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COVID-19 vaccination and household savings: An economic recovery channel

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ABSTRACT

The COVID-19 pandemic increased people's propensity for precautionary savings in response to economic recession (e.g., Mody et al., 2012; Gropp and McShane, 2021; Levine et al., 2021). However, as the relevant vaccine roll-out continues, it mitigates people's concerns and boosts the macroeconomy, which leads to significant declines in household precautionary saving motives. Consistent with this expectation, using U.S. county-level vaccination, deposit, economic, and demographic data, we show that there is a significant negative relationship between COVID-19 vaccination and household savings. We attribute this negative relationship to an economic recovery channel because our findings also suggest that the vaccination has a strong negative impact on the unemployment rate and results in increases in consumer spending. Overall, our study adds to an emerging strand of literature on how COVID-19 vaccination affects households' financial behaviors.

1. Introduction

Since the onset of the COVID-19 pandemic, many aspects of the impact of the pandemic on the economy have been examined (e.g., Bartik et al., 2020; Coibion et al., 2020; Goodell, 2020; Colak and Öztekin, 2021). Studies have also shown that the COVID-19 pandemic has had significant negative effects on people's financial activities, such as consumption, savings, and investments (e.g., Baker et al., 2020; Spatt, 2020; Levine et al., 2021; Dursun-de Neef and Schandlbauer, 2022; Alekseev et al., 2022). To combat the pandemic, many countries have ramped up COVID-19 vaccine studies and subsequent vaccine roll-outs. As the studies and roll-outs have continued, many restrictions have been lifted and the labor market as well as economic conditions have begun to recover.[2] Therefore, there are a few papers on how COVID-19 vaccination affects financial market performance (e.g., Khalfaoui et al., 2021; Chan et al., 2022; Fu et al., 2022).

Nevertheless, few studies touch upon how COVID-19 vaccination affects households' financial decision-making. Our study fills this gap by investigating the effects of COVID-19 vaccination on U.S. households' saving behaviors at the county level. Literature suggests that households would heighten their precautionary saving motives and then increase their savings in response to economic recessions and hazardous events because of the aggravation of uncertainties about the future and the worsening of

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[2] The International Monetary Fund (IMF) said it was upgrading its global growth forecast for 2021 thanks to vaccinations of hundreds of millions of people. These vaccinations are expected to help fuel a sharp rebound in economic conditions. For details, see https://www.nytimes.com/2021/04/06/business/imf-outlook-global-economy.html.

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the macroeconomy (e.g., Skidmore, 2001; Mody et al., 2012; Lydon and McIndoe-Calder, 2021; Zhang et al., 2022). In addition, from a psychological/behavioral perspective, Alhenawi and Yazdanparast (2021) and Yazdanparast and Alhenawi (2022) find that the COVID-19 pandemic is associated with households' increases in fears and uncertainties. As COVID-19 vaccination may mitigate households' uncertainties and boost the macroeconomy, we conjecture that COVID-19 vaccination leads to significant decreases in precautionary saving motives and consequently, in households' bank savings.

In this study, by using U.S. vaccination data provided by the Centers for Disease Control and Prevention (CDC) and deposit data collected from the Federal Deposit Insurance Corporation (FDIC) and adopting fixed effect panel regressions, we show that, at the county level, COVID-19 vaccination leads to decreases in households' savings, as proxied by deposit flows.[3] In addition, using bank-level analyses, we find that our main finding continues to hold. This effect can be explained through an economic recovery channel. Specifically, we argue that as increasing numbers of people get vaccinated, the labor market tends to return to normal and economic conditions bounce back, decreasing households' propensity to accumulate precautionary savings and thus their bank savings. This economic recovery channel is validated by showing the negative effect of the vaccination on the unemployment rate. For robustness, we use an instrumental variable (IV) for the vaccination rate measures. Nevertheless, our finding regarding the unemployment rate remains unchanged. Moreover, we demonstrate that the vaccine roll-out helps boost consumer consumption, implying that households switch to increased spending when they are less concerned about precautionary savings and benefit from economic betterment. This further confirms the existence of an economic recovery channel related to a consumer consumption mechanism.

Our study is timely and important because policymakers and financial economists desire to understand how COVID-19 vaccination may drive the economy and influence households' financial activities. There has been a heated debate regarding the efficacy of COVID-19 vaccines, but at least from an economic perspective, we demonstrate that the vaccination may help mitigate households' uncertainties and concerns and be beneficial to economic recovery. Although, as mentioned before, many finance studies have investigated the pandemic itself (e.g., Coibion et al., 2020; Spatt, 2020; Levine et al., 2021; Alekseev et al., 2022), there is a paucity of literature on the vaccination per se. This study contributes to this emerging literature by examining how COVID-19 vaccination affects the dynamics between households' savings and consumption. In addition, because the COVID-19 pandemic is treated as a hazardous event and is accompanied with an economic recession, our study complements the literature on how households' financial decision-making, especially spending and saving behaviors, react to recovery from economic recessions and hazardous events (e.g., Skidmore, 2001; Hurd and Rohwedder, 2010; Mody et al., 2012; Gropp and McShane, 2021).

2. Sample and empirical strategy

2.1. Data

We first compile a sample of bank deposit flows, COVID-19 infection rates, economic condition indicators, and household demographic data at the county level at an annual frequency from 2021 to 2022. To measure deposit flows, which can be used as a proxy for household savings, we obtain bank branch-level deposit data from the Summary of Deposits (SOD) database provided by FDIC and then aggregate the data at the county level.[4] This measure has been extensively used in finance studies (e.g., Drechsler et al., 2017; Li et al., 2019) as well as in COVID-19 related literature (e.g., Levine et al., 2021; Dursun-de Neef and Schandlbauer, 2022). Relying on confirmed COVID-19 cases data provided by Johns Hopkins University, we calculate *Infection rate* as the mean number of confirmed COVID-19 cases in a county divided by the population in that county in a given year. In addition, we collect county-level unemployment rates from the Bureau of Labor Statistics as a measure of the economic condition in each county in a given year. To measure consumer spending, we use the changes in credit/debit card spending data at the county level provided by "Opportunity Insights Economic Tracker Data". Lastly, we acquire household demographic data, such as age, gender, and race, from the U.S. Census Bureau County Population Totals datasets, and obtain household income, marital status, education, household size, and health insurance coverage data from the American Community Survey. We also obtain a sample of monthly variables at the county level from March 2021 to April 2022 to conduct an economic recovery channel analysis. To counter the influence of outliers, we winsorize all COVID-19 infection rate and vaccination rate variables at the 1% level. Table 1 presents summary statistics, and Table A1 in Appendix A offers variable definitions and data sources in detail.

2.2. Empirical design

We employ the regression specification of county-level bank deposit growth on the vaccination variables and a group of control variables with state and year fixed effects as our baseline regression model.[5]

$$Deposit\ growth_{i,t} = \alpha_0 + \alpha_1 \times Vacc_{i,t} + \alpha_2 \times Z_{i,t} + \gamma_j + \delta_t + \epsilon_{i,t} \tag{1}$$

[3] In this study, we adopt four measures of COVID-19 vaccination. The measures are the ratios of a county's residents who are completely vaccinated (first), who are 18+ and fully vaccinated (second), who get one dose of vaccine (third), and who are 18+ and get one dose of vaccine (fourth). Table A1 provides a comprehensive construction of these variables.

[4] Although we utilize county-level total deposits, household deposits/savings constitute a major share of these deposits for U.S. commercial banks. Specifically, according to our calculation, household deposits account for roughly 80% of U.S. commercial banks' deposits. A detailed explanation and computation can be found in Appendix B.

[5] By September 2022, less than 900 counties' demographic data for 2021 were available from the U.S. Census Bureau. We adopt the Stata built-in command "REGHDFE" in our model specification. If we employed county fixed effects, Stata would drop singletons (i.e., the remaining approximately 2200 observations/counties with only one year of demographic data) in our regressions. For this reason, we employ state fixed effects in this baseline model.

Table 1
Summary statistics.

Panel A								
Variables	N	Mean	Std. Dev.	p5	p25	Median	p75	p95
Deposit growth	6,397	0.084	0.082	−0.037	0.041	0.083	0.128	0.211
Complete pct	6,160	0.396	0.195	0.000	0.297	0.421	0.526	0.689
Complete 18 plus pct	6,167	0.475	0.223	0.000	0.375	0.514	0.627	0.786
Dose-1 pct	6,160	0.448	0.223	0.000	0.334	0.471	0.590	0.790
Dose-1 18 plus pct	6,167	0.533	0.250	0.000	0.419	0.572	0.701	0.899
Median age	6,286	41.719	5.144	33.200	38.700	41.500	44.600	50.900
Male pct	6,286	0.504	0.020	0.480	0.493	0.500	0.509	0.542
White pct	6,286	0.841	0.161	0.474	0.791	0.909	0.952	0.972
Education	3,972	0.246	0.105	0.117	0.169	0.220	0.306	0.465
Log income	3,972	10.930	0.261	10.509	10.766	10.918	11.085	11.411
Marital pct	3,972	0.500	0.069	0.378	0.459	0.503	0.545	0.608
Household size	3,972	2.497	0.253	2.140	2.330	2.460	2.620	2.970
Health insurance	3,973	0.660	0.100	0.482	0.596	0.668	0.734	0.812
Unemployment rate	6,284	0.057	0.022	0.026	0.041	0.054	0.070	0.098
Infection rate	6,284	0.120	0.070	0.034	0.057	0.098	0.185	0.233
Panel B								
	N	Mean	Std. Dev.	p5	p25	Median	p75	p95
Unemployment rate	40,729	0.041	0.017	0.019	0.029	0.038	0.050	0.074
ΔUnemployment	37,680	−0.034	0.152	−0.249	−0.123	−0.050	0.042	0.248
Complete pct	40,008	0.381	0.182	0.000	0.272	0.402	0.506	0.658
Complete 18 plus pct	40,020	0.461	0.211	0.000	0.343	0.495	0.610	0.763
Dose-1 pct	40,008	0.441	0.202	0.000	0.326	0.459	0.572	0.753
Dose-1 18 plus pct	40,020	0.529	0.230	0.000	0.409	0.561	0.684	0.869
Infection increase rate	40,715	0.082	0.094	0.002	0.015	0.046	0.113	0.297
Vacc per capita	43,890	0.001	0.001	0.000	0.001	0.001	0.002	0.003
ΔSpending	30,899	0.123	0.148	−0.098	0.042	0.122	0.202	0.356
Panel C								
	N	Mean	Std. Dev.	p5	p25	Median	p75	p95
Deposit growth–bank	1,858	0.019	0.058	−0.052	−0.009	0.012	0.034	0.121
Bank exposure–complete	2,215	0.500	0.187	0.012	0.406	0.521	0.628	0.766
Bank exposure–complete 18 plus	2,215	0.589	0.205	0.022	0.503	0.621	0.730	0.843
Bank exposure–dose-1	2,215	0.565	0.225	0.014	0.445	0.595	0.718	0.900
Bank exposure–dose-1 18 plus	2,215	0.647	0.245	0.017	0.528	0.707	0.823	0.942
Bank exposure–un rate	2,215	0.041	0.012	0.024	0.034	0.040	0.050	0.062
Log size	2,215	16.145	1.467	14.270	15.232	15.778	16.749	19.140
ETOA	2,215	0.107	0.037	0.065	0.087	0.101	0.119	0.156
ROA	2,203	0.003	0.002	0.001	0.002	0.003	0.004	0.006
NPL	2,215	0.007	0.007	0.000	0.002	0.005	0.008	0.020
Loan growth	2,177	0.022	0.053	−0.041	−0.007	0.015	0.039	0.098
Liquidity	2,211	0.261	0.130	0.087	0.168	0.238	0.328	0.533

Panel A presents summary statistics for the annual variables used in this study at the county level over the sample period. Panel B reports summary statistics for the monthly variables at the county level. Panel C shows summary statistics for the quarterly variables at the bank level. Table A1 provides variable definitions and data sources in detail. p5, p25, p75, and p95 denote the 5th, 25th, 75th, and 95th percentiles, respectively.

where subscripts i and t index county and year, respectively. $Deposit\ growth_{i,t}$ is the dependent variable that proxies household savings. $Vacc_{i,t}$ is the key independent variable, denoting the ratio of people who have been vaccinated in a certain county. $Z_{i,t}$ denotes a set of county-level control variables. γ_j and δ_t denote state and year fixed effects, respectively. In Eq. (1), α_1 captures the relationship between COVID-19 vaccination and household savings at the county level.[6]

3. Main results

3.1. COVID-19 vaccination and household savings

Fig. 1 shows that prior to the COVID-19 outbreak in the U.S. in March 2020, the overall deposit growth rate had been relatively stable. At the time the pandemic started to spread widely, the deposit growth rate more than doubled from 2.7% in March to 6.8%

[6] Due to the unique design of the SOD database provided by FDIC, the deposit growth rate in 2022 is calculated as the percentage change from June 2021 to June 2022. Since vaccination data are cumulative and provided daily, we also calculate the vaccination variables based on the averages of the cumulative data from June 2021 to June 2022 for the year 2022. In other words, the time periods between our household saving variable and vaccination variables are matched.

Table 2
COVID-19 vaccination and household savings.

Panel A				
Dependent variable	Deposit growth			
Independent variables	(1)	(2)	(3)	(4)
Complete pct	−0.092***			
	(0.027)			
Complete 18 plus pct		−0.073***		
		(0.024)		
Dose-1 pct			−0.039*	
			(0.021)	
Dose-1 18 plus pct				−0.026
				(0.018)
Infection rate	0.044	0.051	0.046	0.049
	(0.072)	(0.072)	(0.072)	(0.072)
Control variables	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	3,921	3,921	3,921	3,921
Adjusted R-squared	0.153	0.153	0.151	0.151
Panel B				
Dependent variable	Deposit growth			
Independent variables	(1)	(2)	(3)	(4)
Complete pct	−0.111***			
	(0.032)			
Complete 18 plus pct		−0.088***		
		(0.030)		
Dose-1 pct			−0.092***	
			(0.028)	
Dose-1 18 plus pct				−0.088***
				(0.025)
State × Year FE	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes
Observations	6,192	6,192	6,192	6,192
Adjusted R-squared	0.083	0.082	0.083	0.083
Panel C				
Dependent variable	Deposit growth–bank			
Independent variables	(1)	(2)	(3)	(4)
Bank exposure–complete	−0.034			
	(0.024)			
Bank exposure–complete 18 plus		−0.032*		
		(0.019)		
Bank exposure–dose-1			−0.034*	
			(0.019)	
Bank exposure–dose-1 18 plus				−0.031*
				(0.017)
Bank controls	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Year–quarter FE	Yes	Yes	Yes	Yes
Observations	1,492	1,492	1,492	1,492
Adjusted R-squared	0.175	0.176	0.176	0.177

Panel A reports the regression results of the effect of COVID-19 vaccination on household savings. The dependent variable is county-level or bank-level deposit growth, which is adopted as a proxy for household savings growth. Key independent variables are the vaccination measures, and control variables are *Median age*, *Male pct*, *White pct*, *Education*, *Log income*, *Marital status*, *Household size*, *Health insurance*, *Unemployment rate*, and *Infection rate*. All control variables are lagged by one period, except for *Infection rate*, as both COVID-19 infection and vaccination variables reveal contemporaneous impacts. Panel B presents similar results with State × Year and County fixed effects instead of control variables. Panel C reports the bank-level regression results. Bank exposure to vaccination equals the weighted average of vaccination rate measures (*Complete pct*, *Complete 18 plus pct*, *Dose-1 pct*, and *Dose-1 18 plus pct*) across counties where a bank operates, where the weights are the percentages of the bank's total deposits from the corresponding counties. Bank controls include *Log size*, *ETOA*, *ROA*, *NPL*, *Loan growth*, and *Liquidity* and are measured at the beginning of each quarter. The standard errors appear in parentheses below the parameter estimates. The t-statistics are based on robust standard errors clustered at the county level for county-level analyses and on White heteroskedasticity-consistent robust standard errors for bank-level analyses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table 3
What explains the effect of COVID-19 vaccination on household savings?

Panel A				
Dependent variable	Unemployment rate			
Independent variables	(1)	(2)	(3)	(4)
Complete pct	−0.016***			
	(0.002)			
Complete 18 plus pct		−0.010***		
		(0.002)		
Dose-1 pct			−0.005***	
			(0.001)	
Dose-1 18 plus pct				−0.002*
				(0.001)
County FE	Yes	Yes	Yes	Yes
State × Year–Month FE	Yes	Yes	Yes	Yes
Observations	37,398	37,398	37,267	37,212
Adjusted *R*-squared	0.940	0.940	0.940	0.939
Panel B				
Dependent variable	Deposit growth			
Independent variables	(1)	(2)	(3)	(4)
Complete pct	−0.306**			
	(0.138)			
Complete pct × Unemployment rate	4.064*			
	(2.328)			
Complete 18 plus pct		−0.259**		
		(0.110)		
Complete 18 plus pct × Unemployment rate		3.344*		
		(1.834)		
Dose-1 pct			−0.248**	
			(0.099)	
Dose-1 pct × Unemployment rate			3.117*	
			(1.653)	
Dose-1 18 plus pct				−0.181**
				(0.078)
Dose-1 18 plus pct × Unemployment rate				2.305*
				(1.267)
Unemployment rate	−0.262	−0.291	−0.295	−0.265
	(0.392)	(0.392)	(0.399)	(0.400)
Control variables	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	822	822	822	822
Adjusted *R*-squared	0.099	0.100	0.100	0.099
Panel C				
Dependent variable	Deposit growth			
Independent variables	(1)	(2)	(3)	(4)
Complete pct	−0.310**			
	(0.136)			
Complete pct × Unemployment rate	4.025*			
	(2.373)			
Complete 18 plus pct		−0.262**		
		(0.109)		
Complete 18 plus pct × Unemployment rate		3.294*		
		(1.879)		
Dose-1 pct			−0.251**	
			(0.098)	
Dose-1 pct × Unemployment rate			3.055*	
			(1.697)	
Dose-1 18 plus pct				−0.182**
				(0.078)
Dose-1 18 plus pct × Unemployment rate				2.232*
				(1.314)
Unemployment rate	−0.270	−0.296	−0.296	−0.261
	(0.395)	(0.396)	(0.403)	(0.406)
Control variables	Yes	Yes	Yes	Yes
State × Year FE	Yes	Yes	Yes	Yes

(*continued on next page*)

Table 3 (*continued*).

Observations	822	822	822	822
Adjusted *R*-squared	0.099	0.100	0.100	0.099
Panel D				
Dependent variable	Deposit growth–bank			
Independent variables	(1)	(2)	(3)	(4)
Bank exposure–complete	−0.104***			
	(0.034)			
Bank exposure–complete × Bank exposure–un rate	1.383*			
	(0.792)			
Bank exposure–complete 18 plus		−0.102***		
		(0.032)		
Bank exposure–complete 18 plus × Bank exposure–un rate		1.491**		
		(0.718)		
Bank exposure–dose-1			−0.083***	
			(0.031)	
Bank exposure–dose-1 × Bank exposure–un rate			1.074	
			(0.732)	
Bank exposure–dose-1 18 plus				−0.087***
				(0.030)
Bank exposure–dose-1 18 plus × Bank exposure–un rate				1.306*
				(0.673)
Bank exposure–un rate	−0.214	−0.365	−0.146	−0.322
	(0.447)	(0.480)	(0.471)	(0.505)
Bank controls	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Observations	1,855	1,855	1,855	1,855
Adjusted *R*-squared	0.493	0.492	0.494	0.494

Panel A presents the results of analyses regarding the effects of COVID-19 vaccination on an economic indicator proxied by *Unemployment rate*. Columns (1) through (4) report the effects of different vaccination measures (*Complete pct*, *Complete 18 plus pct*, *Dose-1 pct*, and *Dose-1 18 plus pct*) on *Unemployment rate*. Panel B reports the results regarding the effect of COVID-19 vaccination on household savings with interaction terms between vaccination measures and the unemployment rate. Control variables are *Median age*, *Male pct*, *White pct*, *Education*, *Log income*, *Marital status*, *Household size*, *Health insurance*, and *Infection rate*. Table A1 provides variable definitions and data sources in detail. The standard errors appear in parentheses below the parameter estimates. The *t*-statistics are based on robust standard errors clustered at the county level. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. Panel C presents the results regarding the effect of COVID-19 vaccination on household savings, including the interaction terms between our vaccination measures and the unemployment rate and state × year fixed effects at the county level. Control variables are *Median age*, *Male pct*, *White pct*, *Education*, *Log income*, *Marital status*, *Household size*, *Health insurance*, and *Infection rate*. Panel D presents the regression results at the bank level. Bank exposure to vaccination is equal to the weighted average of vaccination rate measures and bank exposure to the unemployment rate is equal to the weighted average of the unemployment rate across counties where a bank operates, where the weights are the percentages of the bank's total deposits from the corresponding counties. Bank controls include *Log size*, *ETOA*, *ROA*, *NPL*, *Loan growth*, and *Liquidity* and are measured at the beginning of each quarter. The standard errors appear in parentheses below the parameter estimates. The *t*-statistics are based on robust standard errors clustered at the county level for county-level analyses and White heteroskedasticity-consistent robust standard errors for bank-level analyses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

in April 2020. However, as the COVID-19 vaccine roll-out began in early 2021 and increasing numbers of people became fully vaccinated over time, the deposit growth rate began to fall as it has since March 2021 and even turned negative after May 2022. This implies a negative association between the vaccination and deposit flows (i.e., household savings).

To take a deep look at the effect of COVID-19 vaccination on household savings, we adopt a rigorous panel regression approach. Panel A of Table 2 tabulates the findings of this investigation. The coefficients on the vaccination variables are all negative, and most of them are statistically significant, which indicates a negative association between COVID-19 vaccination and bank deposit growth. As mentioned before, household savings are proxied by deposit flows, as measured by bank deposit growth. This also indicates a negative impact of COVID-19 vaccination on household savings, which is consistent with our theoretical prediction.[7] Among the four vaccination variables, we observe that both variables related to vaccine completion show strong statistical significance (at the 1% level), whereas the two variables related to at least one dose display weak effects (one significant at 10% and the other insignificant). This reveals vaccine completion has a more pronounced effect than one dose administration does.[8]

[7] To ensure the robustness of our results, we adopt the percentage changes of county-level control variables. Nonetheless, our baseline regression results continue to hold as shown in Table A2.

[8] Gonzalez-Eiras and Niepelt (2022) examine how political factors shape COVID-19 influences, and we conduct a similar test to determine how local partisanship interacts with the impacts of COVID-19 vaccination. The detailed results are shown in Table C4. We also investigate how government support,

Table 4
Robustness check.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	Complete pct	Unemployment rate	Complete 18 plus pct	Unemployment rate	Dose-1 pct	Unemployment rate	Dose-1 18 plus pct	Unemployment rate
Vacc per capita	9.124***		8.985***		6.847***		6.666***	
	(0.865)		(0.935)		(1.014)		(1.235)	
Complete pct		−0.024**						
		(0.011)						
Complete 18 plus pct				−0.025**				
				(0.011)				
Dose-1 pct						−0.032**		
						(0.015)		
Dose-1 18 plus pct								−0.034**
								(0.016)
Infection increase rate	0.026***	−0.003*	0.014*	−0.004*	0.027***	−0.003	0.015	−0.004
	(0.007)	(0.002)	(0.008)	(0.002)	(0.008)	(0.002)	(0.010)	(0.002)
State × Year–Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F-statistics	111.130		92.269		45.579		29.142	
Stock–Yogo critical values	10% maximal IV size = 16.38		10% maximal IV size = 16.38		10% maximal IV size = 16.38		10% maximal IV size = 16.38	
Observations	34,410	34,410	34,410	34,410	34,279	34,279	34,224	34,224
Adjusted *R*-squared	0.570	0.526	0.557	0.526	0.599	0.524	0.650	0.523

Table 4 presents the regression results of an IV approach. Columns (1), (3), (5), and (7) display the first-stage regressions, while Columns (2), (4), (6), and (8) show the second-stage regressions. The vaccination variables are instrumented with the number of COVID-19 vaccination providers per capita at the county level. *Infection increase rate* is lagged by one period. Kleibergen–Paap rk Wald *F*-statistics are reported for the weak identification test. Table A1 provides variable definitions and data sources in detail. The standard errors appear in parentheses below the parameter estimates. The *t*-statistics are based on White heteroskedasticity-consistent robust standard errors. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table 5
The effect of COVID-19 vaccination on changes in consumer spending.

Dependent variable	ΔSpending			
Independent variables	(1)	(2)	(3)	(4)
Complete pct	0.050***			
	(0.014)			
Complete 18 plus pct		0.037***		
		(0.012)		
Dose-1 pct			0.036***	
			(0.009)	
Dose-1 18 plus pct				0.027***
				(0.007)
County FE	Yes	Yes	Yes	Yes
State × Year–Month FE	Yes	Yes	Yes	Yes
Observations	28,612	28,612	28,510	28,472
Adjusted *R*-squared	0.855	0.855	0.855	0.855

Table 5 reports the results of analyses regarding the effect of COVID-19 vaccination on changes in consumer spending (i.e., *ΔSpending*). This variable is measured by the percentage change in the aggregated and anonymized purchase data from consumer credit and debit card spending at the county level from January 2021 to June 2022. Table A1 provides variable definitions and data sources in detail. The standard errors appear in parentheses below the parameter estimates. The *t*-statistics are based on robust standard errors clustered at the county level. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Specifically, Column (1) shows that a one standard deviation increase in the corresponding county-level vaccination variable is associated with a decline of 1.79% in bank deposit growth at the same level. This magnitude is economically salient when compared with its standard deviation of 8.20%.[9] Using other vaccination variables produces similar results, as shown in Columns (2) through (4).[10] Moreover, to mitigate the confounding effect caused by potential state characteristics across time, we add state × year fixed effects to our baseline regression models. We also include county fixed effects to control for time-invariant characteristics at the county level. Still, our main findings remain unaltered as shown in Panel B of Table 2. To further verify this finding, we conduct a bank-level analysis of the relationship between the vaccination and bank deposits.[11] To that end, we follow the empirical design of Dursun-de Neef and Schandlbauer (2022). Specifically, we compute a weighted average vaccination rate based on a bank holding company's branch-level deposits in a certain county. By generating bank-level vaccination exposure, we can employ bank-level data and adopt the corresponding bank and year–quarter fixed effects.[12] This would mitigate the confounding effect concern caused by potential unobservable characteristics. Again, Panel C of Table 2 shows that there is a negative relationship between COVID-19 vaccination and household savings.[13]

3.2. What explains the effect of COVID-19 vaccination on household savings?

Levine et al. (2021) document that high local COVID-19 infection rates are associated with great anxiety in households about future job and income losses, which causes households to reduce consumption and increase savings. Extant literature offers several

as measured by the Economic Impact Payment and a policy index from the Oxford Covid-19 Government Response Tracker (Hale et al., 2021; link: https://github.com/OxCGRT/covid-policy-tracker), interacts with our main finding. The regression results are presented in Table C5.

[9] To determine fast or slow recovery related to pre-pandemic county-level characteristics, we first divide our total sample into two different groups. One division is for a group with below-median vaccination rates and the other for a group with above-median vaccination rates. We then compare the means of some important pre-pandemic demographic or economic characteristics such as income and education for two such groups. We indeed find some pre-pandemic characteristics that may affect the vaccination rate and thus recovery. The results are shown in Table A3. Also, we conduct subsample analyses regarding two pre-pandemic characteristics: income and education. The regression results are shown in Table C7.

[10] Some studies of households' financial decision-making use data from surveys conducted at the personal or household level. Examples of such surveys are the American Community Survey and the Panel Study of Income Dynamics (PSID). However, the sample size of the American Community Survey is roughly 1 million, accounting for 0.3% of the U.S. population. The size of PSID is relatively small—it uses less than 30,000 observations biannually. This is far from representative of the whole population. Although we adopt county-level data for vaccination and bank deposits, the data are aggregates of everyone in a county. We believe that this arrangement should be more representative than would be individual survey data. Nonetheless, one caveat is that county-level data may not exactly capture personal-level financial behaviors.

[11] Our bank-level sample is retrieved from the FR Y-9C report provided by the Federal Reserve. According to the information on the Federal Reserve website, there has been a wave of asset-size cutoff increases on reporting requirements due to mergers and acquisitions, bank asset growth, and inflation. Please visit the following link for further information: https://www.federalreserve.gov/apps/reportingforms/Report/Index/FR_Y-9C. As such, our bank-level sample is focused on banks with consolidated total assets of more than $3 billion. Our sample has a total of 344 unique banks in the United States. According to our estimate for the second quarter of 2022, the sample's aggregated total assets account for more than 95%, while deposits account for more than 85% of all the corresponding items for U.S. commercial banks. The total assets of all U.S. commercial banks can be found at https://fred.stlouisfed.org/series/QBPBSTAS. Total deposits can be found at https://fred.stlouisfed.org/series/DPSACBW027SBOG. This indicates that our sample retains its generality.

[12] As bank-level data are characterized by a higher frequency compared with the corresponding county-level data, we forward the deposit growth as the dependent variable by one quarter in the bank-level analyses.

[13] As for the bank-level regression analyses, we also conduct some additional regressions including the categorization between brokered and other deposits (Table C1), an examination of bank lending in response to the vaccine roll-out (Table C2), and an investigation of the role played by bank capitalization (Table C3). All these results are presented in Appendix C.

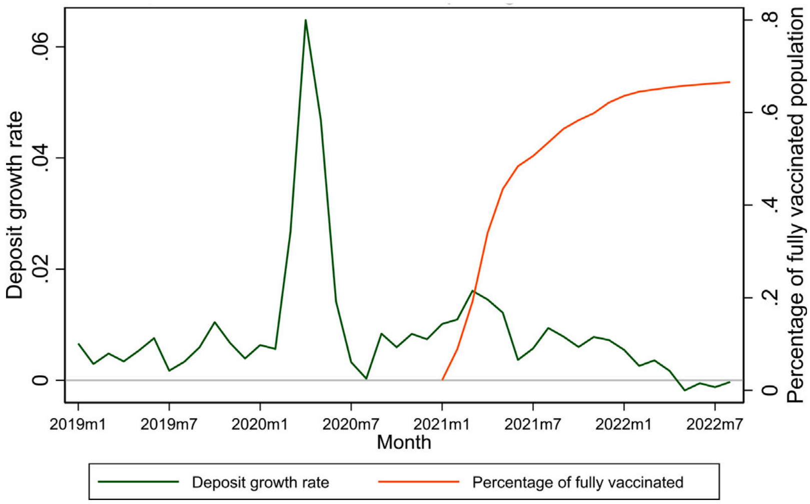

Fig. 1. Vaccination rate and deposit growth rate trend. Fig. 1 plots the trend of the percentage of the fully vaccinated population and the overall deposit growth rate in the U.S. from January 2019 to August 2022. Deposit data is obtained from the Federal Reserve Bank of St. Louis, while the vaccination rate is from the CDC (overall deposit data can be found at https://fred.stlouisfed.org/series/DPSACBW027SBOG).

perspectives that help explain the positive association between infection rates and household savings. One such perspective is related to our study. Households increase precautionary saving motives when they face concerns about job loss and income security, so they are incentivized to raise their savings (Browning and Lusardi, 1996; Carroll and Samwick, 1998; Engen and Gruber, 2001). Vaccination against COVID-19 is an effective way to improve people's mental health and to mitigate their concerns during the pandemic.[14] In fact, Agrawal et al. (2021) suggest that the vaccination helps reduce COVID-19 related mental health issues such as anxiety and depression. Therefore, we expect that vaccination is beneficial in easing people's anxiety about future uncertainties and is crucial to the recovery of the labor market and the macroeconomy, thus decreasing households' motives to accumulate precautionary savings.[15] Precisely, we attribute the negative association between COVID-19 vaccination and household savings at the county level to an economic recovery channel. One mechanism is through the recovery of the labor market proxied by the unemployment rate. As increasing numbers of people get vaccinated, the labor market tends to return to normal, which is reflected in a low unemployment rate. Economic conditions tend to bounce back. This lessens households' burden of spending and increases their propensity to invest, thus decreasing overall household savings.

Fig. 2A and Fig. 2B show the univariate regression results between COVID-19 vaccination (*Dose-1 pct* and *Complete pct*) and *Unemployment rate* using monthly data at the county level. The univariate analyses suggest that there is a negative association between vaccination and unemployment. Such findings are consistent with our expectation that the vaccination has a significant effect on lowering the unemployment rate and is beneficial to economic recovery. Panel A of Table 3 presents the regression results of the effects of COVID-19 vaccination on an economic condition indicator proxied by *Unemployment rate* with the inclusion of state × year–month and county fixed effects.[16] We show that all coefficients on the vaccination measures have expected signs and are statistically significant at the 1% level, suggesting a negative association between the vaccination and unemployment.

Moreover, to validate the results of our channel analysis, we create interaction terms between our vaccination variables and the unemployment rate, as shown in Panel B of Table 3. We demonstrate that the coefficients on the interaction terms are all positive (in contrast to those on the stand-alone vaccination variables) and statistically distinguishable from zero. This finding indicates that a high unemployment rate (which also represents a poor economic condition) dampens the effect of COVID-19 vaccination on household savings, which is consistent with our theoretical argument. We also conduct the corresponding analyses with the inclusion of the state × year fixed effects and at the bank level, as shown in Panels C and D, respectively. Nonetheless, our interaction analysis results continue to hold. Specifically, using the median and 75th percentile of the unemployment rate in our sample as a comparison, we show that, in Column (1) of Panel B, the vaccination results in declines of 8.65% and 2.15% in household savings growth, respectively.[17]

[14] Please see the Economist article at https://www.economist.com/graphic-detail/2022/01/20/covid-19-vaccines-have-made-americans-less-anxious-and-depressed for details.

[15] Using the Economic Policy Uncertainty data, we demonstrate that COVID-19 vaccination is negatively associated with economic uncertainty. The regression results are displayed in Table A4. Data source: https://www.policyuncertainty.com/state_epu.html.

[16] Our vaccination rate and unemployment rate data are measured monthly at the county level. Therefore, we also conduct our analyses at this level.

[17] Additionally, we conduct our baseline regression analyses with and without the control of the unemployment rate, as displayed in Panel A of Table C6. We find that compared with the analysis without the unemployment rate, adding this variable leads to significant declines in the magnitude of the coefficients on the vaccination variables, which accords with our conjecture. Furthermore, instead of using the unemployment ratio as a dependent variable, we adopt the percentage change in the unemployed in Panel B of Table C6; and still our regression results remain unchanged.

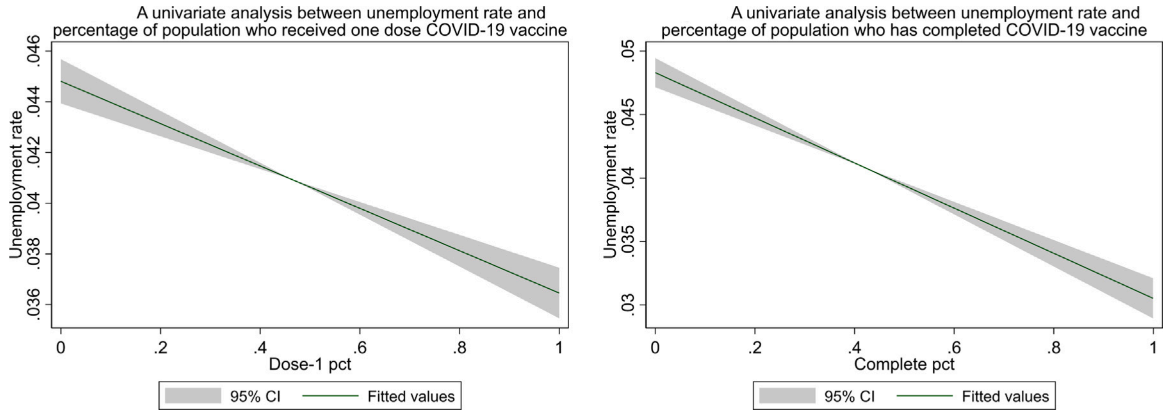

Fig. 2. A univariate analysis between unemployment rate and COVID-19 vaccination. These two figures present the univariate regression analyses between unemployment rate and vaccination measures (*Dose-1 pct* [2A] and *Complete pct* [2B]) using monthly data from March 2021 to April 2022.

3.3. Robustness check

In this subsection, we utilize an IV approach for robustness.[18] The instrument we use is the number of COVID-19 vaccination providers (hospitals, clinics, pharmacies, etc.) in a county divided by the county's population. This variable stands for people's degree of ease of access to COVID-19 vaccines. We contend that this instrument satisfies both relevance and exclusion condition requirements. To satisfy the relevance condition, we expect that the degree of ease of access to the vaccines should be highly correlated with the actual vaccination rate. Regarding the satisfaction of the exclusion condition, we argue that the number of vaccination providers has a marginal effect on economic condition indicators, such as the unemployment rate, beyond the channel of vaccination. Table 4 presents the regression results of this IV approach.[19] The first-stage regressions show that the number of vaccination providers per capita is positively and significantly correlated with the vaccination. The second-stage results demonstrate that the coefficients on the vaccination are still statistically significant and have expected (negative) signs. Overall, our channel analysis results still hold under this IV approach.[20]

3.4. Further discussion

Insofar as we have identified the negative effect of COVID-19 vaccination on the unemployment rate, which supports an economic recovery channel, one may expect that as households decrease their precautionary saving motives, they may switch to household spending/consumption more in response to declines in bank savings and increases in discretionary money. This potential mechanism is also in line with the economic recovery channel in the sense that as the vaccine roll-out improves economic conditions, households will rebuild their confidence in consumption and consequently increase their spending. To investigate this alternative mechanism, we conduct a regression analysis of the relationship between the vaccination and consumer spending. The corresponding data is characterized by changes in credit/debit card spending at the county level.[21] Table 5 presents the results of this examination. Consistent with our theoretical argument, our results suggest that all coefficients on the vaccination are positive and statistically significant, indicating that COVID-19 vaccination is positively associated with consumer spending at the county level.[22]

[18] One of the main advantages of employing an IV approach is that it helps mitigate concerns about the omitted variable bias. This bias is due to the fact that if there are omitted variables, then the error term that absorbs omitted characteristics in a regression will be correlated with the key independent variable and the dependent variable simultaneously. This may lead to a biased estimate of the corresponding coefficient. Compared to a traditional ordinary least squares approach, using IV adopts exogenous variables to predict a key independent variable such that the predicted key independent variable is significantly less correlated with omitted characteristics; the IV approach yields a less biased estimate of the effect of the vaccination on the unemployment rate in this study.

[19] As our IV is time-invariant at the county level, adding county fixed effects would cause perfect multicollinearity between the effects and the IV. Hence, we do not include county fixed effects in our IV regressions.

[20] Our IV is not a static variable as it is updated on a regular basis. However, we picked this variable at a specific time point when we collected the data. As the pandemic has been in progress for roughly three years and our sample period cannot be longer than that, one caveat is that it may be difficult for us to make long-term inferences at this point.

[21] The dataset is provided by "Opportunity Insights Economic Tracker Data". A link to the dataset may be found here: https://github.com/OpportunityInsights/EconomicTracker.

[22] Similar to the previous interaction analyses, we add a table (Table C8) containing the corresponding interaction terms at both the county (Panel A) and bank (Panel B) levels. The regression results are consistent with our theoretical predictions, although some of the results are statistically insignificant due to missing values for spending data at the county level.

4. Conclusion

In this paper, by using U.S. county-level vaccination, deposit, economic, and demographic data, we examine the effects of COVID-19 vaccination on households' financial decision-making. Specifically, our study shows that there is a negative association between the vaccination and household savings, as proxied by bank deposit flows, at the county level. We attribute this negative association to an economic recovery channel. One possible explanation for this negative association is that vaccination helps ease people's uncertainties about their job losses and salaries during the pandemic and boosts the recovery of the labor market, as measured using the unemployment rate. An alternative mechanism is that as economic conditions improve with the vaccination, households switch to increased consumption. Overall, the vaccination lessens households' motives to accumulate precautionary savings, thus decreasing their bank savings.

CRediT authorship contribution statement

He Ren: Software, Data curation, Validation, Writing – review & editing. **Yi Zheng:** Conceptualization, Methodology, Software, Writing – review & editing.

Data availability

This research is based on publicly available data. Researchers can download the data used in this study from their online sources.

Appendix A. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.frl.2023.103711.

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