



# The Paycheck Protection Program and small business performance: Evidence from craft breweries

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**Abstract** The Paycheck Protection Program (PPP) provided approximately US \$790 billion in COVID-19 relief funds to small businesses across the United States. This study merges a verified industry dataset of craft beer producers with government micro-data on PPP loan recipients to examine the relationship between PPP funding and small business performance during the pandemic. Results indicate that firms receiving PPP funding were more likely to remain in operation and experience a smaller decline in annual production. However, even within a single industry, COVID-19 had heterogeneous effects on different market segments, demonstrating the importance of a firm's pre-pandemic business model on its flexibility and resiliency during a crisis. Finally, using a quasi-experiment that exploits a natural break in the loan program, the study suggests a positive causal effect of the role of loan approval timing on short-run

performance outcomes. These findings provide evidence that the PPP alleviated some losses induced by COVID-19, but questions remain about the program's distribution and long-term impacts.

**Plain English Summary** The US federal government created the Paycheck Protection Program (PPP) to minimize the economic damages from COVID-19 on workers and small businesses. One industry hit particularly hard by the pandemic was the craft brewing industry, making it an ideal industry to explore whether the PPP achieved its objectives. The results show that receiving a PPP loan increased the likelihood of remaining in business through the pandemic. Additionally, while most craft breweries experienced a decline in annual production from 2019 to 2020, firms that received a PPP loan experienced a smaller reduction. Breweries that received the earliest funding also performed better, suggesting that loan timing played a key role in performance outcomes. Taken together, the study suggests that the government program helped reduce economic damages associated with COVID-19, but more work is needed to fully understand the program's impact.

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## 1 Introduction

From February to April 2020, the number of business owners in the USA fell by 22% (Fairlie, 2020), and unemployment rates soared from 3.5 to 14.5% (BLS, 2022; Couch et al., 2020). Business closure rates were also 25–33% higher in 2020 than pre-COVID trends over the past several decades (Crane et al., 2020). While these estimates are grim, they likely would have been worse if not for federal policies providing financial support to small businesses.

On March 27, 2020, the US federal government passed the Coronavirus Aid, Relief, and Economic Security (CARES) Act (Public Law 116–136). As part of the US \$2.2 trillion stimulus package, US \$349 billion was appropriated to the Small Business Administration (SBA) to establish the Paycheck Protection Program (PPP). The PPP provided (forgivable) loans to small businesses to alleviate economic damages from COVID-19 and incentivize firms to retain employees on payroll. As the pandemic wore on, PPP funding increased, and US \$790 billion in funds were eventually allocated to nearly 12 million borrowers (Office of Capital Access, 2021; SBA, 2021b). Despite the vast funding and extensive coverage of the COVID-19 relief packages, little is known about the overall effectiveness of the program on small businesses.

This study aligns a verified dataset of craft beer producers with governmental data on PPP loan recipients to examine the role of PPP funding on business survival and performance. The craft beer industry is an ideal subject for analysis, as it comprises small, independently owned businesses whose primary revenue stream was significantly disrupted by the pandemic. In aligning these datasets, this article determines whether receiving a PPP loan increases the likelihood of business survival and contributes to better year-over-year (YoY) production outcomes. A novel feature of our data is that we observe information about market segmentation, which allows us to generalize our results to larger industries with a high level of internal validity.

The study resembles work presented in Bartlett and Morse (2020), Hubbard and Strain (2020), and Li (2021). Bartlett and Morse (2020) analyze the effectiveness of PPP on business survival in Oakland, California, whereas Hubbard and Strain (2020) address

survival rates among larger businesses.<sup>1</sup> Li (2021) uses Small Business Pulse Survey data to demonstrate that PPP loan recipients were less likely to report revenue decreases and a reduction in employee hours following loan approval. The study also draws on the work of Fairlie and Fossen (2021b), who use California administrative sales tax data to show that, on average, sales decreased by 17% during the second quarter of 2020. Moreover, their analysis shows that sales losses were most significant for the accommodation and hospitality industries, further motivating the use of the craft beer industry. Their study, however, does not explore the effects of PPP on performance, leaving an important gap in the literature.

Researchers have also explored the employment effects of the PPP (Autor et al., 2022a; Chetty et al., 2020; Dalton, 2021; Faulkender et al., 2020; Hubbard & Strain, 2020). These studies suggest an employment effect ranging from 0.9% (Hubbard & Strain, 2020) to 16–35% (Bartik et al., 2020b), where the magnitude of the point estimate depends on the sample used and the identification strategy employed (Dalton, 2021). From a policy perspective, the effectiveness of the PPP on employment is the first-order outcome. However, for a small business, the primary objectives are survival and profitability, and thus it is critical to assess how PPP affects the operational status and revenue of the firm.

Our contribution is threefold. Primarily, to our knowledge, this is the first study to align an industry dataset of existing businesses with PPP loan data. In doing so, the article analyzes the relationship between PPP funding and two metrics of small business performance: operational status and production volume (serving as a proxy for revenue). Results suggest that firms that receive PPP funding are more likely to remain in operation and experience smaller declines in YoY production from 2019 to 2020 than firms that do not. Observing different market segments within the industry also allows for heterogeneity analysis, demonstrating that a firm's pre-pandemic business

<sup>1</sup> It should be noted that the smallest loan size explored in Hubbard and Strain (2020) was US \$150,000. In contrast, the average loan size in our sample was US \$128,197 and the median loan size was US \$56,711. The analysis presented here is a necessary extension of Hubbard and Strain, as it teases out the relationship between PPP funding and *smaller* business performance.

model contributed to its degree of flexibility and resiliency during COVID-19, which allows for generalization to larger industries.

Secondly, through a quasi-experimental framework that exploits a natural break in the loan program, the study examines the role of loan timing on changes in YoY production from 2019 to 2020. The framework compares the YoY performance of firms that received funding before the initial US \$349 billion was exhausted and firms that received funding when it was reloaded 2 weeks later. The results show that breweries that receive funding before the structural break experience a decline in YoY production that is 2–4 percentage points smaller than those that receive funding in the week following the break. These findings suggest that loan approval timing affected annual performance, a result that likely generalizes to other service, hospitality, and specialized manufacturing sectors of the economy. This is the study's primary contribution, as it offers new insights for research analyzing the first-come, first-served style of the loan program.

Lastly, the study offers a methodological advancement, highlighting the shortcomings of the publicly available SBA data and speaking to the procedures necessary for future studies to achieve similar objectives. This includes discussing the limitations of the North American Industry Classification System (NAICS) coding system and inconsistencies in the PPP data. Furthermore, evidence suggests that the loan program was subject to fraudulent claims (Beggs & Harvison, 2022; Griffin et al., 2022), making it difficult for researchers to address the economic contribution of the PPP. By anchoring the PPP database to a verified listing of firms at the industry level, the study provides an important advancement that significantly reduces concerns over fraudulent claims being included in the analysis. This enables a more accurate estimate of the true impact of the PPP on business performance, increasing the generalizability of the results.

The remainder of this article is structured as follows. Section 2 provides background on the PPP and explains the impact of the pandemic on the craft brewing industry. Section 3 presents the different data sources used in the analysis. Sections 4–6 present results analyzing business survival, YoY performance, and loan timing, respectively. Section 7 discusses the study's two central limitations. Section 8

discusses the economic significance of the results, and Section 9 concludes.

## 2 Background

### 2.1 Paycheck Protection Program

Closed premises, reduced hours, layoffs, and a loss of customers are just a few consequences for small businesses at the onset of COVID-19 (Belitski et al., 2022). To combat this early economic turmoil, the US government passed the CARES Act (Public Law 116–136) on March 27, 2020. The US \$2.2 trillion economic stimulus package included US \$349 billion to establish the Paycheck Protection Program (PPP), a program administered by the Small Business Administration (SBA) to provide uncollateralized, low-interest loans to small businesses. The primary stated objective of this program was to provide small businesses with an incentive to retain employees on payroll. However, firms could also use the proceeds to pay: (i) worker benefits and protection costs, (ii) mortgage interest payments and rent, (iii) damages from looting or vandalism, and (iv) utilities (SBA, 2021a).

To qualify for a PPP loan, businesses had to meet predetermined criteria set forth by the SBA (e.g., having fewer than 500 employees on payroll in a single location; SBA, 2021a).<sup>2</sup> Additionally, borrowers could also qualify for loan forgiveness if, during the covered period of eight to 24 weeks, they (i) maintained employment and compensation levels, (ii) allocated loan proceeds to eligible costs and expenses, and (iii) spent 60% or more of the loan proceeds on payroll costs (SBA, 2021d). Table 1 summarizes PPP eligibility criteria, maximum loan amounts, and other program information, while Fig. 1 provides a timeline of the loan program.

<sup>2</sup> According to the SBA (2021a), the following businesses were eligible to apply for a first-round PPP loan: "(i) sole proprietors, independent contractors, and self-employed persons; (ii) Any small business concern that meets SBA's size standards (either the industry size standard or the alternative size standard); (iii) Any business, 501(c)(3) non-profit organization, 501(c)(19) veterans organization, or tribal business concern (sec. 31(b)(2)(C) of the Small Business Act) with the greater of: 500 employees, or that meets the SBA industry size standard if more than 500; (iv) Any business with a NAICS code that begins with 72 (Accommodations and Food Services) that has more than one physical location and employs less than 500 per location".

**Table 1** PPP eligibility criteria and key information, by tranche

PPP overview	1st round		2nd round
	1st tranche	2nd tranche	3rd tranche
<i>Loan distribution</i>			
Start date	April 3, 2020	April 24, 2020	January 17, 2021
End date	April 16, 2020	August 31, 2020	May 31, 2021
<i>Eligibility</i>			
Maximum number of employees per location	500	500	300
Must demonstrate a reduction in YoY gross receipts?	No	No	Yes (25%)
<i>Loan calculator</i>			
Loan amount = _____ the average monthly payroll costs	2.5×	2.5×	2.5–3.5×
Maximum loan amount	US \$10 million	US \$10 million	US \$2 million
<i>Loan forgiveness</i>			
	Yes	Yes	Yes

The maximum loan amount for the 2nd round of funding was 2.5× the average monthly payroll for most businesses, but accommodations and food service establishments were allowed to use 3.5× the average monthly payroll

The SBA began distributing the first tranche of funding on April 3, 2020. With the demand for PPP loans far exceeding the available supply, the initial US \$349 billion was exhausted by April 16, 2020—just 2 weeks after the first loans were approved. Given the rush of applications and the first-come, first-served nature of the program, concerns about equity and the role of banks in loan dispersal quickly emerged (Bartik et al., 2020b; Fairlie & Fossen, 2021a; Humphries et al., 2020).

Claims in the literature suggest that government-sponsored COVID-19 relief programs sacrificed targeting for timeliness (Autor et al., 2022b; Belghitar et al., 2022). Most PPP lending came from small- and medium-sized banks (less than US \$50 billion in assets), which allowed for rapid, decentralized loan dispersal (Li & Strahan, 2021). But the distribution mechanism gave firms with a pre-existing relationship with a bank easier access to first-tranche PPP funding (Granja et al., 2020), and this setup negatively impacted the smallest businesses (Humphries et al., 2020). Moreover, the use of banks to distribute funding may have created a wedge between the public interests of the government (i.e., maintaining lower unemployment levels and keeping small businesses in operation) and the private interests of the banks (i.e., the profitability and longevity of their consumers) (Bartik et al., 2020b).

As COVID-19 cases continued to surge, the Paycheck Protection Program and Health Care Enhancement Act (Public Law 116–139) was signed into law on April 24, 2020. The legislation provided the SBA with an additional US \$310 billion to support businesses that had

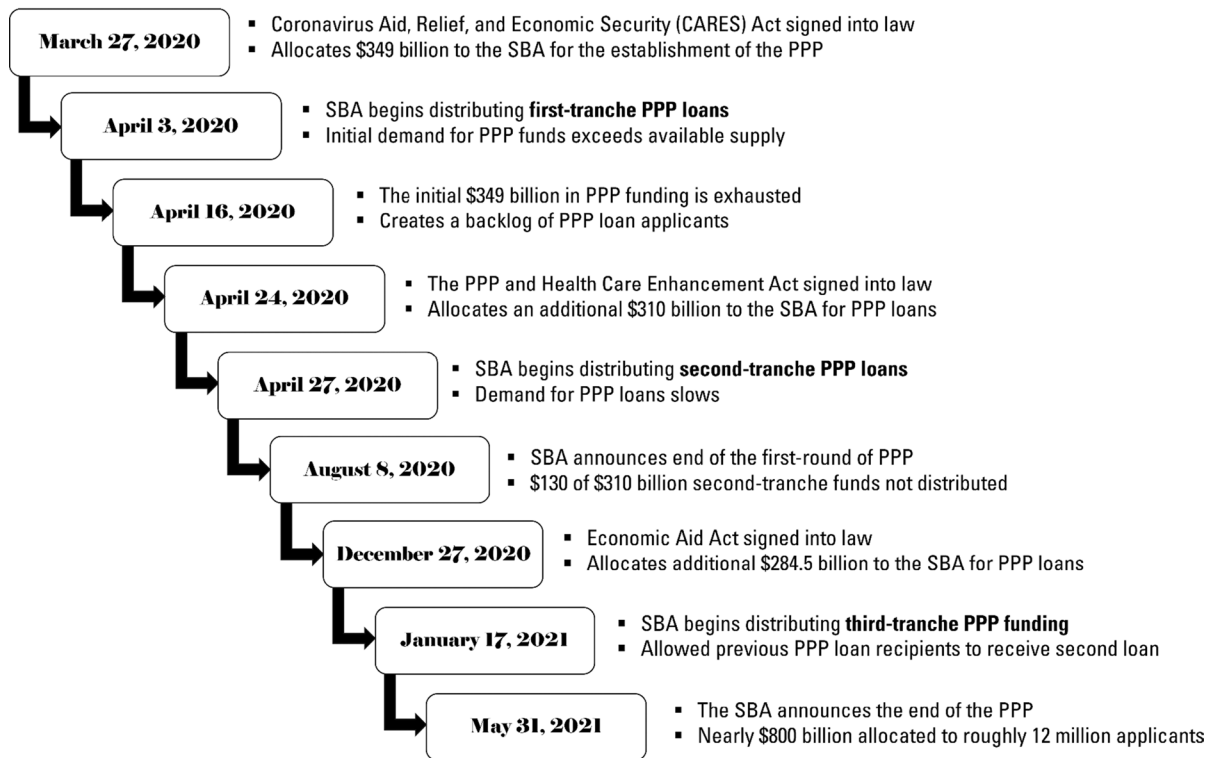
not yet received a PPP loan. Distribution of the second tranche of funding began on April 27, 2020, and ended on August 8, 2020. The first and second tranches of PPP funding spanning April 3–August 8, 2020, are referred to as the first round of PPP funding.

COVID-19 cases began to spike again in December 2020, leading lawmakers to pass the Economic Aid to Hard-Hit Businesses, Nonprofits, and Venues Act (Public Law 116–260) on December 27, 2020. In addition to allocating an additional US \$284.5 billion to the SBA to administer the third tranche of PPP loans, the law modified key provisions and authorized a second round of PPP funding to businesses that had previously received first-round funding. Table 1 highlights key differences across the first and second rounds of funding. Most notably, the third tranche targeted smaller businesses that could demonstrate a reduction in gross receipts from 2019 to 2020 of 25% or more (SBA, 2021i). The third tranche of PPP funding ran from January 11 to May 31, 2021, and is commonly referred to as the second round of PPP funding.

Over the program's lifetime, the SBA approved nearly 12 million loans totaling approximately US \$790 billion (Office of Capital Access, 2021). In April 2020, the Washington Post filed a Freedom of Information Act (FOIA) request for the list of PPP loan recipients. Later that year, a District Court granted the request, making the data publicly available (The Washington Post v. U.S. Small Business Administration, 2020).

With the PPP now closed and the data on loan recipients now available, researchers can descriptively monitor

# PPP Timeline: Key Dates



**Fig. 1** Timeline of key dates in the Paycheck Protection Program (PPP)

and evaluate the success of the program. For instance, several studies have analyzed the effect of first-round PPP funding on employment. Findings vary quite substantially, including small employment effects of 1–2% (Chetty et al., 2020; Hubbard & Strain, 2020), more modest estimates of 2–5% (Autor et al., 2022a), and larger effects of more than 10% (Bartik et al., 2020b; Faulkender et al., 2020). Yet, to our knowledge, no study has sought to link PPP funding to small business performance outcomes. This study fills this gap in the literature using the craft beer industry, given COVID-19’s disproportionate impact on the industry.<sup>3</sup>

<sup>3</sup> Fairlie and Fossen (2021b) demonstrate that sales in California plummeted 17% YoY during Q2 of 2020, but the analysis does not concern itself with PPP. Their analysis divides sales growth by different business types, and their results suggest that accommodation businesses and (alcoholic) drinking places were the two sectors that experienced the steepest decline in Q2 YoY sales.

## 2.2 COVID-19’s impact on the US craft beer industry

Over the past two decades, the number of US craft breweries—an industry comprised of small, independent businesses—has increased by 500% (Brewers Association, 2022d).<sup>4</sup> In 2005, there were 1394 craft breweries in the USA. By 2019, there were 8391, representing 99% of all US beer producers. Craft beer’s market share, measured in dollars, also increased from 5 to 25% over the same time frame (Brewers Association, 2021).

Despite this considerable growth in market share, craft beer only accounts for 12–13% of beer by volume,

<sup>4</sup> The Brewers Association (2022c) defines “small” as producing less than six million barrels of beer per year, and they define “independent” as having less than 25% ownership from a business that is not itself a craft brewer.



measured in barrels (bbls) of production. In other words, 99% of the breweries in the USA account for just 12% of domestic beer production (Brewers Association, 2022d). The critical distinction between market share by sales dollars and market share by volume stems from the difference in business models and marketing strategies employed by craft brewers compared to large, non-craft breweries. Whereas large brewers sell high quantities of standardized products at a low price point, craft breweries brew smaller quantities of high-quality, differentiated products at a price premium to a niche group of consumers. Furthermore, while revenue from beer sales is generated through various outlets (e.g., local liquor stores, grocery outlets, and restaurants), the average craft brewer relies predominantly on on-premise sales. Indeed, it is common for 80–100% of a craft brewery's revenue to come from sales at the brewery (Palardy et al., 2020; Staples et al., 2021). With the emphasis on on-premise sales in a local community—as opposed to a vast distribution network of retail outlets—craft brewers were more vulnerable to COVID-19 than large, non-craft producers.

In response to COVID-19, states and local municipalities throughout the USA implemented public health policies that directly affected the traditional craft brewer business model. For example, stay-at-home orders limited social mobility, and capacity restrictions often limited or shut down indoor dining (CDC Tracker, 2022). However, social institutions and consumer perceptions about the prevalence of COVID-19 in their community appear to have played a larger role in decreasing consumer foot traffic (Chetty et al., 2020; Fairlie & Fossen, 2021b; Goolsbee & Syverson, 2021). For example, Goolsbee and Syverson suggest that social institutions explain much more of the decline in consumer foot traffic from January to April 2020.<sup>5</sup> Their results also state that drinking places ranked

<sup>5</sup> Goolsbee and Syverson (2021) find that from March 1, 2020 to April 12, 2020, total foot traffic fell by 60 percentage points. Their methodology, which allows them to identify the causal effect of county-level governmental on foot traffic, suggests that shelter-in-place policies explained just 7 percentage points of the decline. Instead, much of the decline in consumer foot traffic was attributable to voluntary changes in behavior due to the perception about the risk of contracting COVID-19. In other words, businesses in counties with and without COVID-19 health policies both experienced, on average, substantial declines in consumer foot traffic during the early months of the pandemic. Those businesses operating in counties with shelter-in-place policies, on average, saw a decline in consumer foot traffic that was approximately only one-tenth larger than those in counties without the governmental mandates, holding all else constant.

as one of the most negatively impacted sectors during this time. Irrespective of the reason for the decreased visits, breweries that rely heavily on revenue from on-premise sales needed to reconsider their business model (Morris, 2020; Romano, 2021). This included adjusting production schedules, employment levels, and packaging methods to distribute through alternative channels.

In late March 2020, the Brewers Association, a 501(c)(6) not-for-profit organization aimed at promoting and protecting the interests of US craft brewers (Brewers Association, 2022e), surveyed approximately 900 craft breweries on their concerns and perceptions of COVID-19. Their results showed widespread distress: 90% of respondents had already altered beer production schedules and seen a decline in on-premise sales; 61% expected layoffs; and 60% believed their business would fail in 3 months or less if social distancing guidelines, state and federal assistance, and costs and revenue streams remained at their mid-March levels (Watson, 2020a, 2020b). While this sentiment is not unique to the craft brewing industry (Bartik et al., 2020a), the heavy dependence on on-premise alcohol sales made craft brewers particularly vulnerable. The Brewers Association estimates that aggregate craft beer production fell by 9%, sales decreased by 22%, and craft beer market share fell 1.7 percentage points in 2020 compared to 2019 (Brewers Association, 2022d; Watson, 2021).

To summarize the relevant literature, craft beer makes for an ideal industry to assess the relationship between PPP funding and small business performance due to (i) the growing presence of small producers over the past few decades, (ii) their vulnerability to the decline in consumer foot traffic throughout the pandemic, and (iii) the expectation of large-scale shifts in production, layoffs, and closures if economic conditions or state/federal support did not improve.<sup>6</sup>

<sup>6</sup> When asked what made the craft beer industry more vulnerable to COVID-19 health policies and changes in consumer behavior relative to other sectors, Chief Economist of the Brewers Association Bart Watson wrote:

“The craft beer industry provides an interesting lens through which to study the economic effect of the COVID-19 pandemic, particularly due to the geographic and business model variations that occurred in performance. Craft brewers had high exposure to onsite hospitality shutdowns and shifts in consumer mobility, both due to the primary onsite business model of taprooms and brewpubs, as well as the much higher proportion of draught beer sales for most craft brewers relative to the overall beer industry” (Watson, personal communication, May 26, 2022).

### 3 Data

Data from the Brewers Association and the Small Business Administration are used to (i) explore the relationship between PPP funding and business survival, (ii) examine how YoY production changed as a function of whether a brewery received PPP, and (iii) determine whether the timing of loan approval timing affected YoY performance. The structure of each data source is discussed in the following two sub-sections before describing the merging procedures and presenting summary statistics.

#### 3.1 Brewers Association

Limiting attention to the 50 states and the District of Columbia, the Brewers Association dataset consists of 8946 craft breweries in operation on April 3, 2020 (the start date of the PPP). Then, using Brewers Association records and internet searches, breweries were placed into one of three categories: (i) permanently closed since the start of the PPP; (ii) temporarily closed as of July 2021; and (iii) in operation as of July 2021.<sup>7</sup> July 2021 serves as an adequate date to examine operational status because it eclipses the end date of the PPP, coincides with most states lifting COVID-19 restrictions, and aligns with when nearly half of the US population was fully vaccinated against COVID-19 (CDC, 2021). As of July 2021, 8506 (95.1%)

firms were active, 141 (1.6%) were temporarily closed, and 299 (3.3%) were permanently closed.<sup>8</sup>

The Brewers Association divides the craft beer industry into four market segments based on annual production, revenue streams, and reliance on food sales (Brewers Association, 2022b). Brewpubs are breweries that engage in significant food services, with at least 25% of annual beer production sold on-site. With their reliance on food sales, brewpubs operate much like traditional full-service restaurants, except that brewpubs brew their own beer. Microbreweries produce less than 15,000 barrels (bbls) of beer annually and have at least 75% of their production sold off-site. Regional breweries brew between 15,000 and 6,000,000 bbls of beer per year, and there is no restriction on their revenue streams or food services. However, regional breweries typically have access to a broad range of distribution networks and sell less than 5% of their beer on-site (Palardy et al., 2020). Taprooms are breweries selling 25% or more of beer on-site, with limited or no food services. Using this segmentation, the study considers whether the pandemic disproportionately impacts specific industry segments. Table 2 presents active and closed breweries by segment.

Approximately 36% of the sample are brewpubs, 21% microbreweries, 3% regional breweries, and 40% taprooms. The final column of Table 2 presents suggestive evidence that brewpubs were disproportionately harmed by the pandemic relative to other brewing categories. Early-pandemic public health policies restricted indoor bar and restaurant capacity (or shut them down entirely), and consumers scaled back food-away-from-home purchases during the pandemic (Ellison et al., 2021). As such, breweries that rely heavily on food sales may have experienced a steeper decline in consumer foot traffic. Relative to the other craft beer market segments, brewpubs appear to have less capability to pivot production away from on-site consumption and towards off-premise channels.

<sup>7</sup> Breweries were identified as permanently or temporarily closed in one of two ways. First, breweries could be identified as permanently closed by the Brewers Association, which was captured in the initial dataset the association provided. Then, Google searches were used to identify permanently closed breweries that did not report their operational status to the Brewers Association as well as temporarily closed breweries that were not identified in the initial dataset. Specifically, for each observation included in the dataset, we searched the brewery name and identified businesses that Google listed as temporarily or permanently closed. The internet searches and data collection were conducted in July 2021. Breweries that were identified as temporarily or permanently closed based on Google searches were then sent back to the Brewers Association for confirmation. The Brewers Association then analyzed the list and sent us an updated copy of the closures. Their revised set of closures was used in the analysis.

<sup>8</sup> Note, any brewery that closed before April 3, 2020 was excluded from the analysis. Therefore, in removing the first 3 months of closures in 2020, this study underreports the closure rate. As many closures occurred after COVID-19 was declared a national emergency but before the SBA began distributing PPP loans on April 3, 2020. Using historical closure data from Brewers Association (2022d), the brewery closure rate in 2020 was approximately 4.8%, up from 4.2% in 2019 and higher than the long-run average of 2.7% over the past decade. The reader is directed to the Appendix accompanying this manuscript for further information on the differences between the closure rates reported in this manuscript and the ones reported on the Brewers Association website.

**Table 2** Active brewery locations and temporary and permanent closures as of July 2021 by market segment ( $n = 8946$ )

Brewery segment	# of breweries	Active	Closures after April 3, 2020 (% closed)		
			Temporary	Permanent	Total
Brewpub	3,238	3,046	70 (2.2%)	122 (3.8%)	192 (5.9%)
Microbrewery	1,889	1,791	32 (1.7%)	66 (3.5%)	98 (5.2%)
Regional	228	221	3 (1.3%)	4 (1.8%)	7 (3.1%)
Taproom	3,591	3,448	36 (1.0%)	107 (2.98%)	143 (4.0%)
Total	8,946	8,506	141 (1.6%)	299 (3.3%)	440 (4.9%)

The Small Business Administration began dispersing PPP loans on April 3, 2020. All closures up to April 3, 2020, are excluded from analysis, so these values represent a lower bound estimate of closures following the pandemic. COVID-19 was declared a national emergency on March 13, and many breweries closed during the weeks leading up to the dispersal of PPP funds. According to Brewers Association (2022d) data on brewpubs, microbreweries, and taprooms, approximately 4.8% of breweries closed in 2020

The study also links brewery-specific production volume data over time to serve as a proxy for annual revenue. After removing data outliers and observations with missing data, the analysis is confined to 5877 observations with reliable production data.<sup>910</sup>

<sup>9</sup> Data are available for 6304 (70%) of 8946 breweries for 2019, and 6892 (77%) for 2020. For observations without production volume, yearly production is treated as missing data. Year-over-year (YoY) changes in production volume from 2019 to 2020 are then calculated, allowing for an assessment of how production changed throughout the pandemic. In examining the change in YoY production, there are several outliers, mainly driven by breweries that were in the process of expanding production in the time of interest or opened later in 2019 (and their estimate does not reflect a full year of production). Therefore, in the following analysis, attention is limited to breweries that experienced a negative 100% to positive 100% change in YoY production from 2019 to 2020. For example, the median YoY change in production from 2019 to 2020 is a 12.5% decline, while the mean YoY change is a positive 26.3% change in production. A 0% change in production from 2019 to 2020 is at the 75th percentile, suggesting the distribution is skewed to the left with a long tail to the right. By construction, there is a necessary lower bound of  $-100\%$  change in YoY production (i.e., shutdown with zero production in 2020). An upper bound of  $+100\%$  change in YoY production is imposed to remove significant outliers. For example, a brewery could have opened in November of 2019, had 2 months of production, and this figure reflects their 2019 annual production. Suppose that the brewery remains open for all 12 months of 2020 and reports their 2020 annual production. Then it is reasonable to expect a 500% increase in YoY production from 2019 to 2020. For this reason, the upper bound limit of  $+100\%$  is placed on YoY production volume changes. After removing breweries that fail to meet the specified criteria, the sample contains 5877 breweries with production data, or 93% of the original 6304 observations with production data.

<sup>10</sup> The Brewers Association provided data on the breweries that received funding from the Restaurant Revitalization Fund (RRF). Part of the American Rescue Plan Act of 2021 (Public Law 117-2), passed into law on March 11, 2021, the RRF

### 3.2 Paycheck Protection Program

Data used in the analysis were pulled from the SBA website and contained nearly 12 million PPP loan recipients through the end of the PPP (SBA, 2021b).<sup>11</sup> The study relies on the six-digit NAICS coding system to identify the observations of interest.

First, a dataset of all observations coded in the six-digit NAICS code for breweries (312120) is constructed, yielding 5405 observations. However, many breweries also operate in food service (i.e., brewpubs) and may be coded with full-service restaurants (722511). Observations coded as full-service restaurants are identified within the SBA dataset, and fuzzy matching procedures align addresses listed on the loan application with brewpub addresses.<sup>12</sup> These procedures result in

Footnote 10 (continued)

was an additional government aid program run through the US SBA to support restaurants, bars, and other businesses that provide food or drink services (SBA, 2021e). The program, which ran from May 3, 2021 to July 2, 2021, supported more than 100,000 approved applicants and totaled US \$28.6 billion (SBA, 2021f). The Brewers Association identified 1539 breweries that received RRF funds. By segment, the data suggests that 633 brewpubs, 257 microbreweries, 15 regional breweries, and 634 taprooms received RRFs from the SBA.

<sup>11</sup> Data on PPP loan recipients can be accessed, here: <https://data.sba.gov/dataset/ppp-foia>

<sup>12</sup> One shortcoming with fuzzy matching is that breweries located in large plazas, malls, etc. may share a street address with another full-service restaurant but have different suite numbers. Loan recipients oftentimes failed to list their suite number on their application. Google Maps was used to make manual corrections to improperly matched locations.



an additional 1481 brewpub observations coded as full-service restaurants. Lastly, breweries could be miscoded in the NAICS code for drinking places (722410). Similar fuzzy matching procedures are used to identify an additional 1466 observations. Observations across the three NAICS industries are then combined to create a dataset of 8352 loan observations.

As firms could receive two rounds of PPP funding, a single brewery could have two observations in the dataset. The PPP data are then reshaped to create a one-to-one mapping, yielding 5809 unique observations.<sup>13</sup>

### 3.3 Merging

To merge the brewery data points with PPP observations, datasets are first separated by jurisdiction (50 states and the District of Columbia). The brewery and PPP datasets for each jurisdiction are then paired together to initiate matching. Under the assumption that the Brewers Association dataset is the entire universe of breweries, PPP borrowers either sufficiently map to one of the breweries or are excluded from the analysis. Due to limitations in the PPP data, a three-step manual matching procedure is employed.

The first step attempts to match the PPP borrower name to a brewery name. While a significant proportion of the observations match on name, shortcomings in the PPP data prevent others. For example, loan recipients would often list their official company name rather than their company's trading name (i.e., their *doing business as* name). Other applicants listed their government name as opposed to the brewery name. To overcome this hurdle, the second step matches the address listed on the PPP loan application to the brewery address. Again, borrowers sometimes list a

residential address rather than a business address. For the remaining unmatched observations, step three involves using the borrower's name listed on the PPP application to identify trademarks, alternative trading names, etc., using online resources such as OpenCorporates (OpenCorporates, 2021). Observations were matched if the PPP borrower had a trademark that could be traced to a brewery.

On aggregate, 89% of the PPP loans are matched across 5002 unique breweries in 1210 different counties. The unmatched observations are excluded from the analysis.<sup>14</sup>

### 3.4 Summary statistics

Approximately US \$1.06 billion in PPP funding has been allocated to the craft brewing industry, including US \$576 million in the first round and US \$482 million in the second round. These dollars have supported nearly 98,000 jobs in the first round and over 64,000 in the second round.<sup>15</sup>

Figure 2 provides a timeline of PPP loan funding to craft breweries. Approximately 63% of first-round loans are distributed between April 3 and April 16, 2020, 94% by May 3, 2020, and the remaining 6% through August 8, 2020. The second round of loan

<sup>13</sup> Stata's *reshape wide* command is used complete these procedures. However, the reshape command only works if the borrower's name is identical for both listings (including punctuation and case sensitivity). Oftentimes, small discrepancies existed between two observations for the same brewery. For instance, a brewery may list "Company Name, LLC" in round one but "Company Name LLC" in round two. With the missing comma, Stata cannot match across these two observations. Thus, manual corrections were necessary to complete the reshape procedures.

<sup>14</sup> Most unmatched observations included cideries, wineries, distilleries, pubs, and restaurants that were incorrectly coded into NAICS 312,120. Other businesses coded in NAICS 312,120 did not engage in alcohol production or distribution. Additionally, several observations that were coded into NAICS code 312,120 do not fit the Brewers Association's definition of a brewery (e.g., kombucha brewers not registered with the Brewers Association). The most notable groups excluded from the analysis are breweries in planning or proprietor brewers. These groups were not included in the universe of breweries provided by the Brewers Association, so they are excluded from the analysis. While this may be seen as a limitation, these observations accounted for less than 20% of the unmatched observations, i.e., less than 3% of total PPP observations.

<sup>15</sup> The statistics on the number of jobs supported by the PPP come directly from the PPP application, where applicants had to list the number of workers employed at the business. Unfortunately, the Brewers Association data did not contain statistics on brewery employment over time, meaning the study cannot observe changes in employment as an outcome variable. It is also worth noting that some PPP loan recipients may have more than one business specified under a parent company (e.g., a brewery is one of the trademarks of a larger company), overstating the number of jobs reported.

funding saw an initial spike in demand, with roughly 45% of the loans dispersed by the third full week of the loan program. Then, demand tapered off, where the last 5% of second-round loans were distributed over the last 9 weeks of the loan program.

Table 3 provides a breakdown of summary statistics based on whether a brewery receives (i) first-round funding only, (ii) second-round funding only, (iii) both rounds of funding, or (iv) no funding. Of the 8946 breweries in the dataset, over half receive some form of PPP funding: 23% receive first-round funding only, 6% receive second-round funding only, and 27% receive both rounds of funding; the remaining 44% receive no PPP funding.

There are differences in key outcome variables, including operational status and changes in YoY production volume, across groups. Businesses that receive both rounds of funding are most likely to be open as of July 2021 (98%), while breweries that receive no PPP funding have the lowest probability of remaining in business (92%). For changes in YoY production volume, the average brewery sees a 12.5% decline in production from 2019 to 2020. However, on average, the decline is smaller for breweries that received first-round PPP funding (−10% YoY) than those that did not (−15% YoY).

There is also variation in county-level variables, such as the total number of COVID-19 cases as of April 3, 2020 (the first day of PPP funding), indicating a need to account for observed and unobserved county-level heterogeneity in the subsequent analysis. Interestingly, breweries that received first-round PPP funding have a below-average number of confirmed COVID-19 cases as of April 3, 2020 (the first day of the PPP funding), and December 31, 2020. This finding is in line with Granja et al. (2020), suggesting that the banks involved in distributing PPP loans were more likely to do so in areas that were not as adversely impacted by COVID-19.

Further demonstrating differences across comparison groups, Fig. 3 plots each group's average annual production levels from 2018 to 2020. The sample is limited to breweries open in July 2021, implying that the remainder of this section should be interpreted as YoY production volume changes conditional upon remaining in operation. With this condition, missing

data, and the removal of statistical outliers, data are available for 4257 breweries.<sup>16</sup>

Breweries across each group demonstrate, on average, increasing production from 2018 to 2019, ranging from a YoY increase of 1–8%. Figure 3 suggests that larger (eligible) operations were more likely to receive first-round funds. On average, breweries that received first-round funding produced higher quantities of beer from 2018 to 2020 than those that did not. The graph also reflects the change in loan eligibility for second-round funding, which targeted smaller firms that experienced substantial revenue decreases in 2020. Lastly, the group with the smallest average production did not receive any PPP funding.

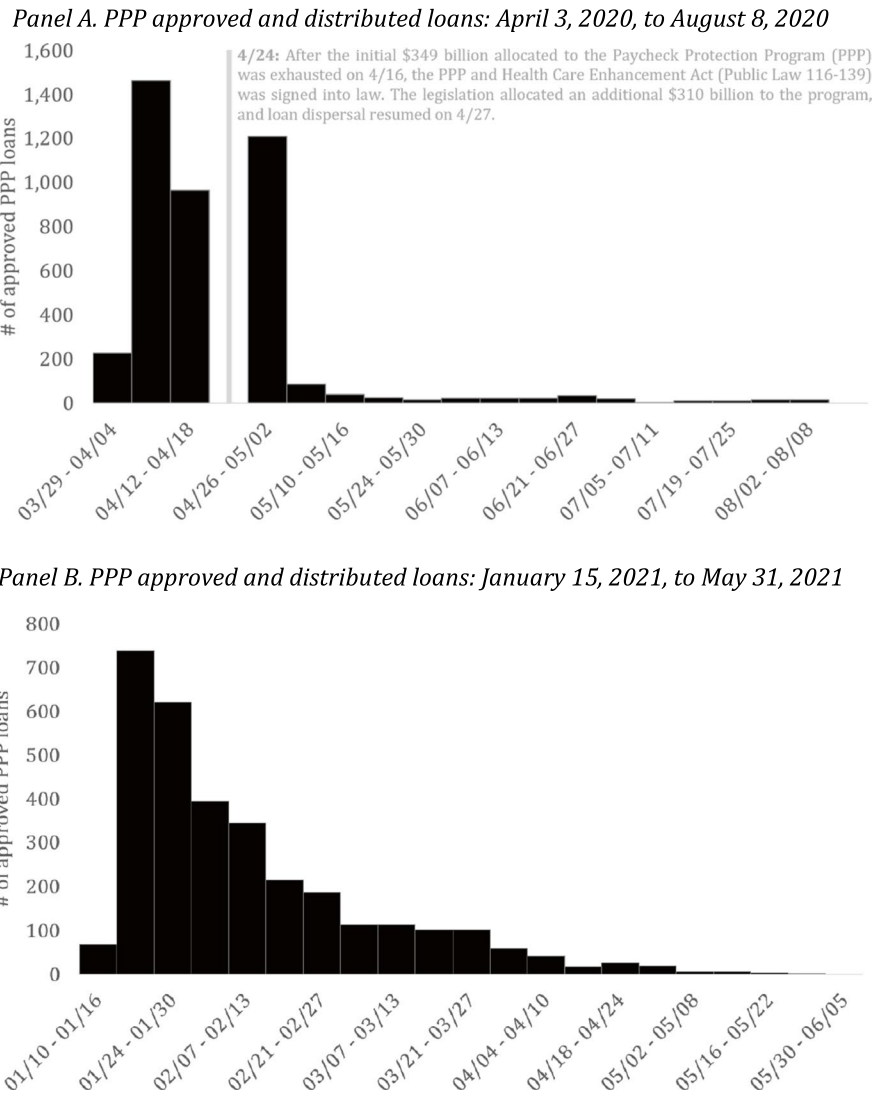
#### 4 Probability of business survival

To understand the relationship between receiving a PPP loan and business survival, a linear probability model (LPM) estimates the likelihood of a firm being open in July 2021 as a function of whether it received PPP funding. While the LPM can produce estimates that fall outside the necessary zero–one range implied by the binary response and may be inappropriate when evaluating marginal effects on the tails of the distribution, it provides computationally convenient, consistent estimates that are a useful approximation of the marginal effect for the average observation (Wooldridge, 2010).

The left-hand side variable is a binary variable equal to one if the brewery was in operation in July 2021; zero otherwise. The primary explanatory variables of interest are indicator variables specifying whether a

<sup>16</sup> Specifically, observations are removed if (i) they are missing data in 2018, 2019, and/or 2020; (ii) the brewery experienced greater than a 100% increase in YoY production from 2018 to 2019 and/or 2019–2020; and (iii) they are statistical outliers that significantly skew the average. Breweries listed as producing 1 bbl of beer per year are also removed, as this may be evidence of an error in the industry production dataset where “1” signals an indicator of having produced in the corresponding year. Additionally, breweries producing above the 99th percentile of annual production in 2018 are excluded from the analysis. Specifically, 99% of the sample produces at or below 66,669 barrels of beer per year, while the remaining 1% of observations range from 66,784 to 2,175,784 barrels per year. Similar statistics hold for the 2019 and 2020 data, with 99th percentiles of 55,660 and 50,084 bbls per year, respectively. As such, the 2018 data is used as the production cutoff point.

**Fig. 2** Timing and frequency of PPP loans to breweries, by week



given brewery received a first-round loan, a second-round loan, or both a first- and a second-round loan. We hypothesize that receiving a single PPP loan will lead to a higher probability of survival (Hubbard & Strain, 2020), while receiving both rounds of PPP funding will further increase the likelihood of survival.

The study also analyzes the relationship between business survival and the brewery segment, controls for important brewery-specific variables, and includes county-level fixed effects to capture unobserved heterogeneity.<sup>17</sup> We hypothesize that COVID-19 will

disproportionately impact brewpubs as their reliance on food and draught beer sales may have made them more vulnerable to declines in consumer foot traffic. Other segments, particularly regional breweries, could more

Footnote 17 (continued)

may be inappropriate given the inclusion of county-level fixed effects. We also consider the inclusion of local bar and restaurant policy over time instead of traditional FIPS codes. However, their inclusion is insignificant and reduces the degrees of freedom. As such, we elect to use the FIPS codes to control for unobserved, county-level heterogeneity. The relationship between local bar and restaurant policy and performance is discussed further in Sect. 5 and in the Appendix accompanying this manuscript.

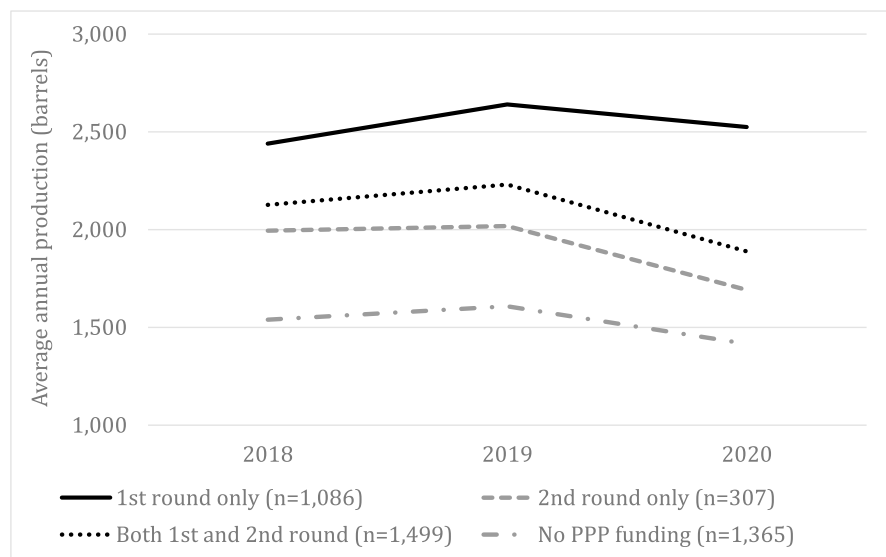
<sup>17</sup> Including state-level control variables in the analysis did not improve explanatory power, produced point estimates that were identical in magnitude to the preferred specification, and

**Table 3** Summary statistics disaggregated by PPP funding

Variable	Population	PPP funding				p-value <sup>a</sup>
		1st round only	2nd round only	Both rounds	None	
Number of breweries	8,946	2,086	513	2,403	3,944	—
<i>Panel A. Outcome variables</i>						
Open, July 2021	0.951	0.959	0.975	0.983	0.924	0.000
Prop. production change, 2019–2020 <sup>b</sup>	−0.124	−0.056	−0.170	−0.139	−0.151	0.000
Avg. production (bbls/year), 2019	3,842.9	3,457.2	2,227.6	2,388.5	5,747.0	0.103
Avg. production (bbls/year), 2020	3,463.6	3,269.2	1,911.3	2,028.9	5,197.6	0.081
<i>Panel B. Firm characteristics</i>						
Proportion of obs. for each segment						
Brewpub	0.362	0.300	0.517	0.409	0.346	0.000
Microbrewery	0.211	0.215	0.189	0.206	0.215	0.505
Regional	0.025	0.033	0.014	0.021	0.026	0.030
Taproom	0.401	0.453	0.281	0.364	0.413	0.000
Prop. of primary locations	0.882	0.954	0.929	0.958	0.791	0.000
Prop. received RRF loan	0.172	0.160	0.236	0.294	0.096	0.000
<i>Panel C. County variables</i>						
Number of counties represented	1,547	834	316	838	1,139	—
Avg. number of COVID-19 cases						
April 3, 2020	590.2	553.3	793.0	610.6	570.9	0.048
December 31, 2020	49,420.5	42,848.9	63,926	55,614	47,376.5	0.000
Avg. ERS amenities score <sup>c</sup>	1.6	1.3	2.1	1.6	1.6	0.000

<sup>a</sup>The *p*-value denotes the results of the ANOVA procedures F-test to detect differences across the four groups. <sup>b</sup>The number of observations for year-over-year (YoY) change in production varies due to limitations in data availability. Additionally, attention is restricted to observations with a −100% and +100% change in YoY production from 2019 to 2020 to exclude outliers. In total, data from 5877 observations are analyzed, and the number of observations by group is as follows: 1st round only (1526), 2nd round only (387), both rounds (1886), and none (2078). <sup>c</sup>The number of observations for the ERS Amenities Score varies due to limitations in data availability (ERS, 2019). For example, data were not available for Alaska and Hawaii. Data were available for 8842 observations, and the number of observations by group is as follows: 1st round only (2059), 2nd round only (507), both rounds (2369), and none (3907)

**Fig. 3** Average annual production (barrels/year) by PPP funding, 2018–2020 (*n* = 4257)



easily pivot to alternative packaging and distribution channels. Brewery-specific variables include 2019 brewery production, whether the brewery is a primary or secondary location, and whether the brewery received a loan from the 2021 Restaurant Revitalization Fund (RRF) program.<sup>18</sup>

Table 4 presents the results from the LPM. Across specifications that control for firm- and county-level fixed effects, receiving PPP funding has a positive and statistically significant relationship with the probability of remaining in operation as of July 2021.

Interpreting the output from the naïve regression, firms that did not receive any PPP funding have a 92.4% chance of survival. Breweries that only received a first-round PPP loan are predicted to have a 95.9% chance of survival, and those that only received a second-round loan have a 97.5% probability of remaining in operation as of July 2021. Breweries that received both rounds of funding are predicted to have a 98.3% probability of survival, where the negative sign attached to the interaction term suggests diminishing marginal returns to PPP funding. There is also suggestive evidence that brewpubs and microbreweries are affected by the pandemic more than taprooms, with brewpubs appearing to be hit the hardest. This reinforces industry expectations that brewpubs were less capable of pivoting away from their pre-pandemic business model.

As a robustness check, a penalized logistic regression is estimated, accounting for rare events and forcing predictions into the zero–one binary response range (Firth, 1993). The results are fairly consistent with the LPM, where the main effects of PPP retain

their sign and statistical significance. The coefficient for receiving both rounds of funding, however, loses its statistical significance, but it retains its negative sign. Concerning the industry segmentation, the results suggest that brewpubs are more likely to close, while the coefficient for microbreweries is not statistically different from zero. The results of the penalized logistic regression are available in the Appendix accompanying this manuscript.

There are two primary limitations to the empirical estimation. First, there is likely an issue of self-selection into the treatment, where breweries that applied for and received PPP could have different characteristics than those that did not. For example, the literature suggests selection issues related to firm size and firms with pre-existing relationships with a bank (Granja et al., 2020). Secondly, the reliance on a cross-sectional analysis fails to capture the temporal dimension of loan dispersion and brewery closures. These limitations are discussed in greater detail in Section 7 of the manuscript.

## 5 Changes in annual production

Breweries were expected to experience a decrease in annual production from 2019 to 2020 due to the shift in alcohol purchasing patterns (Scott, 2021; Watson, 2020a). According to Watson (2020a), most breweries halted or slowed production by late March 2020 and anticipated layoffs. However, once a brewery receives a PPP loan, there is an immediate incentive to retain pre-pandemic employment and compensation levels to qualify for loan forgiveness. There are a finite number of jobs in a brewery, most of which are directly involved in beer production and packaging. Thus, breweries would struggle to reallocate labor if production stagnated.

With uncertainty surrounding how long COVID-19 would affect their business and contribute to the decline in on-premise sales, brewers understood that beer could maintain quality in cold storage for up to five months (Sierra Nevada Brewing Company, 2022). Thus, after receiving a PPP loan, a brewery can retain staff and adjust production based on future expectations despite short-term revenue decreases. However, there is no such incentive for breweries without PPP funding. Breweries without PPP funding may have been more likely to downsize given tighter financial constraints (Lastauskas,

<sup>18</sup> It is reasonable to expect breweries that produce a higher volume of beer per year to benefit from economies of scale and have access to more technologically advanced equipment requiring less labor. Additionally, companies may have multiple locations, with one serving as their headquarters (i.e., primary location) and the other(s) as (a) secondary location(s). Finally, a control variable is included for whether a brewery received an RRF loan. Note that the distribution of RRF loans comes immediately before the data collection on open/closed status. This is important because it is possible that some breweries were temporarily closed in, for example, early-May 2021, and then opened when they received RRF funding in late-May 2021. With the data collection in July 2021, brewery operational status only observes whether a business was open in July 2021, not seeing that they were temporarily closed weeks before. The indicator variable controlling for RRF loan funding is included in the regression analysis to overcome this shortcoming.



**Table 4** Linear probability model predicting brewery operational status (open or closed) as a function of PPP funding

Variable	(1)	(2)	(3)
<i>PPP funding</i>			
<i>First round</i>	0.035*** (0.006)	0.035*** (0.007)	0.050*** (0.011)
<i>Second round</i>	0.051*** (0.008)	0.053*** (0.010)	0.074*** (0.014)
<i>Both rounds</i>	-0.027*** (0.010)	-0.030** (0.012)	-0.052*** (0.016)
<i>Segment</i>			
<i>Brewpub</i>	--	--	-0.025*** (0.009)
<i>Microbrewery</i>	--	--	-0.021** (0.010)
<i>Regional</i>	--	--	-0.024 (0.020)
<i>Constant</i>	0.924*** (0.004)	0.957*** (0.009)	0.870*** (0.037)
<i>N</i>	8,946	8,946	5,877
County-level fixed effects	No	Yes	Yes
Firm-level controls	No	No	Yes
<i>R</i> <sup>2</sup>	0.01	0.17	0.23

<sup>a</sup>Superscript \*\*\*, \*\*, and \* denote statistical significance at the 1, 5, and 10% level, respectively. Observations in specification (3) decrease from 8946 to 5877 due to data limitations and outliers in the brewery production data

2022), contributing to further production delays and more substantial declines in YoY production. As such, we hypothesize that a brewery that receives a first-round PPP loan will, on average, experience a smaller reduction in production in 2020 compared to those that do not receive first-round funds.

To test this hypothesis, the change in YoY production from 2019 to 2020 is regressed on a vector of explanatory variables using ordinary least squares. The key explanatory variable is an indicator variable specifying whether a brewery received first-round PPP funding (first or second tranche). Attention is only given to the first-round loan because these funds were available from April 3 to August 8, 2020, while second-round funds (third tranche) began in January 2021. Thus, second-round funds have no bearing on 2020 production levels. As was done when predicting a firm's operational status, brewery segment and firm- and county-specific controls are included in the regression analysis.

Using production data for 5555 active craft breweries, the results demonstrate how YoY performance varies as a function of PPP funding conditional upon remaining in operation through 2020.<sup>19</sup> Table 5 presents these results.

<sup>19</sup> The described specification was also run with the breweries that were closed as of July 2021. Unsurprisingly, results were more pronounced when these breweries were included as they saw the most substantial declines in YoY production. As a result, the approach described in the article is believed to be the conservative empirical decision that dampens estimated results.

The positive point estimate on the treatment indicator suggests that, on average, breweries that receive a first-round PPP loan see a smaller decrease in YoY production than breweries that do not. Naïve regression analysis indicates a decline that is 3.5 percentage points smaller for first-round loan recipients, translating to an average reduction in production of 9.4% YoY (compared to 12.9% for those without first-round funding). With fixed effects, the magnitude of the point estimate increases from 3.5 to 4.3 percentage points, meaning the relationship becomes more pronounced after including important control variables. These results may suffer from self-selection into the treatment group and other potential confounding effects, but they suggest a positive correlation between PPP funding and relative performance.

The results also demonstrate that COVID-19 had disproportionate impacts across industry market segments. Specifically, brewpubs experienced the most substantial decline in YoY production from 2019 to 2020, while regional breweries performed relatively better than the other industry segments. According to Brewers Association benchmarking reports, the average brewery producing less than 1000 bbls of beer per year (74% of our sample) sells 89–95% of its beer through on-site sales (Watson, 2016). Regional breweries, however, have a diverse distribution network that draws similarities to large non-craft brewers like Anheuser Busch InBev and MolsonCoors. As such, regional breweries may sell just 5% of their beer on-site (Palardy et al., 2020). It is well-established that a firm's business model affects its behavior, flexibility, and

**Table 5** Change in annual brewery production from 2019 to 2020 as a function of whether the brewery received PPP funding

Variable	(1)	(2)	(3)
<i>First round PPP</i>	0.035*** (0.008)	0.037*** (0.009)	0.043*** (0.009)
<i>Segment</i>			
<i>Brewpub</i>	--	--	-0.102*** (0.011)
<i>Microbrewery</i>	--	--	-0.020 (0.013)
<i>Regional</i>	--	--	0.077*** (0.029)
<i>Constant</i>	-0.129*** (0.006)	-0.157*** (0.019)	-0.072** (0.036)
<i>N</i>	5,555		
County-level fixed effects	No	Yes	Yes
Firm-level controls	No	No	Yes
<i>R</i> <sup>2</sup>	0.00	0.29	0.33

<sup>a</sup>Superscript \*\*\*, \*\*, and \* denote statistical significance at the 1, 5, and 10% level, respectively

resiliency (Arend, 2013; Hennart, 2014; Kuratko et al., 2020), and thus these differences in pre-pandemic business models by segment became pertinent following the COVID-19 outbreak. For example, Fig. 4 shows how beer consumption patterns have shifted since the spread of COVID-19 (TTB, 2022).<sup>20</sup>

Specifically, the figure shows the percentage of all taxable US domestic beer (craft and non-craft beer) sold in cans and bottles from 2018 to 2022 by quarter. Results show that, leading up to the pandemic, cans and bottle packaging made up approximately 88–89% of all beer removals. At the end of Q1 2020, the USA saw a substantial increase in the proportion of beer sold in cans and bottles, which then spiked to 96% by the end of Q2 2020. This shift to can and bottle production implies a considerable decline in on-premise sales, the primary revenue stream for the average craft brewer. Packaging rates have approached pre-pandemic levels, but beer removals in cans and bottles are still 1–2 percentage points higher than in 2019, suggesting lingering long-term effects of the pandemic on drinking behavior.

These statistics demonstrate the importance of a firm's pre-pandemic business model on its ability to react to the pandemic by shifting packaging, marketing, and distribution strategies. The smallest firms appear to have been most affected, and while there were areas for entrepreneurship during COVID-19, most initiatives were temporary and could not compensate for the decline in on-site sales. Larger businesses,

on the other hand, could utilize their pre-existing distribution networks, enabling an easier adjustment. The insights presented in Table 5 and Fig. 4 support these claims, and future research could further illustrate how business scale and scope contributed to resiliency and profitability during COVID-19 across other industries.

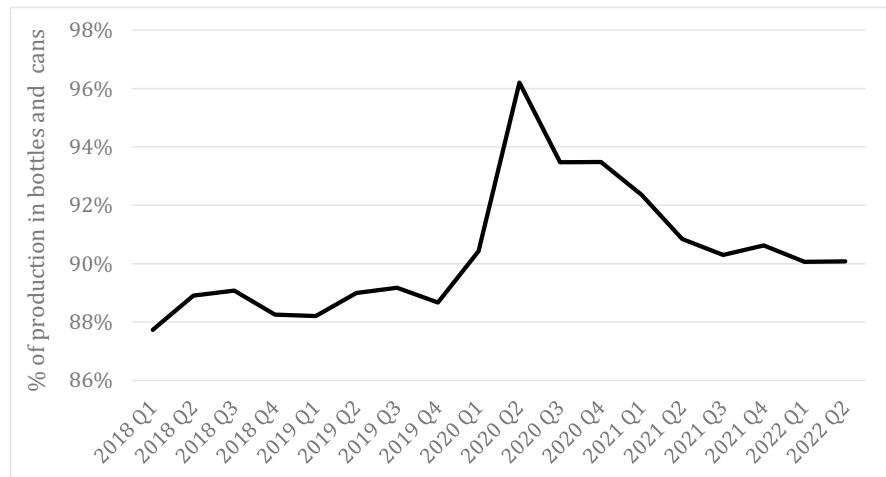
One alternative hypothesis is that local COVID-19 policies drove the decline in YoY production. To test this hypothesis, we conduct a subsample analysis across brewpubs, as they are the segment most affected by the pandemic (Tables 2, 4, and 5). County-level data on restaurant policy restrictiveness through the pandemic is first collected from the CDC Tracker (2022).<sup>21</sup> Then, the analysis presented in Table 5 is replicated with the inclusion of an indicator variable measuring policy restrictiveness: (i) curbside/delivery only or (ii) open. These exploratory results provide little evidence of a statistically significant relationship between policy and the decline in YoY production.<sup>22</sup> Instead, changes in consumption habits and pre-pandemic business models appear as the leading indicators of YoY outcomes.

<sup>21</sup> Brewpubs operate much like full-service restaurants, making local restaurant policy restrictiveness the ideal policy variable to analyze.

<sup>22</sup> These results are exploratory, as Hale et al. (2021) note the difficulty of teasing out the causal effect of COVID-19 policies due to potential confounders and endogeneity concerns. Identifying the causal effect of local restaurant policies on performance lies outside the scope of this manuscript and is left to future research. However, we can offer initial insights suggesting that policies do not appear to be the leading driver behind declines in production. For a more detailed overview of the data analysis and procedures, please see the Appendix accompanying this manuscript.

<sup>20</sup> The data used in the analysis is available at the Alcohol and Tobacco Tax and Trade Bureau (TTB) website: <https://www.ttb.gov/beer/statistics> [last accessed October 25, 2022].

**Fig. 4** The percentage of taxable removal beer packaged for bottles and cans, 2018–2022 by quarter



## 6 Quasi-experiment

### 6.1 Loan timing and YoY performance

It is essential to consider how the timing of loan approval could impact changes in YoY production. In this section, the study assesses whether the timing of the loan approval affects 2020 performance by exploiting the natural break between the first and second tranche of PPP funding (Doniger & Kay, 2022). Specifically, the quasi-experiment compares the YoY performance of breweries that received first-round funding in the last 7 days of the first tranche (April 10–16, 2020) to breweries that received funding in the first 7 days of the second tranche (April 27–May 3, 2020).<sup>23</sup>

<sup>23</sup> Evaluating the causal effect of loan timing on performance in the quasi-experimental setting rest on two identifying assumptions: (i) loan timing did not affect loan demand and (ii) the firms before and after the gap in tranches are similar to one another (Doniger & Kay, 2022). To further assert the validity of the second assumption, we also run the analysis with a constrained framework that analyzes breweries that receive funding within 3 days of the gap between the first and second tranche. That is, the restricted framework explores the YoY production of breweries that receive funding in the last 3 days of first-tranche funding (April 14–16, 2020) and the first 3 days of second-tranche funding (April 27–29, 2020). The results are largely consistent with the findings reported in the main text (Tables 6 and 7). Specifically, tightening the window of analysis leads to (i) similar growth rates from 2018 to 2019 for both the treatment (8.0%) and control (6.7%); (ii) positive and statistically significant point estimates that are of similar magnitude; and (iii) a similar average treatment effect on the treated (ATT) when using propensity score matching. The 7-day window is our preferred specification, as the 3-day window cuts the

Based on the rationale that a brewery has an incentive to retain employees once they receive a PPP loan—which could shift production decisions—we anticipate that the period between the first and second tranche of funding is the critical window in determining YoY performance. If the firms that receive first-tranche funding experienced smaller declines in YoY production than firms that had to wait for second-tranche funding, this would suggest that the timing of loan approval impacts small business performance.

To motivate the framework, first recall that the first round of PPP funding consisted of two tranches: the first tranche from April 3 to 16, 2020, and the second tranche from April 27 to August 8, 2020. Bartik et al. (2020b) surveyed small businesses between tranches (April 25–27, 2020) regarding their decision to apply for PPP funding. Of the nearly 4000 small businesses in their sample that applied for first-tranche funding, 25% of applications were approved, 24% were denied, and the remaining 51% were still pending. In other words, businesses with pending applications submitted their loan application before first-tranche funding expired, yet their application was not approved (nor denied) until after second-tranche funding was available.

While data on loan *submission* dates are lacking, Fig. 2 shows that 78% of the approved second-tranche loans come within the first 7 days of SBA resuming loan

Footnote 23 (continued)

experimental group from 1349 to 748 (55%) and has less variation in propensity scores across observations. Nonetheless, the results of the tightened analysis with the 3-day window are available in the Appendix accompanying this manuscript.

**Table 6** Quasi-experimental results on change in annual brewery production from 2019 to 2020 as a function of whether the brewery received *late* first-tranche funding (April 10–April 16, 2020) or *early* second-tranche funding (April 27–May 3, 2020)

Variable	(1)	(2)	(3)	(4)
<i>Treatment (April 10–16, 2020)</i>	0.027** (0.012)	0.036*** (0.012)	0.034*** (0.012)	0.030** (0.012)
<i>log(PPP funds)</i>	—	−0.029*** (0.006)	−0.029*** (0.006)	−0.022*** (0.008)
<i>Constant</i>	−0.145*** (0.009)	0.173*** (0.065)	0.172*** (0.065)	0.006 (0.079)
<i>N</i>	1,346			
County-level controls	No	No	Yes	Yes
Firm-level controls	No	No	No	Yes
<i>R</i> <sup>2</sup>	0.00	0.02	0.02	0.09

<sup>a</sup>Superscript \*\*\*, \*\*, and \* denote statistical significance at the 1, 5, and 10% level, respectively

**Table 7** Propensity score matching results

Method	# of observations used		ATT	Std. error	t-statistic <sup>a</sup>
	Treatment	Control			
Kernel matching	720	622	0.038	0.012	3.08***
Nearest neighbor matching <sup>b</sup>	720	351	0.030	0.017	1.80*
Radius matching	720	622	0.040	0.013	3.20***
Stratification matching	718	624	0.030	0.013	2.39**

<sup>a</sup>Superscript \*\*\*, \*\*, and \* denote statistical significance at the 1, 5, and 10% level, respectively. <sup>b</sup>Results presented use one-nearest neighbor matching procedures. When using *k*-nearest neighbor with  $k = \{2, 3, 4, 5\}$ , results suggest an ATT of similar magnitude with statistical significance that varies at the 1, 5, and 10% level

approvals. This suggests a backlog of loan applications as first tranche funding expired but a rapid decline in PPP loan demand a week after second tranche funding resumed. It is then reasonable to expect that most second-tranche loan recipients between April 27 and May 3, 2020, submitted their PPP loan application when first tranche funding was still available.

The quasi-experiment restricts attention to breweries that received funding between April 10–16, 2020, and April 27–May 3, 2020.<sup>24</sup> Under the identifying

<sup>24</sup> Attention is also restricted to breweries with production data from 2018 to 2020 to explore pre-trends. The sample begins with the 5555 breweries that were in operation as of July 2021 and had 2019–2020 YoY production volume changes within the bounds of −100 to +100% (analysis shown in Table 5). An additional restriction imposes an upper-bound limit on YoY production from 2018 to 2019 to mirror the restriction imposed on 2019–2020 YoY production changes. Lastly, outliers that significantly skew the sample mean are excluded. This includes breweries producing below the 5th percentile ( $\leq 100$  bbls) and above the 95th percentile ( $\geq 7757$  bbls) in 2018. Then, given the quasi-experimental setting, this portion of the study only analyzes observations with loan approval dates between April 10 and 16, 2020, or April 27–May 3, 2020.

assumptions that businesses receiving funding before and after the structural break are similar and that the delay in approval did not affect loan demand, the quasi-experiment can confidently assess the role of loan approval timing in the 2 weeks between tranches. These assumptions were validated in Doniger and Kay (2022).

The quasi-experimental group consists of 1346 observations: 720 observations with first-tranche funding (treatment) and 626 observations with second-tranche funding (control). Figure 5 shows the average production levels over time for the two groups.

On average, breweries in the treatment are larger than those in the control. In aggregate, both groups experience growth from 2018 to 2019. On average, the group that receives first-tranche funding experiences an 8.2% increase in production over this time period, whereas the group that receives second-tranche funding experiences a 6.0% growth rate. The difference between groups is exacerbated when comparing all first-tranche loan recipients (April

3–April 17, 2020) against all second-tranche loan recipients (April 27–August 8, 2020). Thus, while there appear to be inherent differences between the two groups, analyzing this shorter window around the program's structural break provides the best opportunity to understand the role of loan approval timing on performance.

Table 6 presents the results of the quasi-experiment where the change in YoY production is regressed on a treatment indicator indicating whether the brewery receives first tranche funding between April 10 and 16, 2020; zero otherwise (i.e., April 27–May 3, 2020). Given that each business in the quasi-experimental group receives PPP funding, the analysis controls for the loan approval amount as well as brewery-specific and county-level controls.<sup>25</sup>

Results suggest that the breweries receiving first-tranche funding between April 10 and 16, 2020, experienced a decline in YoY production that is 2–4 percentage points smaller than breweries receiving second-tranche funding 2 weeks later. These findings are robust to the inclusion of brewery and county-specific controls. Intuitively, these results are appealing considering a brewery's decision to adjust beer production based on whether they have received PPP funding. Watson (2020a, b) suggests that breweries shifted production schedules in March and April 2020 due to the decline in on-premise sales. The decision to delay production between tranches (April 17–26, 2020) is particularly attractive for breweries without first-tranche funding, as these businesses were experiencing a decline in foot traffic and sales without governmental support. Therefore, breweries waiting for PPP funding may find it more economical to temporarily shut down and halt production until PPP funding arrives. But breweries that received first-tranche funding could use the loan proceeds to pay staff and adjust production despite the short-term revenue decrease. This framework would suggest that, among

firms that received PPP funding, the period between tranches is critical in determining YoY performance. Put differently, the timing of loan approval mattered to YoY production outcomes.

While the study emphasizes the impact of loan timing on the beer industry, the finding is likely to generalize to other food service, hospitality, and specialized manufacturing sectors whose business model for optimal employment was affected by the incentive structure of the PPP.

## 6.2 Propensity score matching

One limitation to the analysis presented in Table 6—and a fundamental impediment in evaluating the PPP more generally—is that there are inherent differences between the treatment and control groups. One way to overcome these limitations is to use propensity score matching (Rosenbaum & Rubin, 1983). In short, the technique predicts the probability of treatment as a function of a set of covariates, yielding a propensity score for each observation. The outcome variable for each treatment observation is then compared to control observations with similar scores, offering an average treatment effect on the treated (ATT).

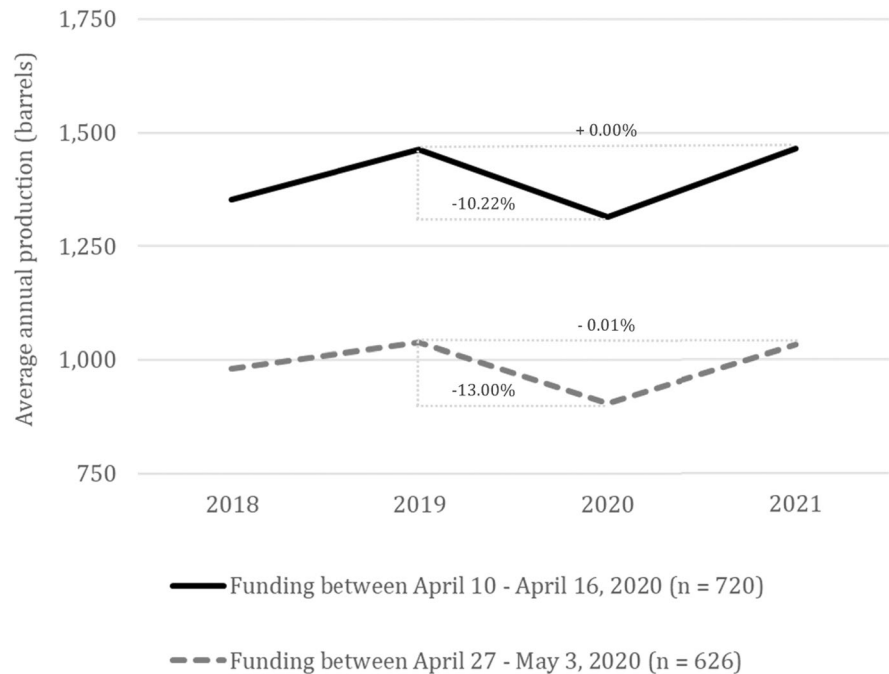
In the quasi-experimental setting, the change in YoY production for breweries that receive funding between April 10 and 16, 2020 (treatment) is compared to breweries that receive funding between April 27 and May 3, 2020 (control).<sup>26</sup> A probit model first predicts the probability of treatment as a function of: (i) county-level COVID-19 cases as of April 3, 2020; (ii) 2019 brewery production; (iii) the change in YoY production from 2018 to 2019; (iv) the loan amount approved; and (v) the number of jobs reported in the PPP loan application. COVID-19 cases are included as a proxy for the decline in foot traffic and sales, which may have prompted a brewery to apply for PPP funding sooner. The other four variables are included as proxies for brewery size and performance. Results to the probit are consistent with previously mentioned findings: COVID-19 cases are negatively associated with the probability of being placed in the treatment group, and larger breweries are more likely to be placed in the treatment. Note that changes in YoY

<sup>25</sup> County-level fixed effects are excluded given the sample size and diminished explanatory power. The models presented in Table 6 is also run with county-level fixed effects. The magnitude of the point estimate is similar (0.025), though it loses statistical significance. By including county-level FIPS codes, the analysis loses its explanatory power and increases its standard errors, leading to lower t-statistics. The inclusion of county-level fixed effects here may also not be appropriate given that of the 1346 observations across 577 counties, 321 counties (56%) are represented by a single observation.

<sup>26</sup> A more detailed overview of the propensity score methodology and results are provided in the Appendix accompanying this manuscript.



**Fig. 5** Average annual production (barrels/year) of breweries that received PPP funding between April 10–16, 2020, and April 27–May 3, 2020 ( $n = 1346$ )



production from 2018 to 2019—the pre-trends in Fig. 5 alluded to earlier—are insignificant in predicting treatment, which lends additional credibility to the validity of the quasi-experiment results presented in the previous sub-section. The total loan amount (in dollars) increases the probability of being placed in the treatment, whereas the total number of jobs reported on the PPP loan application is marginally negative.

After calculating the propensity score for each observation, the ATT is calculated using a variety of matching methods, including (i) kernel matching, (ii) nearest neighbor matching, (iii) radius matching, and (iv) stratification matching.<sup>27</sup> Table 7 presents the ATT for each of the matching methods.

We find an ATT ranging from three to four percentage points, a range coinciding with the results presented in Table 6. The treatment effect is significant at the 1% level for the kernel and radius matching; the 5% level for the stratification matching; and the 10% level for the nearest neighbor matching. Notice, however, that the point estimate and standard

errors for the nearest neighbor matching are similar to the stratification method. The loss in statistical significance comes from the nearest neighbor method using only 351 (56%) of the 624 control group observations, placing more weight on the same observations and reducing the degrees of freedom in statistical analysis.

These results increase confidence in the quasi-experimental estimates presented in Table 6 and allow us to suggest towards a causal impact of the timing of the PPP loan approval on YoY performance.

### 6.3 Longer-run production changes

This study's primary contribution is the short-run relationship between PPP funding and changes in 2019–2020 production. From a policy perspective, however, it is necessary to explore the longer-run relationship between PPP funding and recovery. With 2021 production data now available for a subset of observations, a brief, exploratory assessment of PPP funding on 2019–2021 production is now possible.

Using the quasi-experimental sample, Fig. 5 suggests a short-term benefit to receiving the PPP funding earlier (as discussed previously). However, the benefit appears to dissipate a year removed from the shock. In other words, breweries that receive

<sup>27</sup> The reader is directed to Caliendo and Kopeinig (2008) for an overview on the various matching methods as well as to Huntington-Klein (2022) for a discussion on the benefits and drawbacks of different propensity score matching procedures.

first-tranche funding see a decline in 2019–2020 YoY production approximately three percentage points smaller than breweries that received second-tranche funding. But when considering the overall change in production from 2019 to 2021, both groups appear to have recovered to pre-pandemic production levels, on average.

It is critical to stress once again that these insights are exploratory. The quasi-experiment can accurately assess the short-term impacts of PPP (Doniger & Kay, 2022), but more work is needed to understand the longer-term effects. The statistics presented here do not account for important covariates or address additional confounders that may have arisen over the calendar year. Moreover, there are likely heterogeneous effects in longer-term production recovery, particularly when considering brewery size, the reduction in YoY gross receipts, etc., which are beyond the scope of analysis in this article. Quantifying the long-term effect of the program on performance should be an emphasis of future work.

## 7 Limitations

Identifying the causal effect of government policies during the pandemic is inherently difficult (Hale et al., 2021), and we identify two central shortcomings that limit portions of the analysis. First, the study is limited by data availability, relying on a cross-sectional dataset when a panel structure accounting for temporal variation in closure dates would provide a more compelling causal interpretation for the LPM results. Unfortunately, closure dates are unavailable for each temporarily or permanently closed brewery in the dataset. It is also probable that active breweries were temporarily closed at some point during the pandemic (Cajner et al., 2020), and others may have adjusted their hours of operation to account for decreased consumer foot traffic (Watson, 2020c). Future research that accounts for the time of business closures across the life span of the PPP could better isolate the effect of receiving a PPP loan on operational status.

Also, the SBA dataset only contains data on the loan approval date is observed, not the loan submission date. It is reasonable to assume that all loan applicants would have preferred earlier to later funding, and it is well established that demand for first-tranche PPP funding far exceeded the available

supply. Yet, in the context of the quasi-experiment, we cannot definitively say that all loans approved in the first 7 days of the second tranche had the same application date as those approved in the last 7 days of the first tranche. If data on PPP loan application submission dates are made available, researchers could use that information to address further the pitfalls and unintended consequences stemming from the first-come, first-served design of the loan program.

The second core limitation is that the study cannot completely isolate issues that arise from self-selection into the treatment. That is, we cannot state with certainty that breweries that receive PPP funding have the same probability of survival as firms that do not receive PPP funding. Nor can we say that they had the same expected change in YoY production. For example, a brewery that had a pre-existing relationship with a bank and had more financial resources on-hand at the onset of COVID-19 may have been in a better position to remain in operation than one that did not have such resources available. It is also possible that the firms most likely to close chose not to apply for PPP funding. However, outside of total production, the firm's pre-pandemic economic conditions are unobserved, and any further discussion would be speculation.

Given the different production levels and growth rates between those that received PPP funding and those that did not, it is also possible that the breweries that experienced smaller declines in production were in a better position to adapt to production shocks from COVID-19 irrespective of PPP funding. Thus, while the results suggest a positive relationship between PPP funding and small business performance, questions remain about the efficiency and equality of the loan distribution mechanism and the program's causal impacts.

## 8 Discussion and implications

The *I Can't Go Anywhere But Here IPA* by Proclamation Ale Company and *Zoom Casual IPA* by Denver Beer Company are just two of the COVID-19-inspired beverages created by small, independent breweries that have survived the pandemic. However, not all small businesses were fortunate enough to outlast the early economic turmoil generated by the

pandemic. Analysis suggests that the number of business owners in the USA fell by 22% from February to April 2020 (Fairlie, 2020), and business closures were 25–33% higher in 2020 than in pre-COVID trends (Crane et al., 2020). As such, it is critical to explore whether the federal policies that provided economic relief to small businesses hit their mark.

The results suggest that receiving a PPP loan is associated with a higher probability of business survival and smaller declines in YoY production volume. These results are in line with previous findings on the PPP, where studies have suggested that PPP funding has led to a higher probability of survival (Bartlett & Morse, 2020; Hubbard & Strain, 2020), better employment outcomes (Bartik et al., 2020b; Doniger & Kay, 2022), and smaller reductions in revenue (Li, 2021).<sup>28</sup> More generally, the findings coincide with the notion that sales for the hospitality and accommodation industries decreased substantially during the COVID-19 pandemic (Fairlie & Fossen, 2021b). Industry reports also support these findings, where the Brewers Association reports a 9.3% decrease in volume, a 22% loss in dollar sales, and a 1.6 percentage point decline in market share from 2019 to 2020 (Brewers Association, 2022d; Scott, 2020, 2021). Despite these statistics and the

widespread concern from craft brewers at the start of the pandemic (Watson, 2020a, b), brewery closures have been lower than expected (Brewers Association, 2022d). This ability to weather the storm is likely attributable to innovation, entrepreneurship, and government support (Brewers Association, 2022a; Fairlie, 2013; Watson, 2022).

Even within a single industry, the pandemic has disproportionately impacted specific market segments. In the context of craft beer, brewpubs closed at higher rates and experienced steeper falloffs in YoY production volume, while regional breweries outperformed other market segments. These insights indicate how a firm's pre-pandemic business model affects business dynamics and resiliency in a time of crisis.<sup>29</sup> The COVID-19 pandemic is a once-in-a-century outbreak, and the speed at which the economic damages were felt made planning and preparation for this crisis particularly difficult. But while most businesses were forced to adjust to the new environment, some firms within a single industry could have been more or less vulnerable to the shock given their pre-pandemic business model and financial or technological constraints.

<sup>28</sup> The PPP represents just one of the many policy levers pulled by the US government to minimize the economic damages from COVID-19. Each country had its own unique response to COVID-19, and Hale et al. (2021) tracked government responses to COVID-19 across more than 180 countries. Categorizing policy responses into three overarching themes (containment and closure, economic response, and health systems), the data tracks 19 types of policy responses throughout 2020. The Oxford COVID-19 Government Response Tracker data discussed in Hale (2021) is available at: <https://github.com/OxCGRT/covid-policy-tracker> [last accessed October 28, 2022]. While comparing government responses to COVID-19 is not the main objective of this manuscript, other studies have considered the effects of COVID-19 economic policy responses on small business performance and entrepreneurial behavior in countries such as the UK (Belghitar et al., 2022; Yue and Cowling, 2021), Germany (Block, Fisch, and Hirschmann, 2022a, b; Block, Kritikos et al., 2022a, b; Dörr, Licht, and Murmann, 2022), and China (Liu et al., 2022). These studies have shown that (i) firms adjusted their liquidity decisions in response to COVID-19; (ii) government policies often helped reduce the financial strain on small businesses; and (iii) government policies were sometimes not well targeted, leading to more substantial adverse effects on smaller businesses, entrepreneurs, and self-employed individuals. These findings generally align with those presented in this article.

<sup>29</sup> Each market segment has its unique business model, indicative of different production levels, packaging decisions, revenue streams, etc. For brewpubs, food sales constitute a large portion of their revenue relative to the other market segments, and the food sales are largely driven by on-premise dining. When public health policies limited or shut down indoor dining, and consumer foot traffic fell due to the perceived risk of contracting COVID-19 (Goolsbee and Syverson, 2021), brewpubs saw a large decline in a primary revenue channel. Furthermore, a reliance on sales from indoor dining meant that brewpubs were also primarily selling their beer on-premise. While true that microbreweries and taprooms also rely heavily on on-premise consumption, brewpubs oftentimes have a less diverse portfolio of revenue streams. In other words, it is more common for the other market segments to have canning equipment, relationships with aluminum suppliers (upstream of the supply chain), and relationships with beer distributors and retailers (downstream), making the response to a shift in consumer behavior more likely. Without the necessary equipment and the relationships across the supply chain, brewpubs were particularly vulnerable. Thus, while state governments implemented policies alleviating some of the revenue declines—for example, allowing for to-go beer and brewery delivery—other barriers hindered a brewpub's ability to pivot away from its original business model. Industry reports and anecdotal accounts have also highlighted the disproportionate effect the pandemic has had on brewpubs (Brewers Association, 2022d; Watson, 2022).

The quasi-experiment also provides evidence that the timing of the loan approval mattered. Results of regression analysis and propensity score matching suggest a causal effect of breweries that receive late first-tranche PPP funding, on average, performing better YoY than those breweries that received early second-tranche funding. If the timing of loan approval contributes to YoY performance, then this further raises concern over the first-come, first-served style of the loan program. In the quasi-experiment, firms that received first-tranche funding were, on average, larger and located in counties with below-average COVID-19 cases in April 2020. This finding also holds when exploring the recipients of PPP loans more generally. In sacrificing targeting for timeliness (Autor et al., 2022b), the program disproportionately assisted businesses that had preexisting relationships with a bank (Bartik et al., 2020b; Granja et al., 2020), supporting larger firms over small businesses (Humphries et al., 2020), and contributing to equality issues (Atkins et al., 2021; Autor et al., 2022b; Fairlie & Fossen, 2021a).

By merging a verified industry dataset with the SBA data on PPP loan recipients, the article provides a methodological overview and speaks to the challenges associated with achieving its objectives. COVID-19 was declared a national emergency on March 13, 2020, the CARES Act (Public Law 116–136) was passed on March 27, 2020, and the first-PPP loan recipients were approved on April 3, 2020. The quick turnaround was imperative to small businesses, but bureaucratic shortcomings make it challenging to analyze the effectiveness of the program. For instance, each loan applicant had to list their “Borrower Name” on the PPP loan application. Yet, in some cases, the borrower would list their name or official company name rather than their trading name (i.e., *doing-business-as* name). This inconsistency meant imperfect information in the merging process, which required the manual merging of data sources based on addresses and analysis of a company’s trademarks.<sup>30</sup> Juxtaposing the PPP application

with the Economic Injury Disaster Loan (EIDL) application, EIDL applicants are required to specify both the legal name of the business and the trading name (if different from the legal name). If PPP loan applicants were asked to provide this information, it would have enabled a much cleaner merging procedure. Clarification, consistency, and the collection of all pertinent information across loan applications are critical for future loan programs to improve the functionality of governmental data.

Researchers analyzing the economic impact of the PPP must be cognizant of the delicacies of the NAICS code classification system and the presence of potentially fraudulent observations. While the attention is on the craft breweries—an industry with its own six-digit NAICS code—we necessarily analyzed observations across three different NAICS codes. If attention were restricted to the six-digit NAICS code for breweries (312120), just 63% of the matched PPP loan observations would have been captured—severely underestimating the number of loan recipients. There are also several instances where breweries received both rounds of funding through the same bank yet were coded in different NAICS codes across the two applications (e.g., NAICS 312120: Breweries in the first round and coded with 722410: Drinking places in the second round). Observations were also incorrectly coded into the population of interest (e.g., several wineries and distilleries were coded as breweries when each has its own NAICS code). Moreover, Beggs and Harvison (2022) and Griffin et al. (2022) suggest that the loan program was susceptible to fraudulent claims, implying that researchers must be aware of their potential presence in the data. By addressing shortcomings related to the

<sup>30</sup> Given the number of craft breweries in the USA, the manual matching procedures described in this study were practical. With access to a verified dataset of producers from the largest craft beer industry group, the PPP observations were mapped to known breweries. However, even with less than 9000 total producers, the matching procedures proved extremely time-intensive. If future research wishes to examine the effect of PPP on a larger industry (e.g., full-service restaurants) or full sector (e.g., accommodation and food services), the matching methods are feasible but necessarily will be even more time- and labor-intensive. Additionally, researchers would need to obtain a verified dataset of existing full-service restaurants

Footnote 30 (continued)

before COVID-19 and consider potentially miscoded observations to gain a more accurate representation of the impact of the PPP on the industry. While proprietary datasets (like the National Establishment Time-Series) exist, they have significant limitations which we were able to alleviate through partnering with the Brewers Association (i.e., being able to cross-validate closures, enhancing confidence that we accurately identified all firms that closed from the full universe of businesses in this specific industry and having non-imputed measures of production data). Thus, while analyzing a single, smaller industry has potential drawbacks for identifying the overall causal effect of the loan program, the practicality and internal validity of the methodology described in this paper offer substantial improvements over alternatives.

borrower name listed on the PPP loan application, matching across all pertinent NAICS codes, and removing incorrectly coded or potentially fraudulent observations, this methodology allows for a more accurate representation of PPP loan recipients by industry. This was only possible because of the externally verified universe of businesses from the Brewers Association. As such, researchers seeking to identify the impact of the PPP on a specific industry should consider the ease of obtaining a verified dataset of producers and how PPP observations may be scattered across different NAICS codes.

## 9 Conclusion

The PPP was established to incentivize small businesses to keep employees on payroll and to provide them some relief from economic damages from the COVID-19 pandemic. Using data from the Brewers Association and SBA, this study explores the role of PPP funding on small business performance. Results suggest that breweries that receive PPP funding are more likely to remain in operation and experience a smaller decrease in YoY production from 2019 to 2020. Furthermore, through a quasi-experiment that exploits a natural break in the loan program, the study demonstrates that the timing of loan approval likely affected YoY performance. While the analysis lacks a full causal interpretation, the results support a positive correlation between PPP funding and small business performance.

Several avenues remain for future research. Previous studies have explored the employment effects of the PPP (e.g., Autor et al., 2022a; Chetty et al., 2020; Hubbard & Strain, 2020), but future work could link PPP and employment outcomes with YoY performance or sales data to better understand the dynamic relationship between these outcome variables.<sup>31</sup> Additionally, researchers have explored equity concerns over the distribution of PPP

funding, but much remains unknown about the short- and long-term effects of the first-come, first-served approach of the loan program. For example, researchers could examine network effects in the PPP loan program across time, exploring PPP loan clustering and addressing the role of social networks. Future work should examine the impact of COVID-19 and the PPP on new businesses or businesses in planning. This line of research could provide critical insights into the roles of economic circumstances, government support, and entrepreneurship on short- and long-term business resiliency and growth (Kuckertz et al., 2020). Finally, from a global perspective, future research could compare the effectiveness of the PPP relative to other government efforts (Hale et al., 2021). For example, Block et al., (2022a, b) and Dörr et al. (2022) consider how financial assistance in Germany helped small businesses. With a strong beer industry and a growing presence of small brewers (Statista, 2021), one interesting avenue could be replicating the analysis presented here with a dataset of German producers. Doing so would enable an interesting comparison of how different policy responses influenced performance.

The PPP supported small businesses across the country, and researchers are only beginning to answer whether it hits its mark. Questions remain regarding the loan program's equality, efficiency, and causal impact. As more researchers explore this line of research, we will gain a much clearer insight into the effect of the PPP on small businesses.

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<sup>31</sup> The stated objective of the PPP was to keep workers on payroll. But this study evaluates performance based on changes in annual production: a secondary policy outcome but a primary concern for small businesses. The current analysis is limited by data availability, and future studies that causally link receiving PPP funding to employment and production outcomes would significantly improve our understanding of the program's effectiveness.



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