The COVID-19 vaccine rollout and labor market recovery in the U.S: a note

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Abstract
The study examines the relationship between COVID-19 vaccine rollout and labor market recovery in the United States. We employed the U.S. Current Population Survey (CPS), covering February 2020–October 2021. With December 2020–October 2021 taken as the vaccine rollout period and February–November 2020 as the pre-vaccine period, we regress this on the number of working hours per week while controlling for other potential confounding factors using the ordinary least square (OLS) regression model. The empirical results show that working hours are significantly higher, since vaccines rolled out than in the pre-vaccine period, which probably reflects increased confidence in immunized individuals and vaccination optimism in the U.S. At the same time, we find that working hours are significantly higher, since vaccines rollout than in the pre-vaccine period among white respondents, while it decreases among black respondents. The regional insights also show that working hours increase during vaccine rollout in the Midwest and South, while we find no evidence in the Northeast and West. From the overall economic standpoint, this finding indicates an accelerating pace of labor market recovery in the United States.

Keywords Vaccine · COVID-19 · Labor market · USA

Introduction
The COVID-19 virus has caused countries worldwide to implement stay-at-home orders to curb the spread of the disease because of health and safety concerns (Ogundari 2021). In addition, the shutdown of economic activities and restriction of movement have had devastating impacts on the labor markets, reducing working hours and increasing job losses. According to UNDP (2021), the earnings of approximately 1.6 billion informal workers declined by 60 percent during the pandemic.
The main reason for this is because the sector has been the hardest hit, such as wholesale and retail trade, manufacturing, and hospitality services (IMF 2020). In addition, about 255 million jobs were lost during the pandemic, which is five times higher than the job loss during the 2008 financial crisis globally (IMF 2021). However, the impacts vary significantly across countries, as high-income countries have been more successful at limiting the loss of work, because a larger share of jobs in these countries can be done remotely (UNDP 2021).

In the United States, the unemployment rate increased from 3.8% in January 2019 to 14.2% in April 2020 and declined to 4.2% as of October 2021, as shown in Fig. 1 (BLS 2021). The shock in the U.S. labor market caused millions to leave the workforce. However, despite the recent decline in the unemployment rate, the labor force was still down by about 10 million jobs from its pre-pandemic level in the U.S. (Gould 2021; Bauer et al. 2021). UNDP (2021) report revealed that the availability of vaccines is essential to provide relief to health and safety concerns associated with the COVID-19 pandemic and the gradual reopening of economic activities globally. Also supporting this view, the Penn Wharton Budget model showed that the economic recovery in the United States hinges on the pace of COVID-19 vaccinations (Penn Wharton Budget model 2021).

The COVID-19 vaccine rollout began in December 2020 in the United States following the Centers for Disease Control and Protection (CDC) approval of the Pfizer vaccine. The health care workers, long-term care facility residents, and individuals considered high risk based on age (e.g., 65+) and specific health conditions were prioritized in the earlier rollout phase. After that, other age groups were considered as more shots were made available with the subsequent authorization to use other vaccines, such as Maderna and Johnson and Johnson in 2021. However, because the vaccine’s efficacy decreases after two recommended doses for Pfizer and Maderna and one dose for the Johnson and Johnson over a given period due to new variants of the virus, a booster shot was recommended starting from August 2021 for many Americans. As a result, the share of U.S. populations fully vaccinated is put at about

![Fig. 1 U.S unemployment rate, covering January 2019–October 2021 (BLS 2021)](image-url)
66% (i.e., 219 million), while 45% is boosted (i.e., 99 million) (CDC 2022). To provide more context, Fig. 2 shows the cumulative distribution of total vaccination per hundred of the population on the left-hand side, as the right side figure shows the cumulative distribution of total boosters per hundred. The figure shows an increasing trend in vaccination in the U.S. However, because of vaccine hesitancy, Fig. 3 shows a decreasing trend in the number of new people vaccinated per hundred lately in the U.S.

A review of the literature shows that a few studies have provided empirical insights into the impact of the COVID-19 vaccine on economic activities across the globe. For example, Sexton and Tito (2021) revealed that several measures of...
economic activities, such as restaurant, education, and retail spending, had shown improvement, since the start of the COVID-19 vaccine rollout in the United States. However, the authors found no evidence of the effects of the vaccine rollout on healthcare and employment. In addition, Deb et al. (2022), using cross-country data covering 46 countries over the period December 2020–June 2021, found evidence that an increase in vaccination per capita is associated with a significant increase in economic activities, such as nitrogen dioxide and carbon monoxide emissions and recreation mobility. In a related development, Deb et al. (2022), using cross-country data covering 17 countries, showed that vaccine deployment has persistent positive effects on the level of economic activity. Finally, Agarwal and Gopinath using a cost–benefit analysis, found that vaccinating 40 percent of the world’s population by 2021 could cost around $50 billion, while benefits could reach about $9 trillion in economic gains.

The present study builds on these works to further provide insights into the effects of vaccine rollout on the labor market recovery in the United States. Our findings, however, show that working hours are significantly higher, since vaccines rolled out than in the pre-vaccine period, which probably reflects increased confidence in immunized individuals and vaccination optimism in the U.S. Other results also show that working hours are significantly higher, since vaccines rollout than in the pre-vaccine period among white respondents, while it decreases among black respondents. The regional insights also show that working hours increase during vaccine rollout in the Midwest and South, while we find no evidence in the Northeast and West.

The rest of the paper is structured as follows. “Data sources and description” focuses on the data sources and description. “Estimation strategy” describes the estimation strategy, while “Results and discussion” presents the results and discussion. Finally, “Concluding remarks” contains the concluding remarks.

Data sources and description

The study used monthly labor force survey data from the U.S. Current Population Survey (CPS) from February 2020 to October 2021, covering all 50 U.S. states and the District of Columbia. The data is publicly available at https://www.census.gov/data/datasets/time-series/demo/cps/cps-basic.2021.html. Our final sample has 328,362 observations.

Although the CPS covers numerous topics on labor force participation, we focus on the working hours and number of jobs engaged per week. The data includes the classification of industry (e.g., agriculture and non-agriculture) and occupation (e.g., Federal government, state government, local government, private sector, self-employed, and volunteer). Other information considered consists of the respondents’ age, gender, marital status, and educational levels. It also includes respondents’ race and ethnic groups and income levels (e.g., < 10,000, 10,000–19,999, 20,000–29,999, 30,000–39,999, 40,000–49,999, 50,000–59,999, and 60,000–74,999), which is limited to those earning below $75,000 per annum. This is important, because
COVID-19 job losses are most concentrated among those with income below $75,000 (Fogg and Harrington 2020). The CPS offers supplement weights for both the individual and household to represent the sample nationally. In recognition of this, we use an individual weight so that the estimate reflects the share of the individual labor market participation. The summary statistics of the variable used for the empirical analysis are presented in Table 1.

The COVID-19 vaccine rollout period covers December 2020–October 2021, while the COVID-pandemic period covers February to November 2020. February 2020 is the beginning of the COVID-19 period, because the first case of the virus was reported. In addition, December 2020 was taken as the starting date for the vaccine rollout, given that the first vaccine was approved and made available to the health workers in the month.

**Estimation strategy**

We investigate the effect of vaccine rollout and potential confounding factors on labor market participation using the model specified below:

$$y_{its} = \pi_0 + \delta \text{VACCINE}_\text{ROLLOUT}_{its} + \sum_{k=1}^{K} \gamma_k Z_{ikts} + \varnothing \text{State}_i + \varphi \text{Trend} + \epsilon_{ist},$$  

where \(y_{its}\) is the number of working hours per week for \(ith\) respondent in time \(t\) and state \(s\); \(\text{VACCINE}_\text{ROLLOUT}_{its}\) is equal to 1 for the vaccine rollout period covering December 2020–October 2021 and 0 for the pre-vaccine period covering February–November 2020; \(Z_{ikts}\) is a vector of other potential confounding factors, which include the number of jobs engaged per week, age, gender, marital status, educational levels, race/ethnic groups, industry, and job classification; \(\text{State}\) is the state-specific fixed effect included to absorb time-invariant differences across states; \(\text{Trend}\) is a linear trend in year-monthly to control for time-specific effect; \(\pi_0, \delta, \gamma_k, \varnothing, \text{ and } \varphi\) are parameters to be estimated; \(\epsilon_{ist}\) is the error term of the regression.

Accordingly, a significant positive coefficient (i.e., \(\delta\) and \(\gamma_k\)) indicates higher working hours associated with the vaccine rollout. In contrast, a significant negative coefficient implies lower working hours related to the vaccine rollout. Therefore, and for the estimation of Eq. 1, we employ an ordinary least square (OLS) regression model and use the individual weight provided in the CPS with a robust regression option. In addition, the dependent variable (number of working hours per week) and age are transformed into a natural logarithm to reduce measurement units’ influence in the analysis.

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1 Raifman et al. (2021) also restricted the sample of individuals earning less than $75,000 to focus on the population most at risk of food insecurity during COVID-19 in their study.

2 VACCINE ROLLOUT is included as a structural break in the model specification.
| Variables                          | Unit     | Mean [S.D.] or % |
|-----------------------------------|----------|-----------------|
| Labor Market Participation       |          |                 |
| Number of working hours per week | Number   | 36.562 [10.4778]|
| Number of jobs                   | Number   | 1.0427 [0.2193] |
| Age                              | Years    | 41.4079 [14.9977]|
| Gender                           | Dummy    |                 |
| Male                             | Dummy    | 51.99           |
| Female                           | Dummy    | 48.01           |
| Marital status                   | Dummy    |                 |
| Single                           | Dummy    | 57.74           |
| Married                          | Dummy    | 42.26           |
| Race/Ethnicity                   | Dummy    |                 |
| White                            | Dummy    | 90.85           |
| Black                            | Dummy    | 7.13            |
| Hispanic                         | Dummy    | 23.04           |
| Other races                      | Dummy    | 2.02            |
| Educational Levels               | Dummy    |                 |
| Less than High School            | Dummy    | 10.52           |
| High School                      | Dummy    | 63.45           |
| Bachelor degree                  | Dummy    | 18.87           |
| Postgraduate degree              | Dummy    | 7.16            |
| Income levels                    | Dummy    |                 |
| < 10,000                         | Dummy    | 4.75            |
| 10,000–19,999                    | Dummy    | 2.50            |
| 20,000–29,999                    | Dummy    | 7.31            |
| 30,000–39,999                    | Dummy    | 11.15           |
| 40,000–49,999                    | Dummy    | 19.87           |
| 50,000–59,999                    | Dummy    | 22.47           |
| 60,000–74,999                    | Dummy    | 31.94           |
| Industry classification          | Dummy    |                 |
| Agricultural                     | Dummy    | 1.97            |
| Non-Agricultural                 | Dummy    | 98.03           |
| Occupation classification        | Dummy    |                 |
| Without pay (Volunteers)         | Dummy    | 0.08            |
| Federal Government               | Dummy    | 2.00            |
| State Government                 | Dummy    | 4.42            |
| Local Government                 | Dummy    | 5.77            |
| Private Sector                   | Dummy    | 81.36           |
| Self-employed                    | Dummy    | 6.37            |
Results and discussion

Table 2 presents the empirical analysis of the effect of vaccine rollout on working hours while controlling for other potential confounding factors in the study. And, judging by the sign and significance of the estimated coefficient of VACCINE ROLLOUT, the result shows that working hours are significantly higher, since vaccines rolled out than in the pre-vaccine period. This probably indicates that economic confidence appears to be rising after many activities had been curtailed due to the coronavirus pandemic in 2020, which prompted increased labor force participation. Perhaps this shows that the COVID-19 vaccine is real hope for people to successfully engage in various economic activities, such as labor force participation as fear of future income losses among households diminishes. This, however, is not surprising given that the availability of vaccines is considered essential to provide relief to health and safety concerns associated with the COVID-19 pandemic and the gradual global reopening of economic activities (UNDP 2021). Hence, the implication is that the availability of vaccines and continued expansions are essential to labor market recovery and perhaps the overall economy in the United States.

Figure 4 provides a context to this result which shows the scatter plot of the average working hour per week over the time frame in the data. As the figure indicates, the working hour, since the vaccine rollout period is higher, with an average of about 39 h per week, while the working hour before vaccine rollout is about 33 h per week. In addition, the differences between the two samples are positive and significant at a 1% level of significance based on the t test. Thus, this supports the observed positive and significant coefficient of VACCINE ROLLOUT in Table 2.

A closer look at the recent work from the United States by Sexton and Tito (2021) showed that our result contradicts the authors’ findings. Specifically, using the Census Bureau Household Pulse Survey (HPS), the authors found no evidence that employment has improved, since the COVID-19 vaccine rollout. In contrast, the authors found evidence of improvement in other measures of economic activities, such as education and restaurant spending, since the vaccine rollout. We believe a possible explanation for this variation lies in the data use and how vaccine rollout is constructed or measured in the respective studies. While Sexton and Tito (2021) employed HPS data based on the number of people reporting to have received or plan to obtain the COVID-19 vaccine, we use CPS data with an indicator of vaccination based on the period of vaccine rollout constructed as a structural break.

Table 2 also provides regional insights, which show that the number of working hours increases during vaccine rollout compared to the pre-vaccine period in the Midwest and South. At the same time, we find no evidence of that effect in the Northeast and West. In addition, Table 3 provides the effect of vaccine rollout on working hours disaggregated by race and ethnicity. The results show that working hours are significantly higher, since vaccines were rolled out than in the pre-vaccine

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3 The normality test based on the Shapiro–Francia test statistics with a p-value of 0.7815 shows that we cannot reject that the number of working hours is normally distributed. A similar conclusion was also observed with skewness and kurtosis tests for normality.
Table 2  Estimated impact of vaccine rollout and other cofounding variables on working hours in the United States for full sample and by race

| Variables            | Full sample | Northeast | Midwest | South | West |
|----------------------|-------------|-----------|---------|-------|------|
| VACCINE ROLLOUT      | 0.0079** [0.0033] | −0.0211 [0.0128] | 0.0190* [0.0101] | 0.0154** [0.0063] | 0.0037 [0.0089] |
| Number of Jobs       | 0.2294***[0.0035] | 0.2249***[0.0107] | 0.2199***[0.0068] | 0.2431***[0.0054] | 0.2223***[0.0074] |
| Age                  | 0.0728***[0.0024] | 0.0739***[0.0067] | 0.0652***[0.0053] | 0.0669***[0.0034] | 0.0835***[0.0049] |
| Male                 | 0.1118***[0.0014] | 0.1309***[0.0041] | 0.1275***[0.0033] | 0.0951***[0.0021] | 0.1142***[0.0030] |
| Married              | 0.0011 [0.0012] | 0.0013 [0.0040] | 0.0015 [0.0033] | 0.0034* [0.0020] | −0.0029 [0.0029] |
| Black                | 0.0170***[0.0028] | 0.0097 [0.0075] | 0.0489***[0.0084] | 0.0201***[0.0047] | 0.0034 [0.0046] |
| Hispanic             | 0.0359***[0.0019] | 0.0549***[0.0054] | 0.0410***[0.0059] | 0.0273***[0.0028] | 0.0342***[0.0037] |
| Other races          | 0.0290***[0.0050] | 0.0311***[0.0124] | 0.0634***[0.0142] | 0.0219***[0.0087] | 0.0175***[0.0082] |
| High School          | 0.0170***[0.0028] | 0.1043***[0.0087] | 0.1586***[0.0078] | 0.0716***[0.0041] | 0.0532***[0.0051] |
| Bachelor degree      | 0.1062***[0.0032] | 0.1347***[0.0094] | 0.1666***[0.0085] | 0.0919***[0.0046] | 0.0738***[0.0062] |
| Postgraduate degree  | 0.1010***[0.0039] | 0.1466***[0.0115] | 0.1722***[0.0101] | 0.0711***[0.0058] | 0.0783***[0.0079] |
| Income: 10,000–19,999 | 0.0183***[0.0071] | −0.0048 [0.0217] | 0.0039 [0.0169] | 0.0333***[0.0097] | 0.0144 [0.0158] |
| Income: 20,000–29,999 | 0.0726***[0.0053] | 0.0550***[0.0159] | 0.0624***[0.0126] | 0.0874***[0.0074] | 0.0606***[0.0112] |
| Income: 30,000–39,999 | 0.1125***[0.0049] | 0.1019***[0.0146] | 0.1210***[0.0116] | 0.1149***[0.0069] | 0.1034***[0.0105] |
| Income: 40,000–49,999 | 0.1342***[0.0047] | 0.1291***[0.0140] | 0.1465***[0.0109] | 0.1373***[0.0066] | 0.1196***[0.0101] |
| Income: 50,000–59,999 | 0.1427***[0.0046] | 0.1307***[0.0139] | 0.1535***[0.0108] | 0.1438***[0.0065] | 0.1369***[0.0100] |
| Income: 60,000–74,999 | 0.1535***[0.0046] | 0.1543***[0.0137] | 0.1585***[0.0108] | 0.1493***[0.0065] | 0.1543***[0.0099] |
| Non-Agricultural     | −0.0755***[0.0064] | −0.1337***[0.0261] | −0.0703***[0.0148] | −0.0256* [0.0124] | −0.0953***[0.0082] |
| Federal Government   | 0.1402***[0.0372] | 0.2106***[0.0835] | −0.0796 [0.0763] | 0.2119***[0.0417] | 0.2227***[0.0916] |
| State Government     | 0.0805**[0.0373] | 0.1559* [0.0832] | −0.1561***[0.0763] | 0.1728***[0.0418] | 0.1336 [0.0917] |
| Local Government     | 0.0979***[0.0372] | 0.1172 [0.0829] | −0.1312* [0.0761] | 0.1918***[0.0417] | 0.1739* [0.0916] |
| Private Sector       | 0.0877**[0.0371] | 0.1277 [0.0827] | −0.1303* [0.0758] | 0.1620***[0.0416] | 0.1782***[0.0914] |
| Self-employed        | −0.0756 [0.0373] | 0.0257 [0.0835] | −0.2864***[0.0762] | 0.0236 [0.0419] | −0.0097 [0.0917] |
| State Fixed Effect    | Included       | Included       | Included       | Included       | Included       |
Table 2 (continued)

| Variables     | Full sample                  | Northeast          | Midwest            | South              | West               |
|---------------|------------------------------|--------------------|--------------------|--------------------|--------------------|
| Time Trend    | Included                     | Included           | Included           | Included           | Included           |
| Constant      | 2.8635***[0.0389]            | 2.7941***[0.0947]  | 2.9733***[0.0786]  | 2.7625***[0.0446]  | 2.7853***[0.0938]  |
| Sample Size   | 328, 362                     | 44,176             | 70,302             | 126,696            | 87,188             |
| Prob > F      | 0.000                        | 0.000              | 0.000              | 0.000              | 0.000              |

*, **, and *** Indicate statistical significance at the 0.1, 0.005, and 0.1 level, respectively. The figures in the parentheses are robust standard errors.
period among white respondents. In contrast, we find evidence that it decreases significantly among black respondents. At the same time, we find no evidence of the effect of vaccine rollout on the number of working hours among the Hispanics and other races in the sample.

Although our focus is on the effect of the vaccine rollout on working hours, Tables 2, 3 also show the results of other potential confounding variables considered in the study. Specifically, the table shows that working hours increase as the number of jobs engaged increases. Again, the finding is consistent across the regions and races/ethnicity considered in the study. In addition, the higher the age, the higher the number of working hours, while working hours increase among males compared to the female respondents significantly. Again, these results are consistent across the regions and races/ethnicity. Concerning the race and ethnic disparity in working hours, we find that Black and Other races have higher working hours than white respondents for the entire sample in Table 2. In addition, Hispanics have higher working hours than non-Hispanic in Table 2. The results are also supported across the regions except for Black in the Northeast and West regions in Table 2. Higher educational attainment significantly increases the number of working hours in Tables 2, 3. Likewise, higher income induces higher working hours as expected a priori. The non-agricultural workers have fewer working hours compared to agricultural workers. In addition, those working for the government and private sector have higher working hours than those without pay (volunteers). However, these results are mixed across the regions and races/ethnicity considered in the analysis.

**Concluding remarks**

The study examines the relationship between COVID-19 rollout and labor market recovery in the United States. Our analysis draws on the U.S. Current Population Survey (CPS), covering February 2020 to October 2021. The finding shows that
Table 3  Estimated impact of vaccine rollout and other cofounding variables on working hours in the United States by race

| Variables               | White       | Black       | Hispanic    | Other races |
|------------------------|-------------|-------------|-------------|-------------|
| VACCINE ROLLOUT        | 0.0124***[0.0046] | −0.0393***[0.0156] | 0.0006 [0.0081] | 0.0013 [0.0245] |
| Number of Jobs         | 0.2262***[0.0036] | 0.2674***[0.0227] | 0.2556***[0.0098] | 0.2739***[0.0247] |
| Age                    | 0.0633***[0.0025] | 0.1296***[0.0083] | 0.1317***[0.0048] | 0.0951***[0.0157] |
| Male                   | 0.1119***[0.0015] | 0.1188***[0.0052] | 0.1177***[0.0029] | 0.1053***[0.0102] |
| Married                | 0.0024***[0.0015] | −0.0049 [0.0051] | 0.0077***[0.0028] | 0.0101 [0.0099] |
| High School degree     | 0.0958***[0.0032] | 0.0119***[0.0061] | 0.0407***[0.0036] | 0.0431***[0.0126] |
| Bachelor degree        | 0.1119***[0.0035] | 0.0449***[0.0085] | 0.0665***[0.0074] | 0.0563***[0.0179] |
| Postgraduate degree    | 0.1075***[0.0042] | 0.0210 [0.0136] | 0.0591***[0.0077] | 0.0169 [0.0256] |
| Income: 10,000–19,999  | 0.0197***[0.0077] | 0.0289 [0.0194] | −0.0049 [0.0123] | −0.0253 [0.0097] |
| Income: 20,000–29,999  | 0.0815***[0.0057] | 0.0166 [0.0149] | 0.0502***[0.0089] | 0.0074 [0.0284] |
| Income: 30,000–39,999  | 0.1208***[0.0053] | 0.0606***[0.0138] | 0.0777***[0.0084] | 0.0344 [0.0238] |
| Income: 40,000–49,999  | 0.1426***[0.0051] | 0.0785***[0.0129] | 0.0889***[0.0081] | 0.0413* [0.0236] |
| Income: 50,000–59,999  | 0.1500***[0.0051] | 0.0923***[0.0131] | 0.0949***[0.0082] | 0.0759***[0.0242] |
| Income: 60,000–74,999  | 0.1605***[0.0050] | 0.1056***[0.0129] | 0.1097***[0.0081] | 0.0619***[0.0241] |
| Non-Agricultural       | −0.0717***[0.0073] | −0.1024***[0.0105] | −0.0932***[0.0077] | −0.0932***[0.0310] |
| Federal Government     | 0.1339***[0.0417] | 0.1608***[0.0741] | 0.1636***[0.0602] | 0.0721 [0.0861] |
| State Government       | 0.0774* [0.0417] | 0.0631 [0.0754] | 0.0949 [0.0603] | −0.0828 [0.0939] |
| Local Government       | 0.0939* [0.0416] | 0.0951 [0.0731] | 0.1316**[0.0599] | 0.0101 [0.0839] |
| Private Sector         | 0.0841* [0.0416] | 0.1050 [0.0722] | 0.1201**[0.0597] | −0.0183 [0.0817] |
| Self-employed          | −0.0694* [0.0418] | −0.0082 [0.0733] | 0.0096 [0.0601] | −0.1001 [0.0862] |
| State Fixed Effect     | Included     | Included     | Included     | Included     |
| Time Trend             | Included     | Included     | Included     | Included     |
| Constant               | 2.8838***[0.0433] | 2.8059***[0.0852] | 2.7236***[0.0653] | 3.0537***[0.1118] |
| Sample Size            | 304,438      | 18,743       | 59,123       | 5,181        |
| Prob > F               | 0.000        | 0.000        | 0.000        | 0.000        |
working hours are significantly higher, since the rollout of the vaccine than in the pre-vaccine period. The regional insights also show that working hours increased during vaccine rollout in the Midwest and South, while no evidence was found in the Northeast and West. At the same time, we find evidence that working hours are significantly higher, since vaccines rollout than in the pre-vaccine period among white respondents, while it decreases among black respondents.

In the meantime, the observed positive effect of the vaccine rollout on labor supply indicates that economic confidence appears to rise with vaccination optimism after many economic activities had been curtailed due to the coronavirus pandemic in 2020. Hence, the findings perhaps underscore the importance of the availability of vaccines to labor market recovery and the overall economic recovery in general in the United States.

However, a major limitation of this study is the lack of valid instruments in the data to establish the causal effect of vaccine rollout on the labor supply in the study. Deb et al. (2020) noted that vaccination has a causal impact on incidence levels and economic activities. Because of this, the observed positive effect of the vaccine rollout period on labor supply might suffer from untreated endogeneity or omitted variable bias. Our future challenge is to use data with far better information that permits the identification process to establish the causal effect of vaccine rollout on economic activity, such as labor supply in the United States.

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Data availability statements The data will be available upon request from the author.

Declarations

Conflict of interest The author declares that no known competing financial interests or personal relationships could have appeared to influence the work reported in this paper. Hence, the study does not require ethical approval.

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