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COVID-19 Vaccinations, Business Activity, and Firm Value

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Abstract

Using establishment-level data, we show that COVID-19 vaccinations boost business activity and firm performance in the United States. A 10-percent increase in vaccination rates results in a 4-percent to 6-percent increase in customer visits. We document the channels through which vaccinations increase store visits and the limits to the effect of vaccines on business activity. At the firm level, vaccinations increase sales and earnings, impact expansion decisions, and decrease probability of default, but the benefits vary across businesses. Vaccinations create private economic benefits to firms, shareholders, and employees, in addition to their intended public health benefits.

I. Introduction

The COVID-19 pandemic presented the most significant risk to overall public health and economic activity since the Spanish flu epidemic in 1918. As the initial fears over the public health consequences of COVID increased, states, counties, and businesses adopted various nonpharmaceutical public health interventions in hopes of reducing transmission of the virus. These included business

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closures, mask mandates, state-at-home orders, and numerous other personal and business restrictions. Spiegel and Tookes ((2021), (2022)) show that some of these interventions helped reduce COVID-19-related fatalities.

In addition to its dramatic effect on public health, COVID-19 also significantly inhibited business activity. For example, Goolsbee and Syverson (2021) and Bizjak, Kalpathy, Mihov, and Ren (2022) document that foot traffic to retail establishments declined between 60 percent and 70 percent during the onset of the pandemic in Mar. and Apr. 2020. Kim, Parker, and Schoar (2020) show that both revenues of small businesses and the consumption spending of their owners declined by roughly 40% at the onset of COVID-19. The drop in economic activity led to a substantial increase in unemployment and precipitous drop in GDP in the United States. By May 2020, unemployment had risen to 13 percent, and in the second quarter of that same year, GDP declined by 9 percent.

While the early government interventions had the ability to mitigate the fear and the spread of COVID-19, they could also hurt business activity. In response to the harms the virus was having on public health and business activity, there was an unprecedented push both in government and the private sector to rapidly develop a vaccine for COVID-19. When the results from Phase 3 clinical trials of the COVID-19 vaccine were announced by Pfizer-BioNTech on Nov. 9, 2020 (and soon after by Moderna), they were greeted with optimism that vaccines would lower the spread of the virus, reduce deaths and hospitalizations, and reverse the impact of the virus on the economy.[1] As evidence of the optimism that the vaccines brought, there was a positive stock market reaction to the announcement of the success of the first clinical trials (Acharya, Johnson, Sundaresan, and Zheng (2021)). The expectation was that the introduction of the vaccines would boost the economy.

The conventional wisdom was that vaccines would reduce consumers' anxiety about virus transmission without the negative economic effects of the initial government policies. But the effects of vaccine introduction on both public health and business activity were not obvious, as there were opposing and contentious viewpoints surrounding the vaccines.[2] Concerns about the safety and side effects, a lack of unanimity among medical professionals in recommending vaccines, and mis- and disinformation affected individual attitudes toward the virus and whether to be vaccinated.[3] There was also a divide in the business community whether to promote vaccination. Many firms required vaccinations before employees could work in-person, while many others opposed them (https://www.nbcnews.com/business/business-news/here-are-companies-mandating-vaccines-all-or-some-

[1]Subsequent approvals through Emergency Use Authorizations (EUA) allowed the formal administration of the vaccines. The authorization dates are Dec. 11, 2020, for Pfizer-BioNTech; Dec. 18, 2020, for Moderna; and Feb. 27, 2021, for Johnson & Johnson. https://www.fda.gov/emergency-preparedness-and-response/mcm-legal-regulatory-and-policy-framework/emergency-use-authorization.

[2]Evidence from surveys and academic research points to an ideological divide on the decision of an individual to be vaccinated (Agarwal, Dugas, Ramaprasad, and Gao (2021), Hamel, Sparks, and Brodie (2021) and Kates, Tolbert, and Orgera (2021)).

[3]See a report by McKinsey on the challenges related to vaccinations, https://www.mckinsey.com/industries/life-sciences/our-insights/covid-19-vaccines-meet-100-million-uncertain-americans.

employees-n1275808).[4] At the government level, the federal mandate of private employers requiring their employees to be vaccinated was blocked by the U.S. Supreme Court. States differed in their policies relating to vaccines. Some states imposed vaccine mandates (e.g., for state employees, frontline and health care workers, teachers, and school staff), while others passed legislation or executive orders banning such mandates (https://www.aarp.org/politics-society/government-elections/info-2020/coronavirus-state-restrictions.html; https://www.nytimes.com/2022/01/31/business/texas-florida-vaccine-mandate.html). Individual attitudes toward the vaccines along with business and public policies made it unclear how vaccine rates in the United States would evolve, whether herd immunity could be achieved, and whether vaccine rates ultimately would benefit both public health and overall business activity. Another potential limitation on understanding the effect of vaccinations on business activity were the structural changes in individual shopping and work habits, such as online shopping and work-from-home.

The contributions of our study are as follows: First, we establish the magnitude of the economic benefits of a pharmaceutical intervention, COVID-19 vaccinations, and its value as a public good. While vaccines might be expected to have economic benefits, given the tensions discussed above, it is important to quantify the economic magnitude of the effect. Second, we document how the benefits accrue. To the best of our knowledge, our study is the first to show how vaccinations lead to economic benefits. While several studies document the medical efficacy of vaccines, our focus is on their economic effect (see Harris (2022), Vilches, Moghadas, Sah, Fitzpatrick, Shoukat, Pandey, and Galvani (2022), and Watson, Barnsley, Toor, Hogan, Winskill, and Ghani (2022)). We study the role that COVID-19 vaccinations play in expanding activity in business establishments and how that affects firm operations and market performance. Finally, we identify and measure the limitations of these benefits.

We use establishment-level customer foot traffic as a measure of business activity following the introduction of vaccinations in the United States. With respect to economic magnitude, our findings indicate that a 10-percent increase in the vaccination rate results in a 4-percent to 6-percent increase in establishment visits. These findings demonstrate that vaccinations had a significant economic benefit. The primary ways vaccinations influence business activity include reduced threat of the virus, increased vaccination rates of customers, the relaxing of local government restrictions in response to rising vaccination rates, and higher employment in the establishments. These channels are not mutually exclusive, and they reflect both demand-side as well as supply-side effects that drive up business activity.

A potential competing explanation for the effect of vaccination rates on business activity is that some states relaxed restrictions contemporaneously with the introduction of vaccines. Spiegel and Tookes ((2021), (2022)) find that business restrictions, particularly with respect to high-risk businesses, resulted in lower fatalities. It is unclear, however, whether loosening of restrictions would affect economic activity. On the one hand, by design, many of these restrictions

[4]A poll conducted by Willis Towers Watson reported that more than a third of the large companies included in the survey were not intending to impose vaccine requirements on employees.

(e.g., stay-at-home orders, gym closures, and capacity constraints on restaurants) can lower retail activity and physical foot traffic to establishments. On the other, as shown by Correia, Luck, and Verner (2022), nonpharmaceutical health interventions during the 1918 flu pandemic reduced mortality rates but did not harm business activity. These nonpharmaceutical interventions (e.g., mask wearing and social distancing) helped slow that virus's spread and helped restore economic activity. The introduction of vaccinations can serve as a substitute to these interventions by increasing customers' confidence and willingness to go out. An empirical challenge in assessing the rebound in economic activity is attributing the role of vaccinations versus that of relaxing restrictive orders. We address this challenge by incorporating detailed data on county COVID restrictions in the United States (Spiegel and Tookes (2021)) in our main tests as well as similar data at the province level in Canada. While we find that loosening restrictions increases business activity, vaccines continue to play a vital role.

We recognize that the choice to be vaccinated is endogenous and directly relates to an individual's disposition toward the virus and social distancing measures. Individuals with laissez faire attitudes are less likely to stay at home (and more likely to attend business establishments) while also being less likely to be vaccinated. In contrast, individuals exercising abundant caution might have avoided visiting stores, despite being vaccinated. Therefore, any test using observed vaccination rates potentially biases downward the effect of vaccines on business activity. In addition to using establishment and establishment and time fixed effects, we employ a structural model under a 3-stage least-squares framework with instrumental variables to address the identification issue. We account for the endogenous nature of both vaccination rates and restrictions along with the effect of vaccinations on restrictions and continue to find a positive effect of vaccination rates on customer foot traffic. We also use another identification strategy that relies on a difference-in-differences approach by comparing U.S. states that border Canada, which introduced vaccinations later than the United States. We find a greater increase in traffic to an establishment in a U.S. state, compared to an establishment of the same brand in a bordering province in Canada, during a period when there is increased vaccination in the United States compared to Canada. Overall, our evidence suggests that the effect of vaccinations on business activity is causal.

The increase in visits associated with higher vaccination rates impacts firm performance. Specifically, the increased vaccination rates and visits to an establishment translate into higher sales and earnings for the parent firm. We also find a lower probability of default and stock return volatility, signifying a reduction in firm risk overall. Firms make strategic decisions to expand operations in response to the increased vaccination rates, which speaks to the longer-term effects of vaccines. Firms experience a higher sensitivity in establishment visits to vaccinations rates when they saw a greater loss of foot traffic at the onset of COVID-19, when they are in nonessential industries, and when they had a sharp decline in financial performance during the last 3 quarters of 2020. The stock market reaction to the initial announcement of successful vaccine trials shows higher abnormal returns for firms that had a greater initial loss of foot traffic during the onset of the pandemic and among firms whose financial performance declined most.

Our analysis suggests there are limitations on the benefits of vaccinations to business activity. The "delta" variant in summer of 2021 presents an external shock that demonstrates that the original vaccines had limits in terms of their medical efficacy, as illustrated by the surge in COVID-19 cases. Insofar as customers' shopping behavior responds to the safety of the environment, we find a diminished effect of vaccination rates on foot traffic during this period. The primary economic benefits occur before cumulative vaccination rates reach 15 percent to 37 percent, depending on the specification, after which the effect plateaus. This is much lower than the scientifically proposed level of 70 percent required to achieve herd immunity (https://www.who.int/news/item/23-12-2021-achieving-70-covid-19-immunization-coverage-by-mid-2022). An important insight from our paper is that the rate of vaccination required from a public health standpoint differs significantly from that required to achieve economic benefits.

Our paper most closely relates to the following studies. Acharya et al. (2021) examine the anticipatory effect of COVID-19 vaccine development on asset prices and show that financial markets anticipate increased economic activity with vaccine introduction. Our paper, on the other hand, complements theirs by documenting the realization of benefits of vaccine introduction using customer behavior, and our results are consistent with the market reaction that they document. Our paper also relates to contemporaneous studies in economics that examine how vaccines impact the economy at the county, state, national, or international levels (Deb, Furceri, Jimenez, Kothari, Ostry, and Tawk (2022), Hansen and Mano (2023), Gagnon, Kamin, and Kearns (2023), Gibson (2022), and Tito and Sexton (2022)). In contrast to these studies, we use establishment visits to quantify the effect of vaccinations on economic activity. Unlike aggregate economic data, typically available at a quarterly or annual frequency, the weekly establishment visits capture the economic effects in almost real time, providing a cleaner and more direct inference that is less subject to confounding effects. By using establishment fixed effects for our main tests, we also can account for confounding factors that could be present if economic activity is aggregated at the county, state, or higher levels. For some of our tests, we can measure the geographical source of customer visits at a granular level (Census Block Group (CBG)), which allows us to connect vaccination rates of customers to visits more tightly.

Besides the above contributions of our work, we provide evidence on the important role that vaccines play as a public good and their influence on economic and business activity. Nonpharmaceutical interventions such as lockdowns are controversial and have costs and benefits (Aum, Yoon, and Shin (2021), Spiegel and Tookes (2021)). Our study shows that a pharmaceutical intervention, namely COVID-19 vaccines, helped reverse the harms the pandemic had on business activity. Our findings suggest that immunizations, a public good, create economic benefits for firms, their shareholders, and employees, beyond their intended public health benefits.

II. Empirical Design and Data

A. Identifying Assumptions

A key econometric issue in our empirical analysis is establishing causality in the effect of vaccines on economic activity. For example, as Bizjak et al. (2022)

note, there was a high degree of politicization of the virus and the business responses to containing its transmission. Similarly, Agarwal, Dugas, Ramaprasad, Luo, Li, and Gao (2021), Hamel, Sparks, and Brodie (2021) and Kates, Tolbert, and Orgera (2021) document that political partisanship is one of the strongest predictors of the decision to be vaccinated. Given this evidence, individuals with laissez faire attitudes toward the pandemic are more likely to attend business establishments while also being less likely to be vaccinated. Alternatively, individuals exercising an abundance of caution are likely to stay home even after being vaccinated. This could cause the coefficient on the cross-sectional effect of the vaccination rate on business activity to be biased downward. We address this issue in 3 main ways. First, we use cross-sectional identification using an establishment (or establishment and time) fixed-effects model.[5] By using store fixed effects for our primary tests, we can account for confounding factors at the county, state, or higher levels. In other words, we account for latent factors that could drive establishment traffic that are time-invariant in nature, while allowing foot traffic and vaccinations rates to vary week by week. We estimate the following baseline panel regression specification:

$$\text{(1)} \qquad \ln(\text{VISITS}_{i,t}) = \alpha + \beta_1 \text{VRATE}_{i,t} + X_i + Y_i + \varepsilon_{i,t},$$

where $\ln(\text{VISITS}_{i,t})$ is the logarithm of the visits to establishment i during week t, X_i stands for the lagged firm-level or demographic control variables, Y_i refers to the industry, state, county, establishment, or time fixed effects.

Second, we employ a structural model using a 3-stage least squares with instrumental variables to address identification concerns. In equation (2), we predict VRATE using 2 instruments. In equation (3), we regress restrictions on VRATE and an instrument for restrictions. And in equation (4), we regress ln(VISTS) on the instrumented VRATE and RESTRICTIONS.

$$\text{(2)} \qquad \text{VRATE}_{i,t} = \alpha + \beta_1 \text{Instrument1}_{i,t} + \beta_2 \text{Instrument2}_{i,t} + \varepsilon_{i,t},$$

$$\text{(3)} \qquad \text{RESTRICTIONS}_{i,t} = \alpha + \beta_1 \text{VRATE}_{i,t} + \beta_2 \text{Instrument}_{i,t} + \varepsilon_{i,t},$$

$$\text{(4)} \qquad \ln(\text{VISITS}_{i,t}) = \alpha + \beta_1 \widehat{\text{VRATE}}_{i,t} + \beta_2 \widehat{\text{RESTRICTIONS}}_{i,t} + Y_i + \varepsilon_{i,t}.$$

The specification allows us address causation and the effect of vaccines on restrictions. We provide a detailed description of the instruments in Section IV.A.

Third, we address causation using the staggered introduction of vaccines in the United States relative to Canada. The 2 countries demonstrated significantly different vaccination rates between late Dec. 2020 (the beginning of U.S. vaccinations) through May 2021. Exploiting the difference in vaccination rates between the 2 countries to address causality, we perform a difference-in-differences

[5]Additional specifications include the use of controls for firm characteristics, and industry, state, county, or firm fixed effects.

analysis comparing U.S. states and Canadian border provinces after vaccines were introduced in the United States but not yet in Canada. We explicitly account for whether the states and provinces are contiguous and only include establishments belonging to firms or brands that operate in both countries in those states and provinces. This analysis relies on the assumption of parallel trends in these contiguous states and provinces before the introduction of the vaccines. The U.S. border states and Canadian border provinces are similar in industrial development, commerce, political system, culture, and climate, along with other factors that may jointly affect store visits. Furthermore, Canada effectively closed its border with the United States during our sample period, and thus, the visits on each side of the border reflect strictly local traffic. We estimate a regression specification of the following form:

$$\ln(\text{VISITS}_{i,t}) = \alpha + \beta_1 \text{US}_i + \beta_2 \text{POST} + \beta_3 \text{US}_i \times \text{POST} + Y_i + \varepsilon_{i,t}, \quad (5)$$

where $\ln(\text{VISITS}_{i,t})$ is the natural logarithm of weekly visits to an establishment i during week t; US_i is an indicator variable equal to 1 if the establishment i is in a U.S. border state and 0 if in a Canadian border province; POST is an indicator variable taking the value of 1 during Mar. 1, 2021–Apr. 26, 2021 and 0 during the period June 1, 2020–Dec. 7, 2020; and Y_i stands for brand, contiguousness, or brand-contiguousness fixed effects.

B. Data and Summary Statistics

We use the SafeGraph database to collect data on establishment foot traffic. SafeGraph identifies physical visits to millions of points-of-interests (POIs) by collecting GPS data from mobile phones and provides detailed information on visits and (anonymized) visitors to establishments. The establishments cover millions of POIs and thousands of distinct brands, including public and private companies in such industries as restaurants, grocery stores, retail stores, hotels, banks, and movie theaters.

We identify brand establishments and link them to their parent firms in the United States. In SafeGraph, the variable “brand” reflects an establishment (e.g., Taco Bell, Pizza Hut, or KFC) that ultimately belongs to a corporate parent entity (Yum! Brands). We drop establishments belonging to private firms, thereby restricting our sample to publicly traded firms, to examine the effect of vaccinations on firm performance. We exclude financials (2-digit SIC codes 60–63). We calculate the number of the visits each week (VISITS) in each establishment. Bizjak et al. (2022) show that firm characteristics help explain changes in store traffic, in addition to other variables. Therefore, we add firm controls measured as of 2019 for all our observations (2020–2021), except when we use firm/brand fixed effects or establishment fixed effects, where these controls are not needed. Firm characteristics are obtained from Compustat and CRSP.

We use several sources for vaccination rates. First, we use weekly data at the county level from the Center for Disease Control (CDC) for all U.S. states. Since data for Texas are not included in the CDC data, we obtain the data from the Texas

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TABLE 1

Descriptive Statistics

Table 1 presents descriptive statistics across establishment-week observations for a sample of 327,259 establishments owned by 249 firms for the period Dec. 28, 2020–June 28, 2021, with available firm-level data, and SafeGraph data on store visits. VISITS are calculated at the establishment level on a weekly basis, and VRATE is calculated at the county level measured at weekly frequency. Demographic characteristics are on the county level, and firm characteristics are as of the year preceding COVID (i.e., 2019). Variable definitions are provided in the Appendix.

Variables	No. of Obs.	Mean	Std. Dev.	P25	P50	P75
VISITS	8,287,701	100.579	119.210	26	63	126
VRATE	8,287,701	0.166	0.160	0.017	0.119	0.293
RESTRICTIONS	7,802,975	0.474	0.132	0.361	0.486	0.579
SALES (in $ mil.)	8,287,701	61,302	96,113	4627	16,039	72,148
DEBT	8,287,701	0.539	0.250	0.352	0.512	0.666
MKTBOOK	8,287,701	2.861	2.482	1.286	1.739	3.765
ROA	8,287,701	0.162	0.101	0.101	0.124	0.204
CASH	8,287,701	0.059	0.064	0.018	0.036	0.080
PBLACK	8,287,701	0.139	0.144	0.030	0.086	0.202
PLATINO	8,287,701	0.134	0.137	0.039	0.082	0.185
TRUMP_BIDEN_2020	8,287,701	0.482	0.165	0.369	0.461	0.605

Department of State Health Services (DSHS). For our difference-in-differences analysis, we obtain Canadian vaccination data from the Public Health Agency of Canada. Throughout the analyses, we use the percentage of fully vaccinated individuals as our explanatory variable.[6]

We obtain demographic data from SafeGraph Open Census. We obtain from the *New York Times* county-level data on COVID-19 cases and county-level 2020 Presidential election voting results.

We acquire the Yale COVID Restrictions Database (based on the Spiegel and Tookes (2021) and extended thereafter). The data contain state and county restrictions, such as stay-at-home orders; business closures for gyms, spas, and restaurants; capacity restrictions; mask requirements; and restrictions on gatherings. Finally, we obtain detailed COVID-19 restrictions data from Canada (https://www150.statcan.gc.ca/n1/pub/36-28-0001/2022008/article/00002-eng.htm). The Canadian restrictions data contain indices for specific types of restrictions, such as school closings, workplace closings, stay-at-home requirements, gym closings, restrictions on indoor gatherings.

Our final sample consists of 327,259 establishments owned by 249 public firms operating in 2770 counties during the period Dec. 28, 2020–June 28, 2021. Table 1 presents the summary statistics for our sample. The average number of visits to an establishment in a week is 100.6 with a median of 63. The average vaccination rate during the period in a county is 16.6 percent with a median of 11.9 percent.

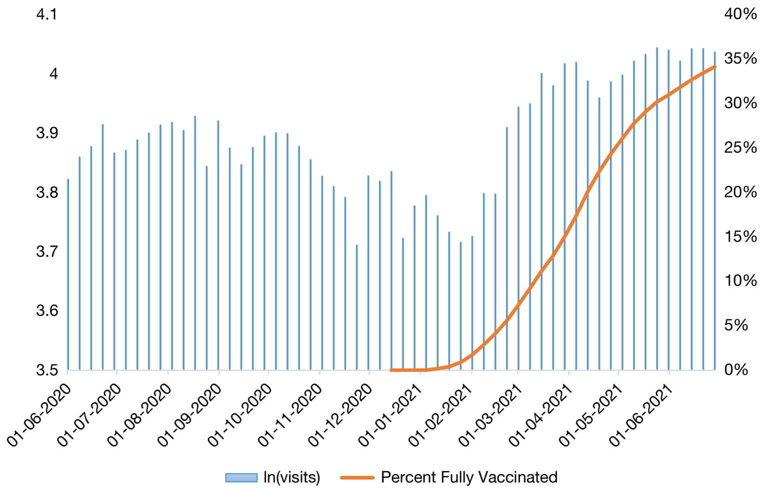
In Figure 1, we plot the distribution of cumulative vaccination rates per capita across time in the United States and the natural logarithm of visits in our sample. As we observe in the figure, visits to establishments exhibit a notable increase in the beginning of 2021, which coincides with the introduction of vaccinations.

[6]We define vaccination rates as the total number of fully vaccinated individuals (2 doses of Pfizer-BioNTech or Moderna or 1 dose of Johnson and Johnson vaccines) divided by the county's population. Our results are robust when we use the first dose only.

FIGURE 1

Store Visits and Vaccination Rates in the USA Across Time

Figure 1 presents, for each week in our sample, the mean of the natural logarithm of weekly store visits obtained from SafeGraph, measured on the left vertical axis, and the number of individuals fully vaccinated in the USA as a percentage of a county's population, measured on the right vertical axis.



III. Main Results

A. Vaccination Rates and Store Visits

Table 2 reports our baseline regression results. We regress ln(VISITS), the dependent variable, on vaccination rates, control variables, and different types of fixed effects. In model 1, we include state and industry fixed effects. In model 2, we include an exhaustive set of firm and demographic control variables as well as state and industry fixed effects. In model 3, we include firm controls and county and industry fixed effects. (County fixed effects fully absorb the demographic characteristics.) In model 4, we include establishment fixed effects. The establishment fixed effects fully absorb all observable and unobservable time-invariant factors that influence foot traffic. In this specification, which is the tightest of all the models, we compare week-by-week foot traffic as a function of vaccination rates for the same store. Across the first 4 models, we observe that a 10-percent increase in vaccination rates is associated with 5.2-percent to 6.6-percent increase in foot traffic. Given the average weekly change in visits of 5.6 percent in our sample, the point estimates we obtain are economically quite large. In model 5, we include time (monthly) fixed effects in addition to establishment fixed effects. The coefficient estimate is much lower, indicating that a 10- percent increase in vaccination rates is associated with 1.4-percent increase in foot traffic. The time fixed effects estimate an average effect at each point in time and assume that the same average effect for all establishments (and, by extension, all counties in which they operate), which is a strong assumption. The time fixed effects also remove the time-series variation in vaccination rates, and the test

TABLE 2

Vaccination Rates and Store Visits

Table 2 presents regression of the natural logarithm of weekly store visits at establishment level, ln(VISTS), on county-level cumulative vaccination rates, VRATE, and control variables for the period Dec. 28, 2020–June 28, 2021. We report coefficient estimates with standard errors in parentheses. Variable definitions are provided in the Appendix. Standard errors are clustered at county level. ∗∗∗, ∗∗, and ∗ indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	ln(VISITS)	ln(VISITS)	ln(VISITS)	ln(VISITS)	ln(VISITS)
Variables	1	2	3	4	5
VRATE	0.5183***	0.5728***	0.6199***	0.6598***	0.1392***
	(0.0145)	(0.0127)	(0.0115)	(0.0118)	(0.0186)
ln(SALES)		0.2722***	0.2754***		
		(0.0036)	(0.0035)		
DEBT		0.0670***	0.0604***		
		(0.0218)	(0.0206)		
MKTBOOK		−0.0817***	−0.0785***		
		(0.0036)	(0.0036)		
ROA		−0.4407***	−0.4989***		
		(0.0603)	(0.0584)		
CASH		2.0508***	2.0055***		
		(0.1089)	(0.1074)		
PBLACK		0.2242***			
		(0.0822)			
PLATINO		0.1963			
		(0.1258)			
TRUMP_BIDEN_2020		0.8758***			
		(0.0841)			
No. of obs.	8,287,701	8,287,701	8,287,701	8,287,701	8,287,701
Adj. R^2	0.3166	0.3762	0.3963	0.9377	0.9404
State FE, Industry FE	Yes	Yes			
County FE, Industry FE			Yes		
Store FE				Yes	
Store FE, Time FE					Yes

becomes a cross-sectional comparison of 2 counties, for example, Dallas County versus Los Angeles County at a given point in time, which is a weaker inference compared to model 4 and likely biases our coefficients downward.

B. Vaccinations, COVID Restrictions, and Business Activity

As discussed previously, it is unclear what effect business restrictions have on economic activity. Spiegel and Tookes ((2021), (2022)) find that restrictions resulted in lower fatalities. Similarly, Correia, Luck, and Verner (2022) find that nonpharmaceutical interventions during the 1918 flu pandemic reduced mortality rates but did harm business activity. By design, many of these restrictions (e.g., stay-at-home orders, gym closures, and capacity constraints on restaurants) can lower retail activity and foot traffic to establishments. To the extent that many states and counties had started relaxing some of these constraints contemporaneously with the introduction of vaccinations, the challenge is to disentangle the effect of vaccination vis-à-vis the role of relaxing restrictive orders.

We address this issue by incorporating detailed data on county COVID restrictions in the United States from the Yale COVID Restrictions Database. We construct a restriction index ranging from 0 (no restrictions, everything open at full

TABLE 3

Vaccination Rates, Restrictions, and Store Visits

Table 3 presents regression of the natural logarithm of weekly store visits at establishment level, ln(VISTS), on county-level cumulative vaccination rates, VRATE, and control variables, including restrictions, for the period Dec. 28, 2020–June 28, 2021. Variable definitions are provided in the Appendix. Standard errors are clustered at county level. ∗∗∗, ∗∗, and ∗ indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	ln(VISITS)	ln(VISITS)	ln(VISITS)	ln(VISITS)	ln(VISITS)
Variables	1	2	3	4	5
VRATE	0.2302***	0.4036***	0.4785***	0.5103***	0.1053***
	(0.0409)	(0.0313)	(0.0165)	(0.0174)	(0.0196)
RESTRICTIONS	−0.6053***	−0.3411***	−0.2736***	−0.2893***	−0.0751***
	(0.0694)	(0.0538)	(0.0278)	(0.0298)	(0.0230)
ln(SALES)		0.2715***	0.2747***		
		(0.0037)	(0.0036)		
DEBT		0.0696***	0.0621***		
		(0.0225)	(0.0213)		
MKTBOOK		−0.0810***	−0.0777***		
		(0.0037)	(0.0037)		
ROA		−0.4299***	−0.4881***		
		(0.0621)	(0.0602)		
CASH		1.9935***	1.9476***		
		(0.1122)	(0.1105)		
PBLACK		0.2313***			
		(0.0886)			
PLATINO		0.1888			
		(0.1201)			
TRUMP_BIDEN_2020		0.8055***			
		(0.0863)			
No. of obs.	7,802,975	7,802,975	7,802,975	7,802,975	7,802,975
Adj. R^2	0.3167	0.3750	0.3952	0.9373	0.9397
State FE, Industry FE	Yes	Yes			
County FE, Industry FE			Yes		
Store FE				Yes	
Store FE, Time FE					Yes

capacity) to 100 percent (full restrictions in place, everything closed).[7] The index describes well the restrictions in the United States, with a maximum value of 95% in the week of Mar. 30, 2020, reflecting the nationwide shut down, after which the restriction index decreases in value, with a minimum of 30% in the last week of our sample, the week of June 28, 2021. The average is 54%, from the onset of COVID through the end of our sample. During the period of our sample, the average value for the index is 0.474 with a median of 0.486. In models 1–5 in Table 3, we observe that the coefficients on VRATE remain economically and statistically significant, albeit slightly lower than those in the baseline Table 2 regressions. We also observe that the restriction index relates negatively to visits. When we include an exhaustive set of dummy variables reflecting individually each restriction and level of capacity (Table A1 in the Supplementary Material), the coefficients on VRATE are virtually the same as those in Table 3. Our main baseline specification (establishment fixed

[7]For each type of restriction, we define a value of 0 or 1 if binary (e.g., emergency orders or stay at home orders) or taking values of 0, 0.25, 0.5, 0.75, or 1, when the restrictions explicitly refer to a certain capacity (e.g., restaurants open at 25% capacity). When capacity relates to vaccinated people, we define the variable to be equal to the contemporaneous vaccination rate. The index takes the average of the individual restrictions in a week.

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effects, model 4) indicates that a 10-percent increase in visits results in 5.1-percent increase in foot traffic, compared to 6.6 percent without accounting for restrictions in model 4 in Table 2. While the reopening of the economy explains part of the increase in business activity, the effect of vaccinations remains economically significant.[8]

C. Robustness Tests

We perform a battery of tests to check for the robustness of our baseline results. First, in order to address potential concerns about non-stationarity in visits and vaccination rates, we use percentage change in visits relative to the same calendar month, pre-COVID in 2019. In Table A2 in the Supplementary Material, we report the results using both weekly vaccination rates (models 1 and 2) as well as cumulative vaccination rates (models 3 and 4) and observe that our main inferences on the effect of vaccinations on store traffic remain unchanged. Second, we address concerns of specifying a log-linear model with count variables by re-examining our main results under a Poisson model (Cohn, Liu, and Wardlaw (2022)). We present these results in Table A3 in the Supplementary Material. The coefficient estimates from models 1 and 2 indicate that a 10-percent increase in vaccine rates translates into a 6-percent ($e^{0.059}$–1) and 1.3-percent ($e^{0.013}$–1) increase in visits, respectively. These estimates are very close to the ones obtained from models 4 and 5 in Table 2. In Table A4 in the Supplementary Material, we present additional robustness tests when we use the first dose of COVID-19 vaccines and account for state-level allocations of vaccinations. We find that our main results on the effect of vaccinations on store traffic remain unchanged.[9]

IV. Causal Inferences

Vaccination rates and restrictive policies are likely not independent of each other – both vaccination and policy restrictions may affect business activity. We observe that the coefficients on VRATE weaken slightly with the inclusion of COVID restrictions. Admittedly, it is very difficult to disentangle the effects of the 2 since restrictions likely respond to vaccination rates, but lifting of restrictions, which is likely to increase business activity, can coincide with the introduction of

[8]In untabulated tests available from the authors, we repeat the endogeneity test of Spiegel and Tookes (2021) by removing the 5 most populous counties in each state. To the extent that restrictions were the tightest in the biggest cities (and populous counties) and the vaccination uptake was also highest in those locales, this may cause a bias in our tests. After removing those 5 most populous counties in each state, we observe similar results with respect to the effect of VRATE on business activity. We also run models using county–time and county–industry–time fixed effects, where time is at monthly frequency. For a given county, we are holding constant the prevalent conditions (including restrictions) in a certain month or in a month for a given industry, in the restaurant sector, for example, and seeing whether weekly vaccination rates in the county can explain the variation in store traffic in establishments in that county. This test aims to complement the evidence from the COVID Restrictions Database. While restrictions play a role in business activity, vaccination rates continue to relate strongly to visits.

[9]In unreported robustness analysis, we exclude politically polarizing firms (based on the 2019 Axios-Harris survey of partisan orientation of a firm's customers) and politically polarized counties (top and bottom 5% based on the 2020 Presidential voting results). We find that our results remain unchanged.

vaccinations. We do not claim that we can resolve this issue fully, but, in this section, we provide evidence on the interdependence of the 2 as well as some evidence on the role that vaccination rates play in the lifting of restrictions. Further, as discussed earlier, an important econometric issue with our empirical analysis is assessing causality in the effect of vaccines on business activity. Vaccination rates are likely not exogenous and could depend on omitted factors correlated with both vaccination rates as well as store traffic.

A. Structural Model Approach

We use a 3-stage least-squares framework with instrumental variables to obtain causal estimates on the effect of vaccination rates on store visits while accounting for their simultaneous effect on restrictions. The structural model addresses the concern that there is likely to be self-selection in terms of both vaccine uptake and the restrictiveness of local policies. For modeling VRATE, our choice of instruments is driven by both the relevance condition (i.e., being highly correlated with COVID-19 vaccinations) as well as the exclusion condition (i.e., affect store traffic exclusively through the COVID-19 vaccination channel). We use 2 different instruments in the analysis. Our first instrument accounts for eligibility criteria based on pre-existing health conditions for COVID-19 vaccinations. We use county data on the proportion of the population with comorbidities (cancer, obesity, and diabetes). We calculate an indicator variable equal to 1 if a county is in the top quintile of any of the above criteria, and 0 otherwise. The second instrument is based on a given county's experience in vaccinating its population against the flu. Unlike COVID-19, flu vaccinations were historically less influenced by political considerations. We define an indicator variable equal to 1 if a county is in the top quintile in flu vaccination rates per capita, and 0 otherwise. We measure all the variables described above as of 2019. We expect our instruments to relate directly related to vaccination rates (instrument relevance) but not directly to store visits (other than through the vaccine channel), thereby satisfying the exclusion condition. Our instrument related to comorbidities/eligibility meets the exclusion criterion since people with higher risk of infection are not more likely to visit retail stores in-person, except for the immunity provided by the vaccination. As for the instrument related to flu vaccinations, we expect the variable to relate highly to the propensity to receive a COVID-19 vaccination but, a priori, we do not expect the instrument to relate directly to store visits (exclusion condition). The 2020–2021 flu season was characterized by a very low incidence of that virus and thus the flu vaccine, in and of itself, is less likely to alleviate people's concerns about in-person shopping (https://www.cdc.gov/flu/season/faq-flu-season-2020-2021.htm).

In modeling RESTRICTIONS, we allow the restrictions to be influenced by the vaccination rate in the county for that week and employ an instrument that is correlated with restrictions in place but not with VISITS directly. Our instrument for a county's level of restrictions is the average of the restrictions index in the top 5 most populous counties in the state in a given week. Our instrument is motivated by the findings of Spiegel and Tookes (2021) that state-wide policies are often implemented with the most populous counties and biggest cities in mind, thus helping meet the relevance criterion for the instrument. A priori, the restrictions

TABLE 4

Three-Stage Least Square with Instrumental Variables

Table 4 displays the results from a structural 3-stage model with instrumental variables examining the effects of vaccination rates and restrictions on store traffic and the effect of vaccinations on restrictions. We report coefficient estimates with standard errors in parentheses. Variable definitions are provided in the Appendix. Standard errors are clustered at county level. ∗∗∗, ∗∗, and ∗ indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	VRATE	RESTRICTIONS	ln(VISITS)
Variables	1	2	3
VRATE		−0.0194***	0.4419***
		(0.0004)	(0.0179)
RESTRICTIONS			−0.6759***
			(0.0255)
ln(SALES)			0.2764***
			(0.0004)
DEBT			0.0679***
			(0.0030)
MKTBOOK			−0.0802***
			(0.0004)
ROA			−0.4804***
			(0.0096)
CASH			2.0452***
			(0.0097)
ELIGIBILITY	0.2170***		
	(0.0002)		
FLU_RATE	0.1229***		
	(0.0002)		
RESTRICTIONS_TOP_5_COUNTIES		0.9321***	
		(0.0006)	
County FE Industry FE	Yes	Yes	Yes
No. of obs.	7,405,312	7,405,312	7,405,312
Adj. R^2	0.3433	0.9578	0.3963

in a top 5 populous counties should not relate directly to the visits in a random county in the state, consistent with the exclusion condition. Further, to ensure that the exclusion condition is not violated, if a county borders one or more of the top 5 counties, the bordering top 5 county or counties are excluded from the average in the calculation, or if a county is part of the top 5 counties, its own restriction index value is excluded from the average.

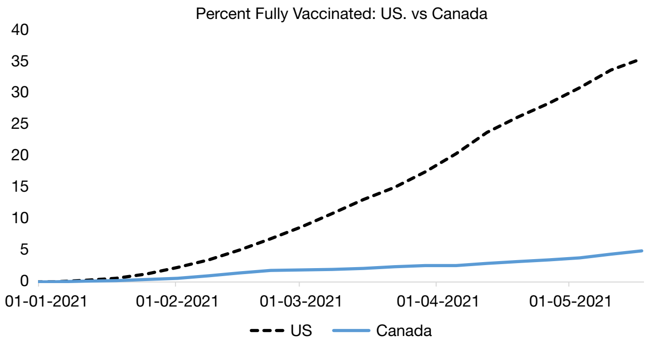
We report the results in Table 4. In model 1, we see that the instruments for VRATE are highly relevant: Both flu vaccination rate and eligibility are significant in predicting the COVID-19 vaccination uptake. In predicting RESTRICTIONS in model 2, we observe that both the instrument and VRATE relate strongly to local restrictions. An important takeaway is that restrictions in a county decrease as a function of vaccine uptake. In model 3, we observe that the coefficient on the instrumented VRATE with respect to ln(VISITS) is positive (0.44) and similar in magnitude to the coefficient reported in model 3 in Table 3. Overall, our results in a structural framework continue to point to vaccination rates significantly affecting business activity. Our results also highlight the importance that vaccination rates play in influencing the restriction policies in a county.[10]

[10]The 3-stage least squares model is run with county and industry fixed effects (like model 3 in Table 2). We cannot estimate establishment fixed effects in this framework due to the high dimensionality with many establishments in our sample.

FIGURE 2

Vaccination Rates in the United States and Canada

Figure 2 presents the percentage of fully vaccinated individuals in the United States and Canada from Jan. 1, 2020 to May, 17, 2021.



B. Difference-in-Differences Approach

We use the staggered nature of the introduction of vaccinations in the United States (the treated group) relative to Canada (the untreated group) to perform a difference-in-differences analysis. As Figure 2 shows, there is a distinct lag between the introduction of the vaccines in the 2 countries.

We identify as prevaccinations the period from June 2020 to Dec. 7, 2020, before vaccinations were administered. We define as postvaccinations the period starting on Mar. 1, 2021, and ending in the last week of Apr. 2021, during which the United States ramped up vaccinations significantly but Canada did not. We exclude the period of Jan. 1 to Feb. 28, 2021, during which the difference in vaccination rates between the bordering states in the United States and provinces in Canada was quite small. As of Mar. 1, the difference in vaccination rates was greater than 5 percent. Note that Canada had much lower vaccination rates (as opposed to being strictly "untreated") and the U.S. had higher rates (as opposed to being fully "treated").

This setup allows us to infer the effect of vaccine introduction on foot traffic, as the 2 countries generally have similar economic and political systems and the same retail store brands. This setup also ensures that the control group (Canada) remains "untreated" since Canada had closed its border with the United States. Our identification is strong because we account for the change in traffic (pre vs. post) for establishments of the same brand across different vaccination regimes. We include U.S. states and Canadian provinces that are on the border to account for latent cultural, social, political, climatic, and other factors based on shared geography. In other words, we compare, for example, a store in Seattle with one in Vancouver of the same brand as opposed to comparing a store in Miami with one in Montreal.[11] Of particular importance are 2 issues: seasonality and government restrictions. By using contiguous states and provinces, for example, Washington State in the United

[11]We exclude the Canadian province of Yukon, which had vaccination rates similar to the U.S. bordering states.

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TABLE 5

Difference-in-Differences Analysis: United States Versus Canada

Table 5 displays the results from a difference-in-differences analysis on the comparison between the United States (the treated group) and Canada (the untreated group) following the introduction of vaccinations in the United States. We identify the prevaccination period as June 1, 2020 to Dec. 7, 2020, before vaccinations started being administered. Contiguous fixed effects are based on an indicator variable taking the value of 1 if for a Canadian province *i* (e.g., British Columbia) a U.S. state *j* is bordering it (e.g., Washington State), and 0 otherwise. We define as post-vaccinations the period from Mar. 1, 2021 to Apr. 26, 2021. We report coefficient estimates with standard errors in parentheses. In model 2, we include indicator variables for common restrictions both for the United States and Canada. Variable definitions are provided in the Appendix. Standard errors are clustered at county level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Variables	ln(VISITS) 1	ln(VISITS) 2
US × POST	0.3838***	0.3034***
	(0.0272)	(0.0334)
US	1.3448***	1.1348***
	(0.0646)	(0.0617)
POST	−0.2715***	−0.1865***
	(0.0268)	(0.0318)
STAY_AT_HOME_ORDER		−0.1307***
		(0.0165)
RESTAURANTS_CLOSED		−0.1129**
		(0.0443)
GYM_CLOSED		−0.0067
		(0.0705)
SPAS_CLOSED		−0.1141**
		(0.0489)
GATHERINGS_LIMITED		0.0312
		(0.0302)
No. of obs.	2,831,391	2,831,391
Adj. R^2	0.5865	0.5834
Brand–Contiguous FE	Yes	Yes

States and British Columbia in Canada, we account for any patterns in in-person shopping that may be caused by seasonality.

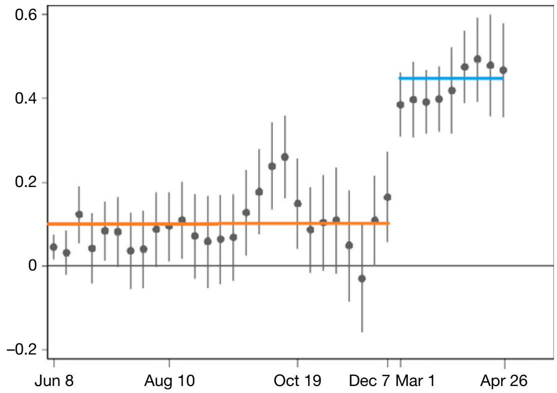
We present the results in Table 5. In model 1, we include fixed effects for brand and contiguousness simultaneously; in other words, we compare the traffic for stores of the same brand in a U.S. state to the traffic of stores of the same brand in an adjacent Canadian province. We find that the coefficient associated with the post-period in the United States is positive and significant, indicating that the visits in U.S. border states are higher by 38 percent relative to contiguous Canadian border provinces after the introduction of vaccinations in the United States, across all 3 models. Figure 3 presents the difference-in-differences weekly coefficient plot, along with the 95 percent confidence intervals. We observe a sharp increase in the coefficient (indicating higher visits in the treated group, United States), starting in Mar. 2021. The average coefficient in the preperiod is 9.5 percent, indicating a higher traffic in the United States than Canada pr vaccinations. Importantly, for the assumption of parallel trends, we do not observe any trends in the coefficients in the preperiod. The coefficient increases sharply in the postperiod, with an average of 43.4 percent.

To address the differences in government policies (likely more stringent in Canada than the United States as a whole), we repeat the difference-in-differences analysis by including detailed COVID-19 restrictions data from Canada. Notwithstanding the differences in how policies may have been implemented in Canada

FIGURE 3

Difference-in-Differences Coefficient Time Plot

Figure 3 displays the weekly coefficients from our difference-in-differences analysis on the comparison between the United States (the treated group) and Canada (the untreated group) along with their 95% confidence intervals. The prevaccination period is June 1–Dec. 7, 2020. The postvaccination period is Mar. 1–Apr. 26, 2021. The figure also displays the average coefficient in the preperiod (9.53%) and the average coefficient for the postperiod (43.36%).



vis-à-vis the United States, we match restriction variables that are common between the 2 countries. Specifically, we identify stay-at-home orders, restaurant closings, gym closings, spa closings, and restrictions on indoor gatherings.[12] In model 2 in Table 5, we include these restriction variables both for U.S. counties and Canadian provinces at the weekly interval, using the most restrictive brand-contiguousness fixed effect specification. We observe that restrictions generally lower physical foot traffic, as expected. Accounting for restrictions lowers the effect of vaccination of business activity, but the coefficient on US × POST remains statistically and economically significant, indicating that the United States experienced a 30% increase in visits relative to Canada after vaccine introduction in the United States. Collectively, these results point to vaccinations having a causal effect on the increase in store visits.

V. Channels Driving Store Traffic

As shown in the structural model analysis, vaccination rates affect local restrictions, which we interpret as one of the ways vaccinations boost business activity. In this section, we document further channels through which increased vaccination rates translate into store traffic. Specifically, we examine the following: i) the mitigation of initial fear of COVID-19; ii) increased vaccination rates among customers; and iii) the effect of vaccinations on increased employment at the retail establishments.

[12]In the U.S. data, “spas closed” is defined as “personal care services, such as barbershops, salons, and related services closed to all indoor activities.” In Canada, the respective variable is “hair salons and barbershop closures.”

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A. Threat of the Virus

One of the primary channels through which vaccinations increase business activity is by alleviating the threat of the virus. In this analysis, we include county transmission rates and fatalities to account for the severity of the threat of the virus and how it affects people's propensity to shop in person. To the extent that the vaccines reduce transmission rates and fatalities, lowering the threat of the virus, we expect that higher uptake should increase store visits by customers. In Panel A of Table A5 in the Supplementary Material, we specify an ordinary least-squares model of store visits. Consistent with the threat of the virus, we observe that transmission rates and fatalities relate negatively to customer visits. Importantly, vaccination rates relate positively related to store visits. The economic magnitudes resemble our baseline results in Table 2. In Panel B of Table A5 in the Supplementary Material, to account for the correlation between store visits and transmission rates, we specify a seemingly unrelated regression model, where, in the first equation, we model store visits (as in Panel A, model 1), and in the second equation, we model county-level transmission rates. The results (reported in Panel B) are unchanged. In an unreported additional analysis, we replace transmission rates with fatalities and obtain similar results. Overall, we find that store visits increase in vaccinations rates, even after we account for the threat posed by COVID-19 in terms of transmission and fatalities.

B. Vaccination Rates among Customers – Visits by Seniors

Early eligibility criteria gave priority for vaccination to seniors (along with individual with certain medical conditions). We obtain the age distribution for the Census Block Group (CBG) in which each establishment is located (in models 1 and 2 in Table 6) as well as that the primary CBG where customers originate (in models 3 and 4).[13] We define HIGH_AGE as an indicator variable equal to 1 if the CBG is in the top quintile of age, and 0 otherwise. In Table 6, we interact HIGH_AGE with VRATE to examine the incremental effect of individuals who are more likely to be vaccinated on store traffic. Note that store traffic decreases with HIGH_AGE, indicating that, on average, older individuals are less likely to shop in person. The interaction variable relates positively to store traffic, suggesting that the effect of vaccination rates on store traffic is amplified when the traffic is driven by senior customers who are more likely to be vaccinated.

C. Labor Market Effects

The last channel that we examine is how vaccinations can boost business activity by increasing employment. SafeGraph provides a variable related to foot traffic that likely indicates the presence of an employee measured by the "dwell time" that an individual spends at a store at prolonged periods. In Table 7, we regress the natural logarithm of number of store employees (ln(EMP)) on VRATE, on weekly basis. A 10- percent increase in vaccination rate is associated with around

[13] SafeGraph reports the CBGs from which the customers come from. We identify the primary CBG from which customers come to an establishment. When multiple customer CBGs are tied as primary, we break the tie randomly.

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TABLE 6

Channels of the Vaccination Effect on Store Visits: Seniors

Table 6 presents regression of the natural logarithm of weekly store visits at establishment level (ln(VISTS)) on county-level vaccination rates (VRATE), and interacted variable indicating high age of the store census block group (CBG) in models 1 and 2 or customer CBG in models 3 and 4, and control variables for the period Dec. 28, 2020–June 28, 2021. We report coefficient estimates with standard errors in parentheses. Variable definitions are provided in the Appendix. Standard errors are clustered at county level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	Store CBG		Customer CBG	
	ln(VISITS)	ln(VISITS)	ln(VISITS)	ln(VISITS)
Variables	1	2	3	4
VRATE × HIGH_AGE	0.0624***	0.0505***	0.0819***	0.0678***
	(0.0162)	(0.0139)	(0.0172)	(0.0159)
HIGH_AGE	−0.0396***	0.0022	−0.1486***	−0.0974***
	(0.0074)	(0.0070)	(0.0094)	(0.0091)
VRATE	0.5600***	0.6090***	0.5721***	0.6208***
	(0.0131)	(0.0113)	(0.0124)	(0.0111)
ln(SALES)	0.2722***	0.2754***	0.2628***	0.2663***
	(0.0036)	(0.0035)	(0.0039)	(0.0038)
DEBT	0.0667***	0.0606***	0.2656***	0.2534***
	(0.0218)	(0.0206)	(0.0217)	(0.0208)
MKTBOOK	−0.0818***	−0.0785***	−0.0668***	−0.0647***
	(0.0036)	(0.0036)	(0.0032)	(0.0032)
ROA	−0.4406***	−0.4989***	−0.8288***	−0.8682***
	(0.0604)	(0.0584)	(0.0550)	(0.0539)
CASH	2.0515***	2.0049***	1.7290***	1.7116***
	(0.1089)	(0.1075)	(0.1147)	(0.1144)
PBLACK	0.2263***		0.2771***	
	(0.0819)		(0.0741)	
PLATINO	0.1874		0.1517	
	(0.1251)		(0.1185)	
TRUMP_BIDEN_2020	0.8872***		1.0010***	
	(0.0839)		(0.0757)	
No. of obs.	8,287,701	8,287,701	7,862,956	7,862,956
Adj. R^2	0.3763	0.3963	0.3718	0.3902
State FE, Industry FE	Yes		Yes	
County FE, Industry FE		Yes		Yes

2.7% increase in employment at the establishment. This provides another mechanism through which vaccination rates can enhance business activity.

VI. Limits to the Benefits of Vaccinations on Business Activity

While COVID devastated business activity, not all businesses fared equally. For some, the effect was much worse, and some benefited from the pandemic (Goolsbee and Syverson (2021)). In this section, we examine the differential effects of the introduction of vaccinations across establishment and firm characteristics.

In Table 8, we examine the effect of vaccinations on establishments or firms that were particularly hurt by COVID. In model 1 in Panel A of Table 8, we define an indicator variable equal to 1 if the establishment was in the highest quintile of decrease in visits in Mar. 2020, or 0 otherwise. We interact that variable with VRATE and show that the establishments that lost the most foot traffic benefit the most from increase in vaccination rates.[14]

[14]We find similar results if we aggregate the initial drop in visits at the firm level.

TABLE 7

Channels of Vaccination Effect: Employment

Table 7 presents regression of the natural logarithm of weekly number of employees at establishment level (ln(EMP)) on county-level vaccination rates (VRATE) and control variables for the period Dec. 28, 2020–June 28, 2021. The number of employees is obtained from SafeGraph data. We report coefficient estimates with standard errors in parentheses. Variable definitions are provided in the Appendix. Standard errors are clustered at county level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Variables	ln(EMP) 1	ln(EMP) 2	ln(EMP) 3	ln(EMP) 4
VRATE	0.2140*** (0.0090)	0.2405*** (0.0081)	0.2728*** (0.0088)	0.0472*** (0.0155)
ln(SALES)	0.1378*** (0.0022)	0.1380*** (0.0022)		
DEBT	−0.1128*** (0.0175)	−0.1164*** (0.0172)		
MKTBOOK	−0.0080*** (0.0023)	−0.0070*** (0.0023)		
ROA	−0.2062*** (0.0517)	−0.2062*** (0.0516)		
CASH	0.1978*** (0.0651)	0.1346** (0.0650)		
PBLACK	−0.0503 (0.0466)			
PLATINO	0.1435* (0.0743)			
TRUMP_BIDEN_2020	0.1155*** (0.0365)			
No. of obs.	5,751,675	5,751,674	5,742,733	5,742,733
Adj. R^2	0.2284	0.2410	0.7374	0.7378
State FE, Industry FE	Yes			
County FE, Industry FE		Yes		
Store FE			Yes	
Store FE, Time FE				Yes

We also examine the essential or nonessential nature of the businesses. Using data from CDC, we classify establishments as essential or nonessential and create an indicator variable equal to 1 if the businesses was nonessential, and 0 otherwise (https://archive.cdc.gov/#/details?q=essentialworkers&start=0&rows=10&url=https://www.cdc.gov/vaccines/covid-19/categories-essential-workers.html). In model 2, we interact the nonessential dummy variable with VRATE and observe much higher the incremental effect of vaccination on foot traffic was for nonessential businesses.

We use data from SafeGraph to determine the percentage of sales that come from online orders on establishment level. We create an indicator variable (LOW_ONLINE) equal to 1 if the establishments are in the lowest quintile of online sales, and 0 otherwise. In model 3, we interact LOW_ONLINE with VRATE and find a higher differential effect for businesses with a low percentage of online sales.

In Panel B of Table 8, we examine the effect of vaccinations on firms that were particularly hurt by COVID-19. We use several measures of performance to examine this: sales, earnings, free cash flow, and stock returns over the last 3 quarters of 2020. We classify whether a firm was in the lowest quintile in each of these 4 characteristics and interact its poor performance status with VRATE. Across all 4 models, we observe firms that had the worst performance across these categories

TABLE 8

Cross-Sectional Analyses: Establishment and Firm Characteristics

Table 8 presents regression of the natural logarithm of weekly store visits at establishment level, ln(VISITS), on county-level vaccination rates, VRATE, and interacted variables. In Panel A, the interact variables indicate high drop in establishment visits at the onset of COVID-19 in model 1, nonessential nature of business in model 2, or low-online percentage of establishment sales in model 3. In Panel B, the interact variables indicate high decrease in sales in model 1, high decrease in net income in model 2, high decrease in free cash flows in model 3, and poor risk-adjusted returns in model 4, all measured over the last 3 quarters of 2020 on firm level. The interacted variables indicate that the change in the firm characteristic falls in the bottom quintile. We report coefficient estimates with standard errors in parentheses. Variable definitions are provided in the Appendix. Standard errors are clustered at county level. ∗∗∗, ∗∗, and ∗ indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A. Establishment Characteristics

	HIGH_DROP_IN_VISITS ln(VISITS)	NON_ESSENTIAL_BUSINESS ln(VISITS)	LOW_ONLINE_SALES ln(VISITS)
Variables	1	2	3
VRATE × Variable	0.1276***	0.2086***	0.0890***
	(0.0185)	(0.0113)	(0.0091)
VRATE	0.6310***	0.6024***	0.5802***
	(0.0120)	(0.0106)	(0.0134)
No. of obs.	8,267,278	7,694,900	5,564,371
Adj. R^2	0.9374	0.9387	0.9410
Store FE	Yes	Yes	Yes

Panel B. Firm Characteristics

	LOW_SALES ln(VISITS)	LOW_NI ln(VISITS)	LOW_FCF ln(VISITS)	LOW_RETURNS ln(VISITS)
Variables	1	2	3	4
VRATE × Variable	0.3903***	0.3463***	0.3176***	0.1333***
	(0.0111)	(0.0144)	(0.0116)	(0.0195)
VRATE	0.4818***	0.5213***	0.4986***	0.5286***
	(0.0122)	(0.0125)	(0.0110)	(0.0184)
No. of obs.	4,706,483	4,551,406	3,698,661	2,861,013
Adj. R^2	0.9371	0.9297	0.9295	0.9480
Store FE	Yes	Yes	Yes	Yes

benefited the most in terms of increase in foot traffic related to vaccinations. Our cross-sectional tests show that the introduction of vaccinations benefits firms differently. While firms that did poorly during the onset of the pandemic benefit more, those that were essential, had higher percentage of online sales, or otherwise performed well do not benefit as much.

To illuminate other dimensions of vaccination's effect on business activity, we examine a period (the "delta" surge in summer of 2021) where the originally developed vaccines were not nearly as medically effective. Insofar as customers' shopping behavior responds to the safety of the environment, we study the effect of vaccination rates on foot traffic during this period. In Table 9, we define an indicator variable, DELTA_VARIANT, equal to 1 during July–Sept. 2021 (the delta variant surge), and 0 otherwise. We interact the variable with VRATE. The interacted variable is negative and significant, indicating a lower impact of vaccination rates on customer traffic during the delta surge.

Further, we show that the effect of vaccination rates on business activity is nonlinear, with higher benefits achieved at lower levels of vaccination, and the benefits diminishing at higher vaccination rates. In Figure A1 in the Supplementary Material, we report results where we model the vaccination rate under a quadratic,

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TABLE 9

Vaccination Limitations: Delta Variant Surge

Table 9 presents regression of the natural logarithm of weekly store visits at establishment level (ln(VISITS)) on county-level vaccination rates (VRATE), and interacted variable indicating the period of the "delta" variant surge (July 1, 2021 to Sept. 30, 2021). We report coefficient estimates with standard errors in parentheses. Variable definitions are provided in the Appendix. Standard errors are clustered at county-week level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	ln(VISITS)	ln(VISITS)
Variables	1	2
VRATE × DELTA_VARIANT	−0.4565***	−0.0405***
	(0.0223)	(0.0139)
VRATE	0.6362***	0.1277***
	(0.0114)	(0.0180)
DELTA_VARIANT	0.1266***	
	(0.0087)	
No. of obs.	12,528,024	12,528,024
Adj. R^2	0.9296	0.9313
Store FE	Yes	
Store FE, Time FE		Yes

cubic, and piece-wise linear frameworks. We observe that the benefits accrue faster at lower levels of vaccination, after which the benefits diminish. Depending on the specification for VRATE, we observe much higher slopes before vaccination rate reaches 15 percent to 37 percent (much lower than the medically suggested 70-percent level for herd immunity), after which the effect plateaus. These findings indicate that the benefits accrue faster at lower levels of vaccination, after which the benefit diminishes. Structural changes, such as online shopping and work-from-home, that COVID-19 accelerated may explain the constraints on how much vaccinations can boost in-person economic activity.

VII. Firm-Level Effects of Vaccinations

Our findings so far indicate that vaccination rates increase establishment-level foot traffic. In this section, we investigate their impact at the firm level.

A. Effect on Firm Performance and Risk

In Panel A of Table 10, we regress the natural logarithm of a firm's quarterly sales for the first 2 quarters of 2021 and the natural logarithm of a firm's quarterly EPS (earnings per share) obtained from Compustat, on the predicted store visits.[15] We calculate the sum of the weekly visits to all establishments of the same firm to obtain the firm visits for the first 2 quarters of 2021. In the first stage of a 2-stage least squares, we regress weekly store visits on vaccination rates along with fixed effects. From this regression, we estimate a firm's average instrumented store visits for each week and calculate the time series average of the firm's instrumented store visits for the second-stage analysis. In the second stage, we regress the quarterly sales or EPS on the instrumented store visits from the first stage. By design, the first

[15]We add a constant equal to the minimum EPS observation to ensure that there are no negative values, resulting in loss of observations when taking the logarithm. As an alternative approach, we calculate the percentile rank of all variables and rerun the same regression. We obtain similar results.

TABLE 10

Vaccination Rates and Firm Performance

Models 1 and 2 in Panel A of Table 10 present regressions of the natural logarithm of a firm's quarterly sales or EPS (earnings per share) for the first 2 quarters of 2021, obtained from Compustat, on predicted store visits. Models 3 and 4 present regressions of default probability (P_DEFAULT) (Bharath and Shumway (2008)) and standard deviation of equity stock returns (SIGMA) on predicted store visits. VRATE is used to predict store visits in the first stage. VRATE is used to predict store visits in the first stage. Panel B presents the results from a multinomial logit model with the following outcomes: no change (the normalized alternative); increase in number of stores; decrease in number of stores as a function of VRATE. We report coefficient estimates with standard errors in parentheses. Variable definitions are provided in the Appendix. We report coefficient estimates with robust standard errors in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A. Effect of Store Visits on Firm Quarterly Sales, Earnings Per Share, and Firm Risk

	ln(SALES)	ln(EPS)	P_DEFAULT	SIGMA
Variables	1	2	3	4
PREDICTED_ln(VISITS)	3.5263***	0.2068***	−0.2165***	−0.1465***
	(0.0462)	(0.0359)	(0.0150)	(0.0244)
SALES			0.0564***	−0.0209**
			(0.0055)	(0.0091)
DEBT	−0.2457**	−0.1270*	0.0061	0.2975***
	(0.0977)	(0.0753)	(0.0288)	(0.0471)
MKTBOOK	0.3181***	0.0545***	−0.0204***	−0.0273***
	(0.0151)	(0.0088)	(0.0045)	(0.0073)
ROA	1.4072***		−0.0776	−1.3588***
	(0.3070)		(0.0939)	(0.1512)
CASH	−6.7233***	−0.4288*	0.2692***	0.3369**
	(0.2986)	(0.2316)	(0.0910)	(0.1435)
No. of obs.	470	469	1412	1418
Adj. R^2	0.9627	0.2821	0.2055	0.4314
Industry FE	Yes	Yes	Yes	Yes

Panel B. Probability of Increase or Decrease in the Number of Stores (Multinomial Logit)

	1		2	
Variables	DECREASE	INCREASE	DECREASE	INCREASE
VRATE	−1.0692***	2.2607***	−1.1617***	2.3266***
	(0.0451)	(0.0684)	(0.0470)	(0.0700)
ln(SALES)	0.0292***	0.2229***		
	(0.0060)	(0.0105)		
DEBT	1.1598***	0.0770		
	(0.0428)	(0.0850)		
MKTBOOK	−0.0441***	0.2142***		
	(0.0063)	(0.0078)		
ROA	3.8854***	−0.9359***		
	(0.1253)	(0.2127)		
CASH	−0.3033***	−2.1238***		
	(0.1139)	(0.2446)		
PBLACK	−0.7889***	−0.6953***	−0.8391***	−0.8177***
	(0.0793)	(0.1377)	(0.0826)	(0.1393)
PLATINO	1.6034***	1.8727***	1.8616***	2.0521***
	(0.0736)	(0.1237)	(0.0777)	(0.1271)
TRUMP_BIDEN_2020	−4.5043***	−3.4029***	−5.1426***	−3.8968***
	(0.0651)	(0.1107)	(0.0694)	(0.1133)
No. of obs.	564,458		564,458	
Pseudo R^2	0.216		0.304	
State FE, Firm FE			Yes	
State FE, Industry FE	Yes			

stage is run at the establishment level and the second stage at the firm level. Our analysis shows that vaccinations benefit firms by increasing their sales and earnings through customers' visits to the firm's establishments.

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At the onset of the COVID-19 pandemic, there were significant concerns about financial distress and viability of businesses. In response to these concerns, the government enacted various fiscal and monetary policies in 2020 with the goal of preserving jobs, preventing bankruptcies, and strengthening the economy overall. By the time of vaccination introduction, it was unclear whether vaccinations would have any additional role in lowering default risk. The effects on earnings and sales discussed earlier indicate a positive effect at the mean. However, it remains to be seen whether there are any significant effects at the tails.

To answer this question, we calculate a probability of default using the naïve measure described in equations (8)–(13) of Bharath and Shumway (2008). This measure translates the distance to default into a default probability, based on a firm's market value of equity, stock return volatility, and level of debt. We calculate the monthly default probability and regress this in a panel regression against the instrumented visits as in the analysis discussed earlier. This analysis includes the period of Jan.–June 2021.[16] We present the results in Table 10 models 3 and 4. We observe that the increase in visits (influenced by vaccination rates) significantly lowers a firm's probability of default (model 3). This result indicates that vaccinations have an incremental role to play in reducing the likelihood of financial distress, beyond the U.S. government's various fiscal and monetary policies. Lower default risk translates to reduced cost of financial distress and lower cost of debt for firms, facilitating capital raising to finance investments. We also observe a significant reduction in stock return volatility (model 4). Reduced volatility is likely to lead to higher firm value by improving investment efficiency (Stulz (1990), Minton and Schrand (1999)) and reducing shareholder–debtholder conflicts (Myers (1977)).

In Panel B of Table 10, we study how vaccines influence corporate decisions to expand or close stores. We examine corporate decisions pertaining to strategic expansion at the extensive margin as a function of vaccination rates. Specifically, we calculate the number of stores for each firm in each county per month for the period of Jan.–June 2021. We compare this to a firm's total number of stores per month in a county for the period of June–Nov. 2020, prior to vaccinations. We estimate a multinomial logit model with the following outcomes: no change (the normalized alternative); increase in number of stores; and decrease in number of stores. Results indicate that vaccination rates increase the likelihood of store openings and decrease the likelihood of closures. Overall, we find that firms incorporate the postvaccination business environment into their strategic decisions relating to expansion or contraction.

One potential channel through which vaccination rates can increase business activity is by the removal of restrictive measures by the firms themselves through their store policies (e.g., relaxing social distancing measures, removing limits of number of customers at a time, or lifting of mask requirements). While we do not have data to examine this channel directly, the evidence presented here does not rule out the possibility of firms doing these things after vaccine introduction.

[16]The number of observations in models 3 and 4 in Table 10 is 3 times that in models 1 and 2, due to the frequency of the dependent variable (monthly vs. quarterly).

TABLE 11

Market Response to Vaccine Announcements

Table 11 presents regressions of cumulative abnormal stock returns (CAR) on firm characteristics. CARs are calculated using a market adjusted model, in Panel A, and relative to the Fama–French 3-factor model, in Panel B, using value-weighted (VW) CRSP index as the market portfolio, with estimation period of 252 trading days ending 30 trading days before the event. The event date is the announcement of Pfizer-BioNTech of successful phase 3 clinical trials on Nov. 9, 2020. The CARs are calculated during days (0,1) relative to the event. We report coefficient estimates with robust standard errors in parentheses. Variable definitions are provided in the Appendix. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	Nonessential		High Drop		Low Net Income		Low Sales		Low Returns		Low FCF	
	1	2	3	4	5	6	7	8	9	10	11	12
Panel A. Market-Adjusted CARs												
Variable	0.0484***	0.0404	0.0791***	0.0589***	0.1208***	0.0750***	0.1150***	0.0788***	0.0161	−0.0174	0.0923***	0.0550***
	(0.0156)	(0.0287)	(0.0181)	(0.0180)	(0.0153)	(0.0165)	(0.0158)	(0.0148)	(0.0164)	(0.0173)	(0.0149)	(0.0183)
ln(SALES)	−0.0031	0.0036	−0.0035	0.0023	−0.0035	0.0009	−0.0024	0.0018	−0.0056*	0.0050	−0.0054*	0.0020
	(0.0036)	(0.0040)	(0.0034)	(0.0037)	(0.0031)	(0.0035)	(0.0030)	(0.0035)	(0.0033)	(0.0037)	(0.0032)	(0.0038)
DEBT	0.0682*	0.0279	0.0538*	0.0250	0.0595**	0.0314	0.0660**	0.0337	0.0581*	0.0103	0.0639**	0.0251
	(0.0348)	(0.0325)	(0.0303)	(0.0304)	(0.0301)	(0.0303)	(0.0291)	(0.0291)	(0.0331)	(0.0307)	(0.0307)	(0.0305)
MKTBOOK	−0.0164***	−0.0163***	−0.0171***	−0.0133***	−0.0183***	−0.0151***	−0.0148***	−0.0136***	−0.0178***	−0.0157***	−0.0193***	−0.0167***
	(0.0043)	(0.0044)	(0.0043)	(0.0039)	(0.0048)	(0.0046)	(0.0038)	(0.0039)	(0.0041)	(0.0044)	(0.0049)	(0.0050)
ROA	0.0290	0.0139	0.0870	0.0138	0.1062	0.0441	0.0944	0.0553	0.0751	0.0333	0.0871	0.0405
	(0.1105)	(0.1043)	(0.1023)	(0.0997)	(0.1034)	(0.1072)	(0.0947)	(0.0981)	(0.1054)	(0.1058)	(0.1061)	(0.1087)
CASH	0.0569	0.0456	0.0985	0.0115	0.0962	0.0732	0.0513	0.0231	0.0849	0.0026	0.0978	0.0676
	(0.0726)	(0.0782)	(0.0734)	(0.0832)	(0.0674)	(0.0793)	(0.0569)	(0.0720)	(0.0694)	(0.0784)	(0.0690)	(0.0799)
No. of obs.	235	229	245	239	245	239	245	239	245	239	245	239
Adj. R^2	0.0950	0.4114	0.1440	0.4389	0.2768	0.4633	0.2589	0.4782	0.0539	0.4003	0.1770	0.4324
Industry FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Panel B. FF CARs												
Variable	−0.0007	0.0117	0.0341**	0.0247*	0.0832***	0.0620***	0.0636***	0.0404***	0.0630***	0.0278	0.0658***	0.0510***
	(0.0135)	(0.0241)	(0.0155)	(0.0144)	(0.0139)	(0.0141)	(0.0150)	(0.0133)	(0.0113)	(0.0169)	(0.0133)	(0.0157)
No. of obs.	235	229	245	239	245	239	245	239	245	239	245	239
Adj. R^2	−0.0043	0.2922	0.0205	0.3014	0.1473	0.3572	0.0881	0.3219	0.0514	0.2989	0.0864	0.3342
Industry FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

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B. Market Response to Vaccine Announcement

We examine the stock market reaction to the initial announcement of successful vaccine trials. On Nov. 9, 2020, Pfizer-BioNTech announced successful phase 3 trials for their COVID-19 vaccine. Our tests capture whether the announcement effects are greater for firms that were more severely affected during the pandemic. In Table 11, we report regressions of cumulative abnormal stock returns (CAR) on firm characteristics. CARs are calculated using a market-adjusted model, in Panel A, and relative to the Fama–French 3-factor model, in Panel B. We use the CRSP value-weighted index as the market portfolio. The estimation period is 252 trading days ending 30 trading days before the event. We cumulate the CARs over days (0,1) relative to the event.[17]

Overall, we observe greater CARs for firms of nonessential nature, those that experience greater initial drop of foot traffic, and those that perform poorly during the last 3 quarters of 2020 based on sales, earnings, free cash flows, or risk-adjusted stock returns. These results reflect the anticipation of increased business activity, particularly for the firms hit the hardest by COVID-19. Overall, the stock market reaction to the news of the vaccines validates the findings reflected in higher foot traffic to firms of similar characteristics that we document earlier.

VIII. Conclusion

We study how COVID-19 vaccines impact business activity, firm performance, and value. Using granular data on store-level foot traffic and county-level vaccination rates, we show that customer foot traffic is increases with vaccination rates, with significant economic effects both at the establishment and corporate level in terms of increased sales, earnings, reduced default risk, and positive announcement stock returns. Our evidence suggests that this effect is causal. We also find that firms incorporate the postvaccination business environment in their strategic decisions to expand or close stores.

We show that the primary channels that influence the effect of vaccinations on increased business activity are reduced threat of the virus, traffic driven by vaccinated individuals, lifting of local government restrictions, and higher employment rates at the establishments as a function of vaccination rates. These channels are not necessarily mutually exclusive; they reflect both demand-side and supply-side factors that influence increased economic activity.

We examine both the market's anticipation of the vaccine announcements and realizations in terms of customer foot traffic once vaccines are introduced. The benefits we document are not uniform across firms or establishments. The benefits are concentrated among firms that perform poorly at the onset of COVID-19, firms that rely less on online sales, and firms that are of nonessential nature. Nonetheless, there are limitations on the benefits of vaccinations on business activity. The effect is reduced during the "delta" variant surge in the summer of 2021, among essential

[17]The 5 industries with the highest CARs are nursing and personal care facilities (43.17%), motion picture theaters (40.07%), paper and paperboard products (Party City's industry, 34.55%), eating and drinking places (28.66%), and apparel and accessory stores (21.28%). The 5 with the lowest CARs are gold and silver ores (−11.00%), building materials (−8.25%), household furniture (−7.53%), miscellaneous general merchandise stores (−7.32%), and computer and software stores (−7.21%).

retail establishments, and among establishments with greater online sales. We also find that the economic effects of vaccinations are nonlinear and accrue early on at lower levels of vaccination and diminish later at higher levels.

By studying a major government intervention that had economy-wide implications, our paper illuminates the effects of public health policies on a firm's business activity. Like prior evidence on the benefits of public health interventions during the 1918 pandemic, our findings have implications beyond the COVID-19 pandemic. A key takeaway is that the provision of a public good aimed at improving public health can also create private economic benefits to firms and their shareholders by boosting economic activity.

Appendix. Variable Definitions

BEACHES_OR_PARKS_CLOSED: Equals to 1 if beaches or parks are completely closed to the public, and 0 otherwise.

CAR: Cumulative abnormal return based on either market-adjusted returns or the Fama–French 3 factors.

CASH: Compustat item CH/Compustat item AT.

DEBT: Compustat item DLTT+ Compustat item DLC)/Compustat item AT.

ELIGIBILITY: Equals to 1 if a county is in the top quintile in (cancer, diabetes, or obesity per capita), and 0 otherwise.

EPS: Compustat item EPSFXQ.

FATALITIES: The weekly change in total COVID-related fatalities is calculated as the difference between current week total confirmed fatalities and prior week total confirmed fatalities.

FCF: (Compustat item IB-Compustat item TXT + Compustat item DP-Compustat item CAPX)/Compustat item AT.

FLU_VRATE: Equals to 1 if a county's flu vaccination rate (per capita) is in the highest quintile, and 0 otherwise.

GATHERINGS_LIMITED: Equals to 1 if gatherings are limited to 10 people, and 0 otherwise.

GYMS_CLOSED: Equals to 1 if gyms are closed, and 0 otherwise.

HIGH_DROP: Equals to 1 if the establishment was in the top quintile of decrease in visits in Mar. 2020, and 0 otherwise.

ln(INCOME): Log of median household income measured at the county level.

LOW_ONLINE_SALE: Equals to 1 if the establishments were in the bottom quintile of online sales in Nov. 2020, and 0 otherwise.

MKTBOOK: [Compustat item AT + (Compustat item CSHO × Compustat item PRCC_F) − Compustat item CEQ]/Compustat item AT.

NI: Compustat item NI.

NON_ESSENTIAL: Equals to 1 if an industry is defined as essential-work industry by Center for Disease Control and Prevention, and 0 otherwise https://archive.cdc.gov/#/details?url=https://www.cdc.gov/vaccines/covid-19/categories-essential-workers.html.

P_DEFAULT: The naïve measure of probability of default presented in equations (8)–(13) of Bharath and Shumway (2008).

PBLACK: The share of the Black population measured at the county level. We aggregate census block group (CBG) data from SafeGraph Open Census at the county level.

PLATINO: The share of the Latino population measured at the county level. We aggregate CBG data from SafeGraph Open Census at the county level.

POPULATION_DENSITY: Number of individuals living per square kilometer measured at the county level.

PVISITS: Percentage change in weekly visits to stores relative to the visits in the same calendar month in 2019, pre-COVID.

REOPENINGS_REVERSED: Equals to 1 if reopenings are reversed, and 0 otherwise.

RESTAURANTS_CLOSED: Equals to 1 if restaurants closed with the possible exception of takeout services, and 0 otherwise.

RESTRICTIONS: Restriction index ranges from 0 (no restrictions, everything open at full capacity) to 100 percent (full restrictions in place, everything closed). For each type of restriction, we define a value of 0 or 1 if binary (e.g., emergency orders, stay at home orders), or a value of 0, 0.25, 0.5, 0.75, 1, when the restriction explicitly refers to a certain capacity (e.g., restaurants open at 25% capacity). When capacity is related to vaccinated people, we define the variable to be equal to the contemporaneous vaccination rate. The index takes the average of the individual restrictions in a county in a given week.

RETURNS: Cumulative abnormal return based on market-adjusted returns for the period between Apr. 2020 and Nov. 2020.

ROA: Compustat item EBITDA/ Compustat item AT.

SALES: Compustat item SALE.

SIGMA: The annualized standard deviation of daily stock returns over the prior 12 months.

SPAS_CLOSED: Equals to 1 if spas are closed, and 0 otherwise.

STAY_AT_HOME_ORDER: Equals to 1 if "Stay-at-home order" issued by the state or county government is effective, and 0 otherwise.

TRANSMISSIONS: The weekly change in total COVID-related cases is calculated as the difference between current week total confirmed cases and prior week total confirmed cases.

TRUMP_BIDEN_2020: Trump share of the presidential 2020 vote at the county level.

VISITS: Weekly visits to stores.

VRATE: Cumulative number of fully vaccinated (second dose for Pfizer-BioNTech or Moderna, single dose of Johnson and Johnson) individuals divided by the population of the county.

Supplementary Material

To view supplementary material for this article, please visit http://doi.org/10.1017/S0022109024000322.

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