3	3.2	-7.6	3.9	-10.8	0.7
Montana	28.7	29.5	29.5	30.4	29.7	30.8	2.8	3.1	0.7	1.3	-2.1	-1.7
Nebraska*	53.0	53.7	54.2	55.4	55.4	53.9	2.3	3.2	2.2	-2.7	-0.1	-5.9
Nevada	88.4	90.9	95.0	97.4	94.7	93.1	7.5	7.2	-0.3	-4.4	-7.8	-11.6
New Hampshire	26.8	26.8	27.5	28.1	26.2	27.4	2.6	4.9	-4.7	-2.5	-7.3	-7.3
New Jersey	157.7	157.7	160.0	160.7	121.9	148.7	1.5	1.9	-23.8	-7.5	-25.3	-9.4
New Mexico	47.5	47.3	48.7	51.1	49.3	48.1	2.5	8.0	1.2	-5.9	-1.3	-13.9
New York	396.3	404.2	408.7	406.4	243.2	365.8	3.1	0.5	-40.5	-10.0	-43.6	-10.5
North Carolina	217.2	221.6	230.6	232.4	218.6	222.0	6.2	4.9	-5.2	-4.5	-11.4	-9.3
North Dakota	25.1	26.1	28.0	28.2	27.9	25.9	11.6	8.0	-0.4	-8.2	-11.9	-16.2
Ohio	218.4	223.4	227.2	227.1	188.5	213.4	4.0	1.7	-17.0	-6.0	-21.1	-7.7
Oklahoma	79.9	81.7	83.0	82.9	75.0	75.6	3.9	1.5	-9.6	-8.8	-13.5	-10.3
Oregon	104.2	106.5	108.3	109.7	99.8	104.7	3.9	3.0	-7.8	-4.6	-11.8	-7.6
Pennsylvania	254.9	254.8	261.7	260.7	158.4	247.3	2.7	2.3	-39.5	-5.1	-42.1	-7.5
Rhode Island	19.1	19.3	20.2	20.0	17.7	18.6	5.8	3.6	-12.4	-7.0	-18.1	-10.6
South Carolina	106.1	105.6	106.5	107.4	102.7	109.6	0.4	1.7	-3.6	2.0	-3.9	0.3
South Dakota*	23.3	24.2	23.9	25.0	26.4	27.7	2.6	3.3	10.5	10.8	7.9	7.5
Tennessee*	127.4	130.6	134.1	134.1	129.7	130.4	5.3	2.7	-3.3	-2.8	-8.5	-5.4
Texas	733.0	746.3	767.5	783.5	729.3	745.2	4.7	5.0	-5.0	-4.9	-9.7	-9.9
Utah	103.7	104.8	107.8	111.1	111.5	117.8	4.0	6.0	3.4	6.0	-0.5	0.0
Vermont	15.3	15.2	15.4	15.2	7.6	11.1	0.7	0.0	-50.6	-27.0	-51.3	-27.0
Virginia	197.6	198.1	202.6	204.1	197.3	207.9	2.5	3.0	-2.6	1.9	-5.1	-1.2
Washington	210.8	215.5	219.0	222.1	148.3	217.5	3.9	3.1	-32.3	-2.1	-36.2	-5.1
West Virginia	36.5	44.6	36.9	34.0	29.1	32.4	1.1	-23.8	-21.1	-4.7	-22.2	19.1
Wisconsin	120.7	123.1	123.8	124.5	115.6	122.0	2.6	1.1	-6.6	-2.0	-9.2	-3.1
Wyoming	19.6	20.1	22.6	22.8	21.6	22.8	15.3	13.4	-4.4	0.0	-19.7	-13.4

Source: Authors' tabulation using BLS surveys (CES State and Metro Area)

*Employment number is for combined mining, logging, and construction industry

Table 7 summarizes the impact of the COVID-19 on construction earnings across different states for April and September. Figure 6 and Figure 7 present the geographic information of the impact of the COVID-19 on construction average weekly earnings by state. Figure 7 shows a darker shade than Figure 6, which indicates an overall decline in construction earnings in September compared to April, especially in the central area. It is observed that some states showed an increase in construction average weekly earnings in April in spite of the decrease in construction jobs, which confirms the substantial job loss among low-paid workers. For instance, Michigan lost more than 40 percent of construction jobs while the weekly earnings inched up 2 percent in April. In contrast to the overall recovery in construction jobs, most states showed a further decrease in average weekly earnings compared to April, which indicates the sustained effect of the pandemic on the construction industry. The drop in construction earnings in Nevada increased from 29.7 percent to 38.8 percent. Only Alabama, Alaska, North Dakota, Rhode Island, and Wisconsin recovered to the pre-pandemic level (positive value in September). The weekly earnings data are not available for some states, such as Delaware, Hawaii, and South Dakota, as data may be too small to publish at the construction industry level.

Table 7. COVID-19 impact on construction average weekly earnings in different states of the U.S.

State	Average weekly earnings (in dollars)						% change 2018-2019		% change 2019-2020		COVID-19 Impact (%)	
	2018		2019		2020							
	Apr	Sep	Apr	Sep	Apr	Sep	Apr	Sep	Apr	Sep	Apr	Sep
Alabama	963.6	968.3	1003.3	993.5	980.5	1025.6	4.1	2.6	-2.3	3.2	-6.4	0.6
Alaska	1456.5	1572.1	1396.3	1562.2	1436.4	1625.2	-4.1	-0.6	2.9	4.0	7.0	4.7
Arizona	1001.9	1008.6	1037.2	1029.9	1053.9	1046.8	3.5	2.1	1.6	1.6	-1.9	-0.5
Arkansas	881.3	899.3	910.3	990.0	987.8	977.3	3.3	10.1	8.5	-1.3	5.2	-11.4
California	1307.0	1347.8	1389.4	1411.5	1317.8	1355.9	6.3	4.7	-5.2	-3.9	-11.5	-8.7
Colorado	1088.3	1144.1	1176.9	1225.4	1201.5	1184.1	8.1	7.1	2.1	-3.4	-6.0	-10.5
Connecticut	1130.3	1205.7	1280.2	1341.0	1342.1	1410.4	13.3	11.2	4.8	5.2	-8.4	-6.0
Delaware*	-	-	-	-	-	-	-	-	-	-	-	-
Florida	999.9	1026.4	1035.4	1075.2	1047.2	1079.0	3.5	4.8	1.1	0.3	-2.4	-4.4
Georgia	1083.7	1080.9	1112.0	1126.3	1077.1	1095.7	2.6	4.2	-3.1	-2.7	-5.8	-6.9
Hawaii*	-	-	-	-	-	-	-	-	-	-	-	-
Idaho	912.4	999.1	930.8	1008.1	989.2	1010.5	2.0	0.9	6.3	0.2	4.3	-0.7
Illinois	1376.8	1513.2	1489.5	1504.5	1420.5	1322.3	8.2	-0.6	-4.6	-12.1	-12.8	-11.5
Indiana	1118.4	1163.4	1134.6	1198.9	1130.2	1065.8	1.4	3.1	-0.4	-11.1	-1.8	-14.2
Iowa	1003.1	1158.4	1063.9	1109.1	1094.9	1036.0	6.1	-4.3	2.9	-6.6	-3.2	-2.3
Kansas	969.5	1019.7	1084.7	1119.3	1133.3	1066.2	11.9	9.8	4.5	-4.7	-7.4	-14.5
Kentucky	991.4	988.6	974.3	1016.0	1015.3	997.9	-1.7	2.8	4.2	-1.8	5.9	-4.5
Louisiana	1124.3	1097.5	1133.6	1214.8	1165.9	1335.3	0.8	10.7	2.8	9.9	2.0	-0.8
Maine	990.1	935.3	989.7	1035.8	997.6	1012.7	0.0	10.7	0.8	-2.2	0.8	-13.0
Maryland*	-	-	-	-	-	-	-	-	-	-	-	-
Massachusetts	1400.0	1449.0	1485.1	1544.1	1446.2	1521.1	6.1	6.6	-2.6	-1.5	-8.7	-8.1
Michigan	1058.2	1148.5	1104.9	1200.1	1175.5	1168.5	4.4	4.5	6.4	-2.6	2.0	-7.1
Minnesota	1216.8	1336.4	1183.7	1332.5	1306.0	1296.2	-2.7	-0.3	10.3	-2.7	13.1	-2.4
Mississippi	925.9	888.3	918.0	984.7	873.8	921.2	-0.9	10.9	-4.8	-6.5	-4.0	-17.3
Missouri	1112.6	1108.9	1151.1	1155.3	1163.7	1076.3	3.5	4.2	1.1	-6.8	-2.4	-11.0
Montana	995.9	1096.7	1079.0	1109.8	1035.2	1048.6	8.3	1.2	-4.1	-5.5	-12.4	-6.7
Nebraska*	-	-	-	-	-	-	-	-	-	-	-	-
Nevada	1052.8	1106.6	1371.2	1430.9	1378.9	1295.4	30.3	29.3	0.6	-9.5	-29.7	-38.8
New Hampshire*	-	-	-	-	-	-	-	-	-	-	-	-
New Jersey	1349.1	1372.7	1440.1	1456.6	1369.1	1499.7	6.7	6.1	-4.9	3.0	-11.7	-3.1
New Mexico	897.0	916.5	965.3	1007.8	989.2	962.4	7.6	10.0	2.5	-4.5	-5.2	-14.5
New York	1436.7	1442.9	1480.6	1495.2	1449.1	1420.8	3.1	3.6	-2.1	-5.0	-5.2	-8.6
North Carolina	972.0	901.3	961.7	1011.6	962.4	1010.1	-1.1	12.2	0.1	-0.2	1.1	-12.4
North Dakota	1108.4	1305.5	1267.2	1232.5	1233.9	1228.5	14.3	-5.6	-2.6	-0.3	-17.0	5.3
Ohio	1108.7	1145.2	1140.4	1190.9	1125.3	1137.0	2.9	4.0	-1.3	-4.5	-4.2	-8.5
Oklahoma	977.7	1016.5	1046.6	1105.0	994.4	1029.0	7.0	8.7	-5.0	-6.9	-12.0	-15.6
Oregon	1135.9	1165.4	1178.9	1185.4	1192.1	1094.0	3.8	1.7	1.1	-7.7	-2.7	-9.4
Pennsylvania	1194.7	1172.0	1225.1	1240.3	1114.2	1225.5	2.5	5.8	-9.1	-1.2	-11.6	-7.0
Rhode Island	1090.8	1075.9	1131.6	1196.5	1371.6	1417.5	3.7	11.2	21.2	18.5	17.5	7.3
South Carolina	975.2	934.8	1015.7	1053.0	1050.0	1089.9	4.2	12.6	3.4	3.5	-0.8	-9.1
South Dakota*	-	-	-	-	-	-	-	-	-	-	-	-
Tennessee*	-	-	-	-	-	-	-	-	-	-	-	-
Texas	1230.6	1138.5	1216.7	1244.5	1168.4	1137.6	-1.1	9.3	-4.0	-8.6	-2.8	-17.9
Utah	1011.2	1077.5	1047.1	1126.0	1117.6	1111.0	3.6	4.5	6.7	-1.3	3.2	-5.8
Vermont	917.3	939.2	993.9	1042.8	986.0	1064.3	8.4	11.0	-0.8	2.1	-9.2	-9.0
Virginia	1032.8	970.2	1077.5	1108.5	1093.3	1135.5	4.3	14.3	1.5	2.4	-2.9	-11.8
Washington	1330.5	1341.1	1382.7	1441.6	1374.9	1375.1	3.9	7.5	-0.6	-4.6	-4.5	-12.1
West Virginia	1103.2	1113.8	1122.8	1160.3	1091.2	1099.1	1.8	4.2	-2.8	-5.3	-4.6	-9.5
Wisconsin	1146.3	1238.8	1141.7	1191.2	1214.6	1205.5	-0.4	-3.8	6.4	1.2	6.8	5.0
Wyoming	1101.2	1194.1	1168.9	1163.1	1026.1	1076.3	6.1	-2.6	-12.2	-7.5	-18.4	-4.9

Source: Authors' tabulation using BLS surveys (CES State and Metro Area)

*Construction average weekly earnings are not available in CES State and Metro Area database

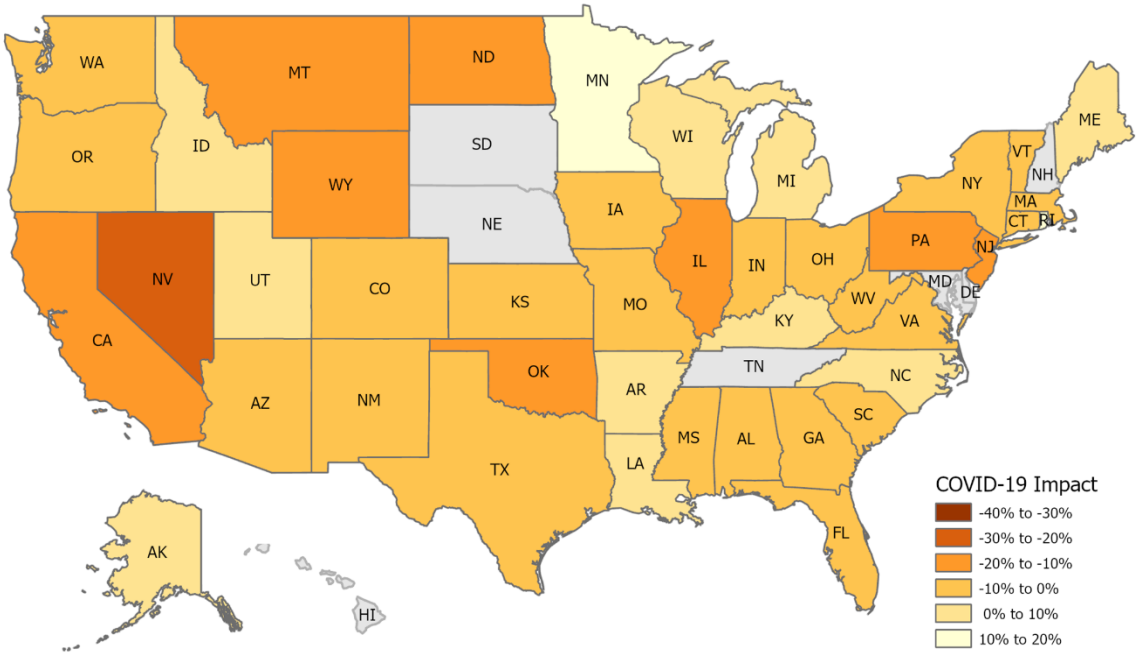

Figure 6. COVID-19 impact on construction average weekly earnings across different states in April 2020 (Source: Authors' tabulation using BLS surveys (CES State and Metro Area))

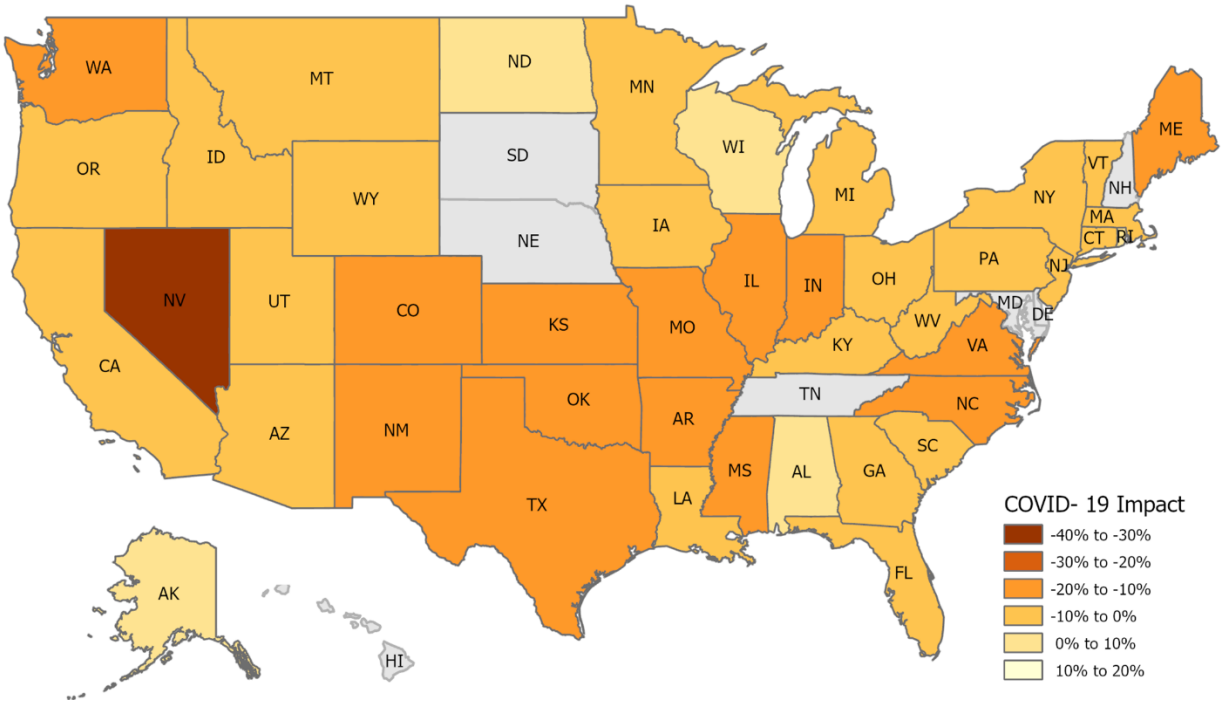

Figure 7. COVID-19 impact on construction average weekly earnings across different states in September 2020 (Source: Authors' tabulation using BLS surveys (CES State and Metro Area))

Discussion

The COVID-19 induced recession caused construction employment to decline by 15.6 percent in April 2020 compared to the same month of 2019 (Table 1). However, the construction industry was quick to add a significant number of jobs after the sharp decline in April despite the reduced construction activities and continued restrictions imposed by states on construction (Figure 1). The most probable reason for the employment gain can be the Paycheck Protection Program (PPP) included in the Coronavirus Aid, Relief, and Economic Security (CARES) act. The PPP provided small businesses with 500 or fewer employees the resources to maintain the payroll, hire back the laid-off workers, and cover the overhead cost (CARES Act 2020). The fund was provided to cover the 8 weeks payroll costs, including the benefits. One hundred seventy-eight thousand construction firms were approved $44.9 billion for PPP loan from the initially allocated $349 billion PPP program in April 2000 (Stewart 2020). In the subsequent months following April, there was a significant increase in the number of construction firms applying for the PPP loan to support their employees. According to a PPP report from the U.S. Small Business Administration (SBA), 466,221 firms were approved for $64.56 billion in PPP loans by June 2020 (U.S. Small Business Administration 2020). The magnitude of the loan received by the construction firms bolsters the fact that the significant gain in construction employment was not only because of increased construction activity but also because of the PPP loans that helped keep the employees on the payroll despite reduced construction works. The PPP loans are subjected to forgiveness if the funds were used to support payroll costs, mortgage interest payment, rent, or other utility costs. The loan forgiveness can help the construction firms overcome the burden of payroll costs that were incurred when no construction activities were performed to curb the spread of the COVID-19. The SBA prepared a loan necessity questionnaire to assess the operations and financial conditions of firms that received more than $ 2 million (Goodman 2020). The strict reassessment of the construction firms' operation and financial conditions to check the eligibility for PPP loan forgiveness will obligate more construction firms to pay back the PPP loan, which was taken at the time of high uncertainty and reduced construction activities, hindering the post-COVID-19 recovery of construction firms as well as the construction employment.

Although the PPP loan provided strong support for sustaining the construction employment in the initial stages of the COVID-19 pandemic, the entire impact on the construction employment was in no way overcome by this program. The impact and challenges introduced by the COVID-19 varied among women workforce, minorities, aging workers, and across the states, and are discussed in the following sections.

Impact on Women

The construction industry has historically low participation of women. Women made up 47 percent of the U.S. workforce and only represent 10.3 percent of the construction workforce in 2019 (BLS 2020a). The CES survey data reveals that women in payroll jobs were impacted less due to the COVID-19-induced job loss compared to overall construction workers in April and September of 2020. In April 2020, the 12-month percentage decline in payroll jobs for women in construction was only 11.9 percent (Table 2) compared to 15.8 percent (Table 1) for overall payroll jobs in construction. The 12-month employment decline among women for three different construction sectors in April 2020 was also lower than the employment decline for overall construction workers (Figure 8). This finding contrast with the overall impact on the U.S. women workforce during April 2020, when women's unemployment rate was 16.2 percent, 3 points higher than the U.S. men's workforce (Schmidt 2020). The low impact on women's construction employment obtained from payroll or CES survey can be explained based on the nature of women's work in the construction industry. 86.7 percent of women involved in construction mostly hold office positions that require less involvement in construction site works (Zitzman 2020). Women only represent 3.7 percent of total construction laborers, 2.2 percent of total carpenters, and 1.9 percent of total masons in the construction industry (BLS 2019). The lower involvement of women in construction site works, which were temporarily shut to minimize the risk of COVID-19 spread, might have caused a lower employment decline for women's construction workforce compared to men. However, the increasing evidence shows that working mothers face difficulty in managing time between work and childcare due to the closure of daycare centers and schools in the United States (Alon et al. 2020; Karageorge 2020). The additional burden of childcare imposed by the COVID-19 pandemic can further widen the participation gap between men and women in the construction sector as the pandemic length increases. Alon et al. (2020) compared the COVID-19 pandemic with World War II and suggested

that it is likely that the COVID-19 may change the American family dynamics and gender norms, which can have a lasting impact on the U.S. women workforce. Many women who joined the workforce during World War II did not revert to previous household works when the war was over. For COVID-19-induced employment decline for women, it may be possible that women who are out of the U.S. construction labor force may never join the industry again. On the other hand, the pandemic could also play a crucial role in changing the traditional gender role beliefs (e.g., traditional way of parenting by women). The pandemic allowed many white collars jobs holders to work remotely during the lockdown. The fathers who were working remotely were involved in more household chores and childcare than they did before the pandemic (Chung et al. 2021). The shared responsibility of parenting can provide working women additional time for their career development. Also, women workers in various industries except construction have experienced higher job loss compared to men's workforce. The women workforce who lost their jobs in other industries (e.g., retail, hospitality) can find new opportunities in construction as more resources are streamed for the construction of critical infrastructure, housing, and sustainable cities. As the construction sector creates more opportunities during the post-pandemic economic recovery stages, the women workforce has a strong possibility to rebuild their proportion in the construction industry.

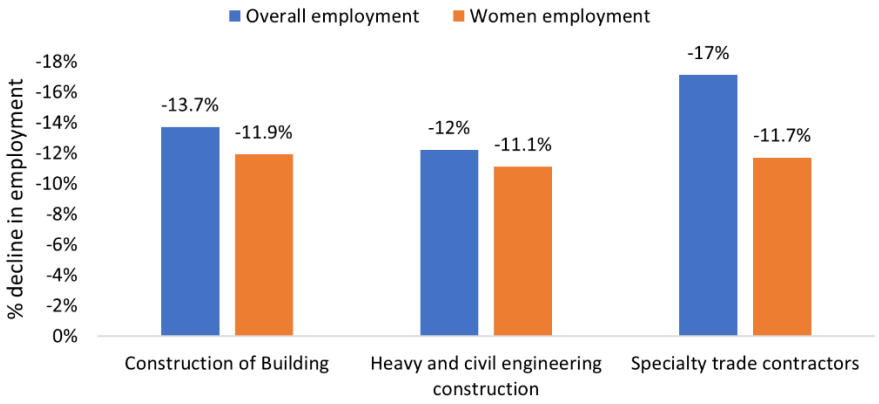

Figure 8. Employment decline among women and overall construction workers in April 2020 (Source: Authors' tabulation using BLS surveys)

Although the impact on jobs of women in construction is lower compared to men during the initial stage of the COVID-19 pandemic, it is necessary to note that any decline in the women workforce in the construction sector,

which already has a lower representation of women, will further impact the gender diversity of the U.S. construction industry. The construction sector and policymakers must be aware of the effect the COVID-19 had on women in construction and draft policies that promote women hiring not only to ameliorate the current impact but to eliminate future labor shortages in the construction industry.

Impact on Minorities

The analysis of construction employment data reveals that minorities, such as Black or African Americans, Asians, and Hispanic or Latino communities are more likely to be affected by any shock in the construction industry. In April of 2020, construction workers from the Hispanic and Asian communities were most impacted by the sudden decline in construction employment. The initial impact of the COVID-19 in April 2020 caused more than a 19 percent decline in construction employment for Hispanics and Asians compared to 12.6 percent for Whites. The impact of the COVID-19 has been more severe among the Black or African American community than other races or ethnicities. In July 2020, the Black or African American community had a 46 percent decline in construction employment (Figure 2). This magnitude of impact on the Black or African American community is more alarming as the Black or African American community only represents 6.4 percent of the construction workforce compared to their 12.3 percent representation in the U.S. workforce (BLS 2020b). The disproportionate impact of the COVID-19 on minority workers in the construction industry may be because a higher number of minorities worker are involved in COVID-19 prone construction site jobs that were forced to close during the pandemic. Also, Hispanics and African American workers in construction are less likely to get insured from work, rendering them vulnerable during the COVID-19 pandemic (Brown 2020; Samantha et al. 2020). Lower representation of the Black or African American community in management-level construction jobs can also be one of the reasons for the higher impact of the COVID-19 among African American construction workers. According to BLS employment data published in 2019, 90.9 percent of construction managers were whites, 3.5 percent were African American, while the proportion of African Americans in the entire construction industry was 6.4 percent (BLS 2020c). Moreover, the minority-owned construction firms experienced severe impacts during the COVID-19 pandemic. General

contractors subcontracted only those firms with which they had a good relation, leaving the minority-owned small business with little or no work. The 90 days waiver on equal opportunity and affirmative action requirement for the COVID-19 relief contract exempted federal organizations from ensuring the participation of minority contractors (Slowey 2020). The policy level work should be able to promote the representation of minorities in all levels of the construction industry to eliminate the disproportionate effect on minorities in future shocks caused by a pandemic or financial crisis. Further, the construction industry provides access to good jobs, which are essential in minimizing the persistent and large racial wage inequalities (Mishel 2013). A lower proportion of minorities in the construction sector will prevent these communities from jobs generated from large infrastructure projects created out of private and governmental spending. The current COVID-19 pandemic has caused a sharp employment decline among the minorities in the construction industry. Hence, it is necessary that new economic plans to overcome the effects of the COVID-19 pandemic incorporate the policy that will promote the participation of minorities in all levels of the construction industry.

Impact on Age Groups

The construction industry workforce is aging. The construction workers' median age is 42, a year more than a standard worker in the national labor force (Zhao 2019). Experienced workers are valuable for apprenticeship in the construction industry, which is regarded as one of the antidotes of the skilled worker shortage, a problem that has plagued the construction industry for years (U.S. Department of Labor 2020). A 2018 survey by Autodesk and the Associated General Contractors of America (AGC) shows that 80% of contractors report difficulty finding qualified craft workers to hire (AGC 2018). In August 2020, Autodesk and AGC conducted the workforce survey again with 2,000 participating firms. The results show that during the pandemic, even though 60% of firms report future projects have been canceled or delayed, 52% of firms still have a hard time finding craft workers (AGC 2020). Despite the importance of experienced workers, elderly people and people with underlying conditions are at high risk of the COVID-19 (CDC 2020). Therefore, the impact of the COVID-19 on construction employment for two age groups (16 to 55 years & 55 years and over) is examined using CPS employment statistics. It is observed that 12-month employment decline among the age group of 55 years and older was lower than the age group of 16

to 55 years during April to August of 2020. However, in September, the employment decline among the age group of 55 and over was higher than the construction workers within the age group of 16 to 55 years (Figure 9). The lower impact on employees in the age group of 55 and over during the initial months of the COVID-19 because maybe some employees in this age group have more personal leave, vacation, or sick leave to use up before they had to take unemployment. Proper measures should be employed by the companies to retain experienced elderly workers and minimize their risk during the pandemic. Any abrupt impact on the aging workforce will not only create a swift labor shortage but also will impact the skill transfer to the new workers coming into the construction industry, including youth, women, and minority workers.

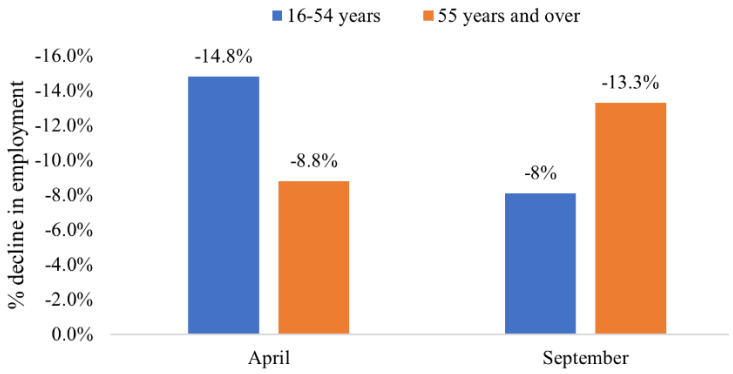

Figure 9. Employment decline among two age groups in April and September of 2020 (Source: Authors' tabulation using BLS surveys)

Geographic Impact

The study of the construction jobs across the United States showed that all but South Dakota had a decline in construction jobs in April 2020 (Figure 3). Massachusetts, Michigan, New York, Pennsylvania, Washington, and Vermont had more than a 30 percent decline in construction employment in April 2020. The drastic employment decline in these states can be because of two reasons. First, these states only allowed some construction projects to proceed and issued a stay-at-home order to curb the spread of the COVID-19 (Construction Drive 2020). Emergency constructions permitted in these states had to follow social distancing norms, which further limited the number of workers in the construction site. This caused a significant reduction in construction employment in April 2020. Second, the cancellation of projects amid the increasing fear of the COVID-19 forced the construction firms to

furlough or terminate the employees (Coronavirus - AGC Surveys 2020). However, as of September 2020, the drastic impact on employment jobs caused during the initial impact of the pandemic was overcome to some extent. The decline of construction employment in all states across the U.S. was below 20 percent except for Vermont, which still had a 27 percent decline in construction employment (Table 5). Also, analyzing the COVID-19 impact for different months from April 2020 to September 2020, it was observed that 13 states had the strongest impact in months other than April 2020. These states are Arizona, Florida, Iowa, Maine, Mississippi, Montana, Nebraska, Nevada, New Hampshire, New Mexico, North Dakota, Oklahoma, Texas. The strongest impact in the different months can be due to a surge of the COVID -19 cases in different months across the United States. California and Texas had the highest number of job losses compared to all other states in the U.S. during the initial wave of the COVID-19. Comparing the 12-month difference in employment from September 2019 to September 2020, California and Texas lost 50 thousand and 38 thousand jobs, respectively (Table 6). In California and Texas, Hispanic workers account for more than half of construction workers (Simpson 2021). Although California and Texas experienced a significant number of job losses, the 12-month percent decrease in construction employment was severe in Alaska, Iowa, Massachusetts, Minnesota, New York, North Dakota, Rodhe Island, Vermont, and Wyoming (Figure 5). Of the states where the percentage of job loss was significantly higher than the U.S. overall construction (Figure 5), New York has the highest representation of Black and African Americans in the state's construction workforce. New York has a 14 percent representation of Black or African Americans in the state's construction industry, as opposed to nearly 7 percent of the nation's African American construction workforce (Torres 2020).

Moreover, the employment recovery in the construction industry shall also vary geographically. In a state like Alaska, the impact of the COVID-19 jobs can be overcome after seasonal construction workers commute freely following the uplifting of travel bans. Hawaii being self-contained experienced a lower impact on construction jobs during the initial wave of the COVID-19 and will likely be quick to recover the construction jobs. The recovery of a state's construction industry will most likely depend on the state's population growth, housing demand, affordability of housing, the state's resiliency, and the state department of transportations (DOTs) ability to fund

the transportation projects (Pain et al. 2020; Black 2020). The states with increasing housing demand (Khater et al. 2020), such as California, Florida, Texas, and North Carolina, can experience speedy recovery in construction jobs if the current depression does not aggravate with the increasing length of the pandemic. On the other hand, the state DOTs that have experienced a precipitous decline in transportation revenue, mostly due to reduced collection from motor fuel tax, highway use tax, and department of motor vehicle fees, will likely limit the funding for ongoing and planned construction projects shedding significant construction jobs form highway and transportation sector. The $10 billion aid to the state DOTs, approved by congress as a year-end legislative package on December 21, 2020 (Franks 2020), will boost the DOTs' capacity to fund the capital and maintenance project in the upcoming years. However, the $10 billion relief will not be sufficient to overcome all the impacts on state DOTs that are expected to face revenue shortfall totaling $ 37 billion over the next five fiscal years (AASTHO 2020).

In contrast to construction jobs, the impact of the pandemic on construction earnings is more persistent. The significant job loss among low-paid construction workers created the illusion of an increase in construction earnings in 12 states at the beginning of the pandemic. However, the lagging effect of the pandemic exacerbated the decline in construction earnings as observed in 30 states in September. This can be partially attributed to the precipitous drop in the project pool and dramatic increase in projects placed “on-hold”: American Road and Transportation Builders Association (ARTBA) reported $9.6 billion infrastructure projects in total had been delayed or canceled amidst the COVID-19 pandemic. Till August, sixteens states announced project delays or cancellations counting up to $5 billion (ARTBA 2020). The effect of the pandemic on the industry is likely to continue. First of all, the “shelter-in-place” policies significantly impact construction site activities, causing schedule shifts, change orders, labor shortage, which impose a heavy burden on timely project delivery. Secondly, relaxing and lifting the restrictions does not necessarily lead to a full recovery in the industry, since the global shock of the pandemic has interrupted the supply chain of major materials. Construction activities were disturbed by material and equipment shortages, as reported by several states. Last but not least, it takes time for construction companies to develop and implement appropriate operating practices and protocols to adapt to the “new normal” working environment (e.g.,

personal protective equipment (PPE), social distance). The above uncertainty and risks all add to projects delays and disruptions.

Conclusion

This article reviews the impact of the COVID-19 on the U.S. construction labor market. This study contributes to the state of knowledge by (1) revealing how the COVID-19 pandemic impacted the construction employment across different demographic groups and geographic regions in the U.S. and (2) identifying vulnerable demographic groups (e.g., minorities, women, older workers) in the construction workforce that are disproportionally impacted by the pandemic. The impact of the COVID-19 on construction employment is examined using the employment data collected from the Central Population Survey (CPS) and the Current Employment Statistics (CES) Program. Analysis of CES employment data reveals a 15.6 percent decline in construction employment in April of 2020. By September 2020, some construction jobs were recovered, and the decline in construction employment was 5.3 percent. However, the construction earnings remained 3.4 percent lower than the pre-pandemic level. CES survey reveals that there has been less payroll job loss among women workforce compared to the overall decline in construction employment. Minorities, especially the Black or African American community have been disproportionately affected by the employment decline during the COVID-19. In September 2020, there was a 29.6 percent decline in construction employment compared to a 10.3 percent decline in April 2020. The employment decline among the age group of 16 to 55 years was higher compared to the age group of 55 years and over in the initial stage of the COVID-19; however, by September 2020, the employment decline in the age group of 55 years and over was 13.3 percent, 5 points higher than the age group of 16 to 55 years. The study of the geographic impact of the COVID-19 on construction employment reveals that the Northeastern coast of the United States suffered a significant employment decline in April of 2020 when most businesses were shut down to curb the spread of the COVID-19.

To conclude, the ongoing COVID-19 has caused a significant impact on the construction employment for the different demographic groups and across various states in the U.S. Without appropriate intervention through policymaking or informed decisions by workforce managers, the minorities who are disproportionately affected by

this pandemic, the women workers facing challenges managing the time between work and childcare, and elderly workers in high risk of the COVID-19 will have difficulty maintaining their representation in the construction industry. Given that government regulations to address the COVID-19, and actions being taken to mitigate financial risks vary significantly in addition to the volatility in the construction market and economic condition, there is no "one size fits all" solution. Owner organizations, contractors, and professionals in the industry shall have a better understanding of the challenges brought by the virus and variability in the construction market to maximize the utilization of limited resources and prepare proactive risk mitigation strategies for enhanced decision-making. This study contributes to the state of practice by helping policymakers understand the pandemic's disproportionate impact across different demographic groups and geographic regions. It is expected that this study assists policymakers draft equitable recovery policies to overcome the setbacks caused by the pandemic. This study, however, only focused on the employment and earnings change to assess the impact of the COVID-19 in the U.S. construction labor market. Further research assessing the impact on demand for building construction, large infrastructure, and utility construction projects can help policymakers and organizations draft long-term policies to overcome the adverse impacts of the COVID-19 on the construction industry.

Data Availability Statement

All data, models, or code used during the study were provided by a third party. Direct requests for these materials may be made to the provider as indicated in the 'Acknowledgment' section of this paper.

Acknowledgment

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Link to CPS database: https://www.bls.gov/cps/data.htm

Link to CES database: https://www.bls.gov/ces/data/

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