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Labor Impacts of COVID-19 in U.S. Agriculture: Evidence from the Current Population Survey

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Abstract

Early research hypothesized impacts of COVID-19 on agricultural workers, food supply, and rural health systems based on population characteristics from data collected preceding the pandemic. Trends confirmed a vulnerable workforce and limits to field sanitation, housing quality, and healthcare. Less is known about eventual, realized impacts. This article uses the Current Population Survey's COVID-19 monthly core variables from May 2020 through September 2022 to document actual impacts. Summary statistics and statistical models for the probability of being unable to work reveal that 6 to 8% of agricultural workers were unable to work early in the pandemic and that impacts were disproportionately negative for Hispanics and those with children. An implication is that targeted policies based on vulnerabilities may minimize disparate impacts of a public health shock. Understanding the full impacts of COVID-19 on essential labor remains important for economics, public policy, and food systems in addition to public health.

Keywords Agricultural workers · COVID-19 · Employment · Current Population Survey

Background

Early research during the COVID-19 pandemic examined health profiles and work environments of U.S. farmworkers to better understand COVID-19 risk factors to essential workers, food supply, and rural health systems nationally (Fan and Pena 2021) and for regional case studies (Onel et al. 2020; Beatty et al. 2020). Trends

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using the U.S. Department of Labor's National Agricultural Workers Survey (NAWS) confirmed a vulnerable, marginal, and essential workforce experiencing limits to field sanitation, housing quality, and healthcare access. Bochtis et al. (2020) used the Bureau of Labor Statistics (BLS)'s Occupational Information Network (O*NET) classification system to categorize agricultural occupations according to number of tasks and to assess the distribution of COVID-19 contagion risk levels. This research suggested high risk in specific farming, fishing, and forestry occupations with work in close proximity. Early research documented variation in COVID-19 risk factors by legal status, including H-2 A status under which workers are less able to adjust their physical work environments due to program restrictions (Flocks 2020; Lauzardo et al. 2021). Much of this past research presented *hypothesized* impacts of COVID-19 based on population risk characteristics recorded in survey data from times either preceding or early in the pandemic. Observations offered inputs into predictions regarding labor supply and optimal mitigation strategies.

Geographic correlation between agricultural employment and COVID-19 growth rates was confirmed nationally using BLS' Quarterly Census of Employment and Wages (QCEW) data by Charlton (2022), who showed that counties with 100 additional workers per month in fruit, vegetable, and horticultural employment in 2019 were associated with 4.5% more COVID-19 cases on average in 2020. Lusk and Chandra (2021) demonstrated that spatial correlations also held for death counts for agricultural workers and documented differences between rural and urban areas which could be used for public health intervention targeting. Peña-Lévano et al. (2020)'s examination of unemployment rates by agricultural subsectors showed that food services were disproportionately impacted early in the pandemic.

Data sources for understanding *realized* impacts of COVID-19 in farmwork at the individual level have remained limited. Chicas et al. (2022) provided a small sample (n=92) summary of their descriptive survey of Central Florida farmworkers that illustrated persistent gaps in vaccination information and provision. Luckstead. et al. (2021) showed increasingly favorable attitudes towards essential workers and the H-2A program across two rounds of another original survey (n=612) of low-skilled domestic workers. Farnsworth (2020) predicted that the COVID-19 experience may lead to institutional change in H-2A policies related to migrant workers, as did Ramos et al. (2020) and Reid et al. (2021). In contrast to previous literature, this article relies on large-scale data on individual workers in agriculture from the Current Population Survey (CPS), a data source not yet explored for questions regarding COVID-19 impacts with the U.S. agricultural workforce.

Data and Methods

Data came from the 2020–2022 basic monthly samples of the U.S.'s monthly labor force survey, the Current Population Survey (CPS), as published as the Integrated Public Use Microdata Series (Flood et al. 2022). Supplemental questions on COVID-19 were asked from May of 2020 through September of 2022. The sample used in this article was drawn from January of 2020 through September of 2022. This period

incorporates *all* monthly rounds of the COVID-19 supplement, and adds four preceding months to serve as a baseline reference for pre-pandemic summary statistics.

Industry and Occupation Sub-Samples

In the CPS and similar data sources, industry indicates economic sector while occupation specifies job function. An implication is that there are different, sometimes partially overlapping, ways to define the agricultural sector and no clear consensus in agricultural labor literature. As such, three major subsamples (followed by an aggregation) were used for comparison in this article. The first sample restricted to the industry corresponding to the respondent's primary occupation in the preceding week to the survey based on "crop production" (industry 0170) from the 2017 Census classification scheme. The second sample corresponded to "animal production" (industry 0180). Forestry, logging, fishing, hunting, and trapping, and support activities for agriculture and forestry were excluded.

The third comparison sample was based on the 2018 Census classification scheme for occupations restricted to "graders and sorters, agricultural products" (occupation 6040) and "miscellaneous agricultural workers" (occupation 6050). Fishing and hunting workers, forest and conservation workers, and logging workers were excluded, as were "first-line supervisors of farming, fishing, and forestry workers" and "agricultural inspectors." First-line supervisors are less relevant for public policies addressing vulnerability and often are owner-operators. Agricultural inspectors are often governmental employees who visit work sites temporarily.

Occupations in the CPS correspond to the respondent's job for which he/she worked the most hours in the preceding week. While the two industry samples are mutually exclusive, the agricultural occupation sample includes some (but not all) workers in the crop and animal production industries and some others in miscellaneous, additional industries.

COVID-19 and Demographic Variables

The CPS introduced several COVID-19-related questions in May of 2020. Respondents were asked if they worked remotely for pay due to the pandemic, if they were unable to work due to the pandemic, and if they received pay for hours not worked due to the pandemic. The question regarding if the worker teleworked or worked from home for pay was asked in relation to the previous four-week period and was only asked to respondents who reported being currently employed. This question, however, was less relevant to the farmwork population than in other work settings. Whether the respondent was unable to work also was based on a four-week period, but was asked to all those whose employer closed or *lost business* due to the pandemic. The experience of losing business during COVID-19 was common across economic sectors including in agriculture. Respondents who answered yes to this question were subsequently asked if they were paid when not working, and respondents not in the labor force were asked whether the pandemic prevented them from

looking for work.[1] Due to this survey method, these latter two questions were asked to a smaller sample of respondents. The unable to work question therefore was most comprehensive and relevant to understanding workers in agriculture. This question forms the basis of the analysis presented in this article.

Demographic variables included age (topcoded at 85) and a variable for married that included both spouse present and spouse absent. Non-married included separated, divorced, widowed, and never married. Given care and educational responsibilities associated with both older and younger children during COVID-19 related to homeschooling, number of own children in the household was included with no restriction imposed on child's age.

Hispanic origin was defined as a binary indicator variable equaling 1 for Mexican, Puerto Rican, Cuban, Dominican, Salvadoran, and other Spanish including those from other parts of Central and South America. Origin is inclusive of ancestry, lineage, heritage, national group, or birth country.[2] A binary variable for immigrant equaled 0 for those who reported a birthplace of either the United States or a U.S. outlying area/territory (American Samoa, Guam, Northern Mariana Islands, Puerto Rico, U.S. Virgin Islands, or other unspecified U.S. outlying area). Citizens were defined as being born in the U.S, in U.S. outlying, or abroad of American parents, or naturalized.

A basic education binary variable equaled 1 for having either graduated from high school, obtained a GED or other equivalent, or achieved higher education with 0 corresponding to less than a high school education. A disability variable equaled 1 for any disability that included hearing, vision, and other physical difficulties, as well as difficulty remembering, limited mobility, or a personal care limitation.

Summary statistics of all variables were based on the full CPS COVID-19 supplement sample frame from May of 2020 through September of 2022. An additional sample covering demographic characteristics from January through April of 2022 was used as a baseline reference for these summary statistics. All summary statistics and data analysis incorporated person-level basic weights.[3]

Determinants of COVID-19 Impacts on Agricultural Work

The probability of being unable to work was modeled as a function of demographic variables using Probit regression. The basic specification is as follows:

[1] A final question in the CPS COVID-19 module regarded not being able to get non-COVID-19 related health care. This was only asked from May through October 2020 and also was excluded from this analysis.

[2] Ethnicity was used instead of race given low responses for races other than white in agricultural sector sub-samples.

[3] This weight is "based on the inverse probability of selection into the sample and adjustments for the following factors: failure to obtain an interview; sampling within large sample units; adjustments to the known distribution of the entire population according to stage, age, sex, race, and Hispanic ethnicity; and allotting a weight of zero to populations not sampled in other monthly surveys (i.e., persons in the Hispanic oversample and members of the armed forces in ASEC samples)" (https://cps.ipums.org/cps-action/variables/WTFINL#description_section).

$$P\left(unable\_to\_work_{ism}=1|\boldsymbol{X}_{ism}\right)=\Phi\left(\boldsymbol{X}_{ism}\beta+\gamma_s+\delta_m\right) \quad (1)$$

The vector $\boldsymbol{X}_{ism}$ in Eq. (1) includes age, sex, marital status, number of children, Hispanic origin, having at least high school level education, and the presence of a disability for individual *i* in state *s* at time *m* (where *m* is defined at the monthly timestep). Due to high correlations between Hispanic origin, citizenship, and being an immigrant for these industry and occupational subsamples evident in the summary statistics, these latter two variables were not included in estimated probability models.

State fixed effects (γ_s) and month-by-year fixed effects (δ_m) were included in comparison specifications due to the rapidly changing progression of the spread of COVID-19 both geographically and temporally. State fixed effects also reflect differences in state COVID-19 policies, including those specifically related to work. Month-by-year fixed effects were used instead of time trends given the number of peaks and troughs throughout the disease's waves.[4] Estimations were completed in turn for each of the agricultural work subsamples of interest separately, with Probit marginal effects calculated and reported.

Results

There were 15,235 crop production workers surveyed between May of 2020 and September of 2022 (Table 1). An additional 2,689 workers were surveyed earlier in 2020 (from January through April) before the introduction of the CPS' COVID-19 supplement. In addition, 12,579 workers were surveyed in the animal production industry during the period of the COVID-19 supplement with another 2,160 workers represented in the earlier part of 2020.

Summary Statistics

Overall responses confirmed that many workers in both crop and animal agricultural industries continued to work during the pandemic in a way similar to pre-pandemic, which was expected because of their classification as essential. Summary statistics revealed that the COVID-19 experience varied over time with responses for being unable to work being highest in 2020 relative to 2021 and 2022. For example, 6.5% of the crop production sample and 5.9% of the animal production sample indicated being unable to work due to the pandemic between May and December of 2020 in comparison to only 1.3% and less than 1% respectively by 2022 (Table 1).

For the agricultural occupation sample (which included some crop and some animal production industry, as well as miscellaneous other industries), 8.3% of workers

[4] Hean and Chairassamee (2022) split the CPS data into seasonal (several months in length) "phases" of COVID-19 for their examination of labor market attachment and race, and Albanesi and Kim (2021) do similar for their examination of recessionary impacts of COVID-19 by socio-demographic group. The month-by-year fixed effects used here, as per Eq. (1), serve a similar statistical purpose while allowing for a more flexible treatment of time during the pandemic given the longer data time period available for the current article.

Table 1 Means of Demographic and Work-Related Variables, Crop versus Animal Production Industries (percentages unless noted)

	Crop Production Industry				Animal Production Industry			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Jan.-Apr. 2020	May-Dec. 2020	2021	Jan.-Sept. 2022	Jan.-Apr. 2020	May-Dec. 2020	2021	Jan.-Sept. 2022
Unable to work due to COVID?		6.499	2.3916	1.27		5.8961	2.4377	0.6912
		[24.6539]	[15.2802]	[11.199]		[23.5589]	[15.4233]	[8.2864]
Age (years)	46.4302	47.5484	46.7086	47.1827	47.2173	47.7868	48.07	47.8393
	[16.576]	[17.4556]	[17.192]	[17.3843]	[17.9293]	[18.127]	[17.89]	[18.0368]
Female	30.0868	30.26	28.1981	28.8694	28.4671	28.242	29.5293	27.2785
	[45.8749]	[45.9441]	[45.0003]	[45.321]	[45.1396]	[45.0246]	[45.6221]	[44.5458]
Married	62.9518	62.1765	60.3253	60.1333	64.0771	66.1095	64.2129	61.5367
	[48.3054]	[48.5008]	[48.9265]	[48.9683]	[47.9922]	[47.341]	[47.9424]	[48.6581]
Own children in household (#)	1.0204	0.8385	0.8132	0.7693	0.7584	0.8757	0.8407	0.7558
	[1.3742]	[1.3443]	[1.2861]	[1.2483]	[1.2]	[1.5026]	[1.448]	[1.3445]
Hispanic origin	35.9739	30.6055	34.7827	32.0029	23.633	16.4172	17.7335	18.7129
	[48.0043]	[46.0911]	[47.6322]	[46.6544]	[42.4958]	[37.0488]	[38.1992]	[39.0073]
Immigrant	31.1202	27.7479	29.3256	26.3727	18.382	15.1013	16.0223	17.7739
	[46.31]	[44.7811]	[45.5294]	[44.0706]	[38.7456]	[35.8116]	[36.685]	[38.235]
Citizen	75.9475	80.7008	78.1783	80.2103	86.6573	88.9772	89.2803	87.681
	[42.7508]	[39.4696]	[41.3071]	[39.8462]	[34.014]	[31.3222]	[30.9396]	[32.8705]
High school/ equivalent or higher	69.8911	72.7208	68.963	71.2464	80.0582	77.8267	78.1104	78.063
	[45.8845]	[44.545]	[46.2685]	[45.2668]	[39.9685]	[41.5476]	[41.354]	[41.3882]
Disability	4.4737	5.8881	5.8237	6.3914	8.2797	8.737	8.9101	9.3022
	[20.6778]	[23.5431]	[23.4212]	[24.4629]	[27.566]	[28.242]	[28.4919]	[29.0507]
Observations	2,689	3,992	6,470	4,773	2,160	3,266	5,445	3,868

Source: January 2020-September 2022 basic monthly samples of the Current Population Survey and author's calculations. Standard deviations in brackets

indicated being unable to work due to the pandemic between May and December of 2020 (Table 2). This higher percentage in the occupational sample relative to the industry samples is understandable as the occupational sample excludes agricultural supervisors and inspectors as described. Between approximately 4 and 6% of the occupational sample over time was classified as graders and sorters or agricultural products with the remaining majority (excluded category) corresponding to "miscellaneous agricultural workers." Columns (5) through (8) of Table 2 present summary statistics for those in agricultural occupations *conditional on* reporting being in either

Table 2 Means of Demographic and Work-Related Variables, Agricultural Occupations (percentages unless noted)

	Agricultural Occupations				Ag Occupations if in Crop or Animal Production			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Jan.-Apr. 2020	May-Dec. 2020	2021	Jan.-Sept. 2022	Jan.-Apr. 2020	May-Dec. 2020	2021	Jan.-Sept. 2022
Unable to work due to COVID?		8.318	3.2251	1.3541		7.5753	3.0299	1.2372
		[27.6205]	[17.6687]	[11.5596]		[26.4658]	[17.1431]	[11.0563]
Age (years)	40.5437	39.9386	40.618	40.3027	40.5942	40.0758	40.9958	40.4747
	[15.8497]	[16.5748]	[16.1387]	[16.2347]	[15.8916]	[16.6454]	[16.1648]	[16.4402]
Female	28.9042	28.1824	27.7533	27.8023	27.3994	27.2836	25.4808	25.9775
	[45.3466]	[44.9969]	[44.7834]	[44.8104]	[44.6175]	[44.5508]	[43.5811]	[43.8599]
Married	51.9708	49.112	48.2172	48.4053	52.1629	49.5442	49.0054	49.033
	[49.9775]	[50.0011]	[49.974]	[49.9834]	[49.9721]	[50.008]	[49.9967]	[50.0007]
Own children in household (#)	1.1093	0.911	0.8479	0.8192	1.0998	0.9312	0.8537	0.8086
	[1.4]	[1.3693]	[1.3122]	[1.2474]	[1.4027]	[1.3952]	[1.3259]	[1.2472]
Hispanic origin	55.8988	45.4793	48.2606	50.903	54.754	45.8103	49.1936	50.6752
	[49.6671]	[49.8042]	[49.9755]	[50.0006]	[49.7923]	[49.8342]	[50.0001]	[50.0055]
Immigrant	46.7017	39.8954	40.8928	44.219	46.8613	41.2087	42.0654	44.6079
	[49.9075]	[48.9772]	[49.1693]	[49.6734]	[49.9203]	[49.231]	[49.3729]	[49.7184]
Citizen	63.672	69.4748	67.9929	64.8463	64.0744	68.5802	67.1739	64.5682
	[48.1102]	[46.0597]	[46.6558]	[47.7534]	[47.9964]	[46.429]	[46.9642]	[47.8402]
High school/ equivalent or higher	55.93	57.9631	55.4722	52.2397	55.8877	57.4823	53.6252	51.5209
	[49.6634]	[49.3707]	[49.7054]	[49.9586]	[49.6709]	[49.447]	[49.875]	[49.9869]
Disability	3.8679	4.5936	4.4439	4.5845	4.0625	4.1802	4.6327	4.5377
	[19.2893]	[20.9384]	[20.6093]	[20.9185]	[19.7494]	[20.0176]	[21.022]	[20.8171]
Graders and sorters, ag products	4.9773	4.3452	6.1123	4.6726	2.2727	1.5847	2.2315	1.6029
	[21.7547]	[20.3908]	[23.9584]	[21.1088]	[14.9089]	[12.491]	[14.7727]	[12.5612]
Crop production industry					60.9783	63.9963	67.3037	67.6247
					[48.7983]	[48.0108]	[46.9165]	[46.8001]
Observations	2,091	2,775	4,897	3,333	1,811	2,472	4,303	2,914

Source: January 2020-September 2022 basic monthly samples of the Current Population Survey and author's calculations. Standard deviations in brackets

crop or animal production. Between 60 and 70% of this sample over time was in crop production with the remainder in animal production. Approximately 7.5% of respondents in the industry-restricted subsample indicated being unable to work due to COVID-19 in the earliest part of the pandemic.

Across all subsamples in Tables 1 and 2, response patterns of being unable to work are consistent with the most acute shock of COVID-19 happening at the start of the pandemic when lockdowns were common, with impacts decreasing over time for agriculture as was the experience in other industries. While tabulations of the COVID-19 variable revealed time-varying, though small in magnitude, impacts on the extensive margin of work in agriculture during the pandemic, it remains possible that changes in the agricultural labor force itself during and after COVID-19 also may impact on food supply going forward. Changing demographic features of the agricultural work population therefore also are examined in Tables 1 and 2. While most summary statistics were stable across subperiods, the largest changes were noted for Hispanic origin and for being an immigrant and/or being a U.S. citizen. Starting from 36% of the crop production workforce in the earliest part of 2020, the percentage of workers reporting Hispanic origin declined to less than 31% in the early pandemic before increasing in early 2021 and then trending downward again subsequently (Table 1, columns (1)-(4)). Concurrently, the immigrant share fell from 31 to 28% over the course of 2020 and the citizen share rose from 76 to 81%.[5] These patterns for Hispanic origin, for immigrant status, and for citizenship also were evident for animal production (columns (5)-(8)), though the fractions Hispanic and immigrant are lesser for this industry and the fraction U.S. citizen is higher on average. These demographic patterns similarly appear for the two agricultural occupation subsamples in Table 2 with varied magnitudes.

The percentage that reported having a high school level education or higher marginally rose after the start of the pandemic for both crop workers and those declaring agricultural occupations before declining again. The opposite, however, is seen in animal production on average (Table 2). This is suggestive of nuances in changes to worker composition within agriculture more broadly and supports the examination of occupation in addition to industry for the agricultural sector.

Determinants of COVID-19 Impacts

Marginal effects from Probit estimation for the probability of being unable to work due to COVID-19 are presented respectively in Table 3 for crop production (columns (1) through (3)) and for animal production (columns (4) through (6)). Table 4 then shows marginal effects for the probability of being unable to work due to the pandemic for the agricultural occupation sample (columns (1) through (3)) and finally for agricultural occupations conditional on crop or animal production (columns (4) through (6)).

[5] The immigrant and citizen variables do not add to 100% since the immigrant variable reflects birthplace and citizenship includes naturalization. These variables are highly correlated and inversely related as expected.

Table 3 Determinants of probability of being unable to work due to COVID-19 (Probit marginal effects), Crop versus Animal Production Industries

	Crop Production			Animal Production		
	(1)	(2)	(3)	(4)	(5)	(6)
Age/10	0.002	0.002	0.001*	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Female (=1)	0.003	0.003	0.002	0.016***	0.010**	0.008***
	(0.004)	(0.004)	(0.003)	(0.005)	(0.004)	(0.003)
Married (=1)	-0.007	-0.007*	-0.006*	0.001	-0.001	-0.001
	(0.004)	(0.004)	(0.003)	(0.005)	(0.004)	(0.003)
Own children in household (#)	0.004***	0.004***	0.003***	-0.000	-0.000	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Hispanic origin (=1)	0.020***	0.022***	0.017***	0.021***	0.009	0.006
	(0.005)	(0.006)	(0.005)	(0.007)	(0.006)	(0.005)
High School/equivalent or higher education (=1)	-0.009**	-0.009**	-0.008**	0.009*	0.008**	0.006**
	(0.005)	(0.004)	(0.003)	(0.005)	(0.004)	(0.003)
Disability (=1)	0.007	0.007	0.007	0.006	0.005	0.006
	(0.008)	(0.008)	(0.006)	(0.008)	(0.006)	(0.005)
State fixed effects?	no	yes	yes	no	yes	yes
Month-year fixed effects?	no	no	yes	no	no	yes
Observations	13,853	13,562	13,562	11,335	11,153	10,849

Source: May 2020 through September 2022 basic monthly samples of the Current Population Survey and author's calculations. Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

The most economically significant and policy relevant finding was the robust and positive correlation between being of Hispanic origin and being unable to work. For crop workers in Table 3, the estimation results show that a Hispanic person had an approximately 2% point higher probability of being unable to work due to COVID-19 than did a non-Hispanic person even in the presence of demographic controls, controls for states, and controls of periods of the pandemic (measured at a refined month-by-year level). This pattern also was suggested for the animal production industry with a 2% point differential estimated in the specification without fixed effects (Table 3, column (4)), though this magnitude is lesser and statistically insignificant once fixed effects are added for this industry sample. For agricultural occupations in Table 4, 1.4 to 2.0% point differentials between Hispanic and non-Hispanic workers were recorded across the various specifications.

Additional demographic pattern findings are also worth noting. Having more children in the household, for example, was a statistically significant predictor of being unable to work in crop production, a pattern consistent with new care responsibilities associated with home schooling and the closures of care facilities during the pandemic. This pattern was also evident for agricultural occupations (Table 4). For animal production, being female in contrast was associated with higher risk of being unable to work during COVID-19 (Table 3). This pattern also may reflect care responsibilities as well as differences in worker compositions within parts of the agricultural sector.

The relationship between having at least a high school level of education and being unable to work due to COVID-19 also varied between crop production and

Table 4 Determinants of probability of being unable to work due to COVID-19 (Probit marginal effects), Agricultural Occupations

	Agricultural Occupations			Ag. Occupations if in Crop or Animal Production		
	(1)	(2)	(3)	(4)	(5)	(6)
Age/10	0.002	0.002	0.001	0.003*	0.003**	0.003**
	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)
Female (=1)	0.005	0.006	0.004	0.008	0.008	0.006
	(0.006)	(0.005)	(0.004)	(0.006)	(0.005)	(0.004)
Married (=1)	-0.009*	-0.009*	-0.008*	-0.008	-0.008	-0.007*
	(0.005)	(0.005)	(0.004)	(0.006)	(0.005)	(0.004)
Own children in household (#)	0.006***	0.006***	0.004***	0.007***	0.007***	0.005***
	(0.002)	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)
Hispanic origin (=1)	0.020***	0.017***	0.014***	0.020***	0.019***	0.014***
	(0.005)	(0.006)	(0.005)	(0.005)	(0.006)	(0.005)
High School/equivalent or higher education (=1)	0.000	0.002	-0.001	-0.003	-0.002	-0.004
	(0.005)	(0.005)	(0.004)	(0.005)	(0.005)	(0.004)
Disability (=1)	0.040**	0.033**	0.027**	0.012	0.007	0.006
	(0.016)	(0.015)	(0.013)	(0.013)	(0.011)	(0.010)
Graders and sorters, ag products (=1)	0.037**	0.036**	0.037**	0.048*	0.044*	0.038
	(0.016)	(0.016)	(0.015)	(0.029)	(0.026)	(0.023)
Crop production industry (=1)				0.002	-0.005	0.000
				(0.005)	(0.005)	(0.004)
State fixed effects?	no	yes	yes	no	yes	yes
Month-year fixed effects?	no	no	yes	no	no	yes
Observations	9,722	9,509	9,209	8,553	8,338	8,076

Source: May 2020 through September 2022 basic monthly samples of the Current Population Survey and author's calculations. Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

animal production industries. For crop production, the relationship was estimated to be negative with higher education associated with a lower impact of the pandemic on work (less likely to report being unable to work). This finding contrasts with that for animal production where higher educated workers had higher predicted probabilities of being unable to work because of COVID-19 all else equal, again highlighting the role of different worker demographic distributions in U.S. animal production in comparison to crop production.

In contrast to the findings based on the industry definitions in Table 3, disability status was associated with higher probability of being unable to work for agricultural occupations broadly (Table 4). This pattern is consistent with some workers having preexisting conditions that changed work patterns during the advent of COVID-19. Marginal effects for the disability indicator are estimated to be positive though statistically insignificant for the sample where the agricultural occupation sample is conditional on either the crop or animal production industry. Graders and sorters of agricultural products (relative to the excluded category of miscellaneous agricultural workers) had higher probabilities of being unable to work due to COVID-19 all else equal.

Discussion and Conclusions

Estimates in this article suggest that 6 to 8% of agricultural workers, broadly defined, were unable to work in the early part of the COVID-19 pandemic. The U.S. Department of Agriculture reported that there were 22.2 million agricultural and food sector jobs in 2019. Together with data from the CPS, this suggests that more than one million people were unable to work in this sector during the pandemic. Furthermore, there were compositional changes in average worker characteristics in the agricultural sector over COVID-19 that are documented in this article. This is consistent with a combination of workers changing industries within the U.S., moving to unemployment, or moving internationally when public health and employment conditions changed.

Understanding the full impacts of COVID-19 on essential labor remains important for economics and public policy in addition to public health. As shown in this article, Hispanic agricultural workers were disproportionately impacted by the pandemic in terms of their ability to continue work. Disproportionate impacts are not surprising given research on COVID-19 disparities among Mexican migrants more broadly (Vilar-Compte et al. 2022). Also using CPS data, Hean and Chairassamee (2022) document that non-white workers were more likely to be in "low teleworkable" industries translating into attrition from the labor market all together. As agriculture is exceptionally low in terms of "teleworkability" and as agricultural workers are significantly non-white (shown here and elsewhere), the findings in this article are consistent with this previous study.

Findings in this article also are consistent with recent work that suggests that targeted policies based on vulnerabilities can minimize disparate impacts of a public health shock. Qualitative interviews of Latino workers near the U.S.-Mexico border, for example, revealed the critical role of Spanish-speaking community-based organizations (Quandt et al. 2022). Other research determined that web-based Spanish-speaking health information was limited during COVID-19 (Kusters et al. 2022). Finally, some research suggests that immigrant serving organizations were able to quickly refocus from immigration policy concerns to public health concerns at the start of COVID-19 (Doering-White et al. 2022). An implication is that the identified disparities in this article could have been even more bleak without this organizational positioning.

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