

# The Paycheck Protection Program & Small Business Performance: Evidence from Craft Breweries

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**Abstract:** The Paycheck Protection Program (PPP) provided approximately \$790 billion in COVID-19 relief funds to nearly 12 million small businesses. We use data from the craft beer industry to explore the role of PPP funding on small business performance. By merging an industry dataset of producers with data from the Small Business Administration on PPP loan recipients, we examine the relationship between PPP funding, business survival, and changes in year-over-year production volume. Results suggest that firms that receive PPP funding are more likely to remain in operation and experience a smaller decline in annual production. Further, we use a quasi-experiment that exploits a natural break in the loan program to demonstrate that the average decrease in YoY production is smallest for breweries that receive the earliest funding. Using regression analysis and propensity score matching, results suggest towards a positive causal effect of the role of loan approval timing on short-run performance outcomes. These results provide evidence that the PPP alleviated losses induced by COVID-19, but questions remain about the program's distribution and long-term impacts.

**Plain English Summary:** The U.S. federal government created the Paycheck Protection Program (PPP) to minimize economic damages to workers and small businesses during the pandemic. One industry hit particularly hard by the pandemic was the craft brewing industry. Therefore, we use this industry to explore whether the PPP achieved its objectives. The results show that receiving a PPP loan increases the likelihood of remaining in business. Additionally, while most craft breweries experienced a decline in production from 2019 to 2020, firms that receive a PPP loan see a smaller decline. Breweries that receive the earliest funding also performed the best, suggesting that the timing of loan approval plays a key role in determining annual performance. Taken together, our study suggests that the government program helped to reduce economic damages, but more work is needed to fully understand the program's impact.

**Keywords:** annual performance, breweries, COVID-19, closures, Paycheck Protection Program, small business

**JEL codes:** H12, L66, M20

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1 **1. Introduction**

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

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

18         By aligning an industry dataset of producers with governmental data on PPP loan  
19 recipients, we examine the relationship between PPP funding and small business  
20 performance. Specifically, we use data from the U.S. craft beer industry to explore the role of  
21 PPP loans on business survival and annual production. The craft beer industry is comprised  
22 of small, independently-owned businesses whose primary revenue stream was significantly  
23 disrupted by the pandemic, making it an ideal subject for analysis. As such, the objective of

24 this article is to determine whether receiving a PPP loan increases the likelihood of business  
25 survival and contributes to better year-over-year (YoY) production outcomes.

26 Our study resembles work presented in Bartlett III and Morse (2020), Hubbard and  
27 Strain (2020), and Li (2021). Bartlett III and Morse (2020) analyze the effectiveness of PPP  
28 on business survival in Oakland, California whereas Hubbard and Strain (2020) address  
29 survival rates amongst larger businesses.<sup>1</sup> Li (2021) uses Small Business Pulse Survey data  
30 to demonstrate that PPP loan recipients were less likely to report revenue decreases and a  
31 reduction in employee hours following loan approval. We also draw on the work of Fairlie  
32 and Fossen (2021b), who use California administrative sales tax data to show that, on  
33 average, sales decreased by 17% during the second quarter of 2020. Their analysis, however,  
34 does not explore the effects of PPP on performance, leaving an important gap in the  
35 literature. Fairlie and Fossen also show that sales losses were most significant for the  
36 accommodation and hospitality industries, further motivating our use of the craft beer  
37 industry.

38 Researchers have also explored the employment effects of the PPP (Autor et al.,  
39 2022a; Chetty et al., 2020; Dalton, 2021; Faulkender et al., 2020; Hubbard and Strain, 2020).  
40 These studies suggest an employment effect ranging from 0.9% (Hubbard and Strain, 2020)  
41 to 16-35% (Bartik, Cullen, et al., 2021), where the magnitude of the point estimate depends  
42 on the sample used and the identification strategy employed (Dalton, 2021). From a policy  
43 perspective, the effectiveness of the PPP on employment is a first-order outcome. However,

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<sup>1</sup> It should be noted that the smallest loan size explored in Hubbard and Strain (2020) was \$150,000. In contrast, the median loan size in our sample was \$56,711. We view our analysis as a necessary extension over this important work, in that we are able to tease out the effect more specifically on smaller businesses.

44 for a small business, the primary objectives are survival and profitability, and thus it is  
45 critical to assess how PPP affected the operational status and revenue of the firm.

46 Our contribution is threefold. Primarily, to our knowledge, we are the first to align an  
47 industry dataset of existing businesses with PPP loan data. In doing so, we provide analysis  
48 on the relationship between PPP funding and two metrics of small business performance:  
49 operational status and production volume (serving as a proxy for revenue). Results suggest  
50 that firms that receive PPP funding are more likely to remain in operation and experience  
51 smaller declines in YoY production from 2019 to 2020 than firms that do not. Additionally,  
52 our ability to observe different segments of the craft beer industry allows us to perform  
53 within industry heterogeneity analysis. The results indicate that a firm's pre-pandemic  
54 business model contributes to its ability to adapt to the sudden shock of COVID-19, which is  
55 also a novel contribution.

56 Secondly, through a quasi-experimental framework, we examine the role of loan  
57 timing on changes in YoY production from 2019 to 2020. We use a natural break in the loan  
58 program to compare the YoY performance of firms that receive funding before the initial  
59 \$349 billion was exhausted and firms that receive funding when it was reloaded two weeks  
60 later. We find that breweries that receive funding before the structural break experience a  
61 decline in YoY production that is 2-4 percentage points smaller than those that receive  
62 funding in the week following the break. These findings suggest that loan approval timing  
63 contributes to 2020 performance, which is an important new insight for research analyzing  
64 the first-come, first-served style of the loan program.

65 Lastly, we offer a methodological advancement, highlighting the shortcomings of the  
66 publicly available SBA data and speaking to the procedures necessary for future studies to

67 achieve similar objectives. This includes a discussion on the limitations of the North  
68 American Industry Classification System (NAICS) coding system and inconsistencies in the  
69 PPP data. Further, evidence suggests that the loan program was subject to fraudulent claims  
70 (Beggs and Harvison, 2022; Griffin, Kruger, and Mahajan, 2022), making it difficult for  
71 researchers to address the economic contribution of the PPP. By anchoring the PPP database  
72 to a verified listing of firms at the industry level, we provide an important advancement that  
73 significantly reduces concerns over fraudulent claims being included in the analysis. This  
74 means we can more accurately estimate the true impact of the PPP on business performance,  
75 increasing the generalizability of our results.

76 The remainder of this article is structured as follows. Section 2 provides background  
77 on the PPP and explains the impact of the pandemic on the craft brewing industry. Section 3  
78 presents the different data sources used in analysis. Sections 4 – 6 present results analyzing  
79 business survival, YoY performance, and loan timing, respectively. Section 7 discusses the  
80 study’s two central limitations. Section 8 discusses the economic significance of our results,  
81 and Section 9 concludes.

82

## 83 **2. Background**

### 84 ***2.1 Paycheck Protection Program***

85 To combat the economic turmoil felt at the onset of COVID-19, the CARES Act (Public Law  
86 116-136) was signed into law on March 27, 2020. Included in the \$2.2 trillion economic  
87 stimulus package was \$349 billion to establish the Paycheck Protection Program (PPP), a  
88 program administered by the Small Business Administration (SBA) to provide  
89 uncollateralized, low-interest loans to small businesses. The primary stated objective of this

90 program was to provide small businesses with an incentive to retain employees on payroll.  
91 However, businesses could also use the proceeds to pay: (i) worker benefits and protection  
92 costs, (ii) mortgage interest payments and rent, (iii) damages from looting or vandalism, and  
93 (iv) utilities (SBA, 2021a).

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

102 [TABLE 1 HERE]

103 [FIGURE 1 HERE]

104 The SBA began distributing the first tranche of funding on April 3, 2020. With the  
105 demand for PPP loans far exceeding the available supply, the initial \$349 billion was  
106 exhausted by April 16, 2020—just two weeks after the first loans were approved. Given the  
107 rush of applications and the first-come, first-served nature of the program, concerns about

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<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.”

108 equity and the role of the banks quickly emerged (Bartik, Cullen, et al., 2020; Fairlie and  
109 Fossen, 2021a; Humphries et al., 2020).

110 Claims in the literature suggest that the program sacrificed targeting for timeliness  
111 (Autor et al., 2022b). The majority of PPP lending came from small and medium sized banks  
112 (less than \$50 billion in assets), which allowed for rapid, decentralized loan dispersal (Li and  
113 Strahan, 2020). But the distribution mechanism provided firms that had a pre-existing  
114 relationship with a bank easier access to first tranche PPP funding (Granja et al., 2020); and  
115 this setup negatively impacted the smallest businesses (Humphries et al., 2020). Moreover,  
116 the use of banks to distribute funding may have created a wedge between the public interests  
117 of the government (i.e., maintaining lower unemployment levels and keeping small  
118 businesses in operation) and the private interests of the banks (i.e., the profitability and  
119 longevity of their consumers) (Bartik, Cullen, et al., 2020).

120 As COVID-19 cases continued to surge and states implemented new, or extended old,  
121 stay-at-home orders, the Paycheck Protection Program and Health Care Enhancement Act  
122 (Public Law 116-139) was signed into law on April 24, 2020. The legislation provided the  
123 SBA with an additional \$310 billion to support businesses that had not yet received a PPP  
124 loan. Distribution of the second tranche of funding began on April 27, 2020 and ended on  
125 August 8, 2020. The first and second tranches of PPP funding spanning April 3 – August 8,  
126 2020 are referred to as the first round of PPP funding.

127 COVID-19 cases began to spike again in December 2020, leading lawmakers to pass  
128 the Economic Aid to Hard-Hit Businesses, Nonprofits, and Venues Act (Public Law 116-260)  
129 on December 27, 2020. In addition to allocating an additional \$284.5 billion to the SBA to  
130 administer the third tranche of PPP loans, the law modified key provisions and authorized a

131 second round of PPP funding to businesses that had previously received first-round funding.  
132 Table 1 highlights key differences across the first and second rounds of funding. Most  
133 notably, the third tranche targeted smaller businesses that could demonstrate a reduction in  
134 gross recipients from 2019 to 2020 of 25% or more (SBA, 2021i). The third tranche of PPP  
135 funding ran from January 11 – May 31, 2021, and it is commonly referred to as the second  
136 round of PPP funding.

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

142 With the PPP now closed and the data on loan recipients now available, we can  
143 descriptively monitor and evaluate the success of the program. For instance, several studies  
144 have analyzed the effect of first-round PPP funding on employment. Findings vary quite  
145 substantially, including small employment effects of 1-2% (Chetty et al., 2020; Hubbard and  
146 Strain, 2020), more modest estimates of 2-5% (Autor et al., 2022a), and larger effects of more  
147 than 10% (Bartik, Cullen, et al., 2020; Faulkender et al., 2020). Yet, to our knowledge, no  
148 study has sought to link PPP funding to business performance metrics. We fill this gap in the  
149 literature using the craft beer industry given COVID-19’s disproportionate impact on the  
150 industry.<sup>3</sup>

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<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.

151

152 *2.2 COVID-19's Impact on the U.S. Craft Beer Industry*

153 Over the past two decades, the number of U.S. craft breweries—an industry comprised of  
154 small, independent businesses—has increased by 500% (Brewers Association, 2022d).<sup>4</sup> In  
155 2005, there were 1,394 craft breweries in the United States. By 2019, there were 8,391,  
156 representing 99% of all U.S. beer producers. Craft beer's market share, measured in total  
157 dollars, also increased from 5% to 25% over the same time frame (Brewers Association,  
158 2021).

159 Despite this considerable growth in market share, craft beer only accounts for 12-  
160 13% of beer by volume, measured in barrels (bbls) of production. In other words, 99% of the  
161 breweries in the United States account for just 12% of domestic beer production (Brewers  
162 Association, 2022d). The critical distinction between market share by sales dollars and  
163 market share by volume stems from the difference in business models and marketing  
164 strategies employed by craft brewers compared to large, non-craft breweries. Whereas large  
165 brewers sell high quantities of standardized products at a low price point, craft breweries  
166 brew smaller quantities of high-quality, differentiated products at a price premium to a niche  
167 group of consumers. Further, while revenue from beer sales is generated through a variety  
168 of outlets (e.g., local liquor stores, grocery outlets, and restaurants), craft brewers rely  
169 predominantly on on-premise sales. Indeed, it is common for 80-100% of a brewery's  
170 revenue to come from on-premise sales, and this is especially true for the smallest craft  
171 breweries (Staples, Malone, and Serrine, 2021). With the emphasis on taproom sales in a local

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<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.

172 community—as opposed to a wide distribution network of retail outlets—craft brewers  
173 were more vulnerable to COVID-19 than large, non-craft producers.

174 In response to COVID-19, states and local municipalities throughout the U.S.  
175 implemented public health policies that directly affected the traditional craft brewer  
176 business model. For example, stay-at-home orders limited social mobility, and capacity  
177 restrictions often limited or shut down indoor dining. But social institutions and consumer  
178 perceptions about the prevalence of COVID-19 in their community also played a role in  
179 decreased foot traffic (Chetty et al., 2020; Fairlie and Fossen, 2021b; Goolsbee and Syverson,  
180 2021). Indeed, Goolsbee and Syverson suggest that social institutions explain much more of  
181 the decline in consumer foot traffic from January to April 2020.<sup>5</sup> Their results also state that  
182 drinking places ranked as one of the most negatively impacted sectors. Irrespective of the  
183 reason for the decreased visits, breweries that rely heavily on revenue from on-premise sales  
184 needed to reconsider their business model (Morris, 2020; Romano, 2021). This included  
185 adjusting production schedules, employment levels, and alternative revenue streams.

186 In late March 2020, the Brewers Association, a 501(c)(6) not-for-profit organization  
187 aimed at promoting and protecting the interests of U.S. craft brewers (Brewers Association,  
188 2022c), surveyed approximately 900 craft breweries on their concerns and perceptions of  
189 COVID-19. Their results showed widespread distress: 90% of respondents had already

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<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.

190 altered beer production schedules; 61% expected layoffs; and 60% believed their business  
191 would fail in three months or less if social distancing guidelines, state and federal assistance,  
192 and costs and revenue streams remained at their mid-March levels (Watson, 2020a, 2020b).  
193 While this sentiment is not unique to the craft brewing industry (Bartik, Bertrand, et al.,  
194 2020), the heavy dependence on on-premise alcohol sales made craft brewers particularly  
195 vulnerable (Fairlie and Fossen, 2021b). According to Brewers Association estimates,  
196 aggregate craft beer production fell 9% in 2020, sales decreased by 22%, and craft beer  
197 market share fell 1.7 percentage points compared to 2019 (Brewers Association, 2022d;  
198 Watson, 2021).

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

205

### 206 **3. Data**

207 We use data from the Brewers Association and the Small Business Administration to achieve  
208 our primary objectives. These objectives are to (i) explore the relationship between PPP

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<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).

209 funding and business survival; (ii) examine how YoY production changed as a function of  
210 whether a brewery received PPP; and (iii) determine whether the timing of loan approval  
211 timing affected YoY performance. We discuss the structure of each data source in the  
212 following two sub-sections before describing our merging procedures and presenting  
213 summary statistics.

214

### 215 *3.1 Brewers Association*

216 We first identify active breweries as well as ones that temporarily or permanently closed  
217 during the COVID-19 pandemic. Analysis is limited to the 50 states and the District of  
218 Columbia, and we restrict closures to those that occurred after the April 3, 2020 start date of  
219 PPP funding. The sample consists of 8,946 breweries. Utilizing Brewers Association records  
220 and internet searches, breweries were placed into one of three categories: (i) permanently  
221 closed since the start of the PPP (April 3, 2020); (ii) temporarily closed as of July 2021; and  
222 (iii) in operation as of July 2021.<sup>7</sup> July 2021 serves as an adequate date to examine  
223 operational status because it eclipses the end date of the PPP, coincides with most states  
224 lifting COVID-19 restrictions, and aligns with when nearly half of the U.S. population was  
225 fully vaccinated against COVID-19 (CDC, 2021). As of July 2021, 8,506 (95.1%) firms were  
226 active, 141 (1.6%) were listed as temporarily closed, and 299 (3.3%) were identified as

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<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, 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, we used Google searches. Specifically, for each brewery included in the dataset, we searched the brewery name and identified breweries 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 the 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.



246 food sales may see a steeper decline in consumer foot traffic. Relative to the other craft beer  
247 market segments, brewpubs exhibit less capability to pivot production away from on-  
248 premise, draught consumption towards canning or other off-premise channels.

249 We also obtain brewery-specific production volume data over time and link these  
250 estimates to the universe of breweries where available. Annual production volume serves as  
251 a proxy for annual revenue, and data are available for 6,304 (70%) of 8,946 breweries for  
252 2019, and 6,892 (77%) for 2020. For observations without production volume, yearly  
253 production is treated as missing data. Year-over-year (YoY) changes in production volume  
254 from 2019 to 2020 are then calculated, allowing for an assessment of how production  
255 changed throughout the pandemic. In examining the change in YoY production, there are  
256 several outliers, driven largely by breweries that were in the process of expanding  
257 production in the time of interest or opened later in 2019 (and thus their estimate does not  
258 reflect a full year of production). Therefore, in the analysis that follows, attention is limited  
259 to breweries that experienced a negative 100% to positive 100% change in YoY production  
260 from 2019 to 2020.<sup>9</sup> In doing so, the sample is confined to 5,911 (94%) of the initial 6,304  
261 observations with available production data.<sup>10</sup>

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<sup>9</sup> For example, our 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 75<sup>th</sup> 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). We impose an upper bound of +100% change in YoY production as to remove significant outliers. For example, a brewery could have opened in November of 2019, had two 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, we place the upper bound limit of +100% on our YoY production volume changes.

<sup>10</sup> We also partner with the Brewers Association to collect information on which breweries 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 was an additional government aid program run through the U.S. 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

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### 263 *3.2.2 Paycheck Protection Program*

264 Data used in the analysis were pulled from the SBA website on June 23, 2021 and contain  
265 nearly 12 million PPP loan recipients through May 31, 2021, the end of the PPP (SBA,  
266 2021b).<sup>11</sup> To identify our observations of interest, we use the six-digit North American  
267 Industry Classification System (NAICS) coding system.

268 We first construct a dataset of all observations coded in the six-digit NAICS code for  
269 breweries (312120), yielding 5,405 observations. However, a significant number of  
270 breweries also operate in food service (i.e., brewpubs) and may be coded with full-service  
271 restaurants (722511). To account for these businesses, we pull all PPP loan recipients coded  
272 as full-service restaurants and use fuzzy matching procedures to align the address listed on  
273 the PPP loan application with brewpub addresses.<sup>12</sup> This results in a dataset of 1,481  
274 brewpub observations coded as full-service restaurants. Lastly, breweries could be coded in  
275 the NAICS code for drinking places (722410). Similar fuzzy matching procedures are used to  
276 identify an additional 1,466 observations. We then aggregate observations across the three  
277 NAICS industries (312120: Breweries; 722511: Full-service restaurants; and 722410:  
278 Drinking places) to create a dataset of 8,352 loan observations.

279 As firms could receive two rounds of PPP funding, a single brewery that receives two  
280 loans has two observations in the dataset. To create a one-to-one mapping across the

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and totaled \$28.6 billion (SBA, 2021j). The Brewers Association identified 1,539 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, and thus we manually corrected for improperly matched locations using Google Maps.

281 Brewers Association data and PPP data, we reshape the PPP data yielding 5,809 unique  
282 observations.<sup>13</sup>

283

### 284 3.3 Merging

285 To merge the brewery data points with PPP observations, we separate both datasets by  
286 jurisdiction (50 states and the District of Columbia). For each jurisdiction, we then pair the  
287 breweries and PPP data to initiate matching. As we assume that the Brewers Association  
288 dataset is our entire universe of breweries, PPP borrowers either sufficiently map to one of  
289 the breweries or are excluded from the analysis. Due to limitations in the PPP data, we resort  
290 to a three-step manual matching procedure.

291 First, we attempt to match the borrower's name listed on the PPP loan application to  
292 the brewery's name. While a significant proportion of the observations match on name,  
293 shortcomings in the PPP data prevent others. For example, loan recipients would often list  
294 their official company name rather than their company's trading name (i.e., their *doing*  
295 *business as* name). Other applicants listed their government name as opposed to the name of  
296 the brewery. To overcome this shortcoming, the second step matches the address listed on  
297 the PPP loan application to a brewery's address. Again, borrowers would sometimes list a  
298 residential address rather than a business address. For the remaining unmatched  
299 observations, step three involves using the borrower's name listed on the PPP application to  
300 identify trademarks, alternative trading names, etc. of the loan applicant using online

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<sup>13</sup> We use the *reshape wide* command in Stata to complete these procedures. However, the reshape command only works if the borrower's name is identical for both listings (including punctuation, case sensitivity, etc.). 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.

301 resources such as OpenCorporates (OpenCorporates, 2021). If the PPP borrower had a  
302 trademark that could be mapped to a brewery, these observations were matched.

303 On aggregate, we match 89% of the PPP loans across 5,002 unique breweries in 1,210  
304 distinct counties. The unmatched observations are excluded from our analysis.<sup>14</sup>

305

### 306 *3.4 Summary statistics*

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

311 Figure 2 provides a timeline of PPP loan funding to craft breweries. Approximately  
312 63% of first-round loans are distributed between April 3 – April 16, 2020, 94% by May 3,  
313 2020, and the remaining 6% through August 8, 2020.

314 [FIGURE 2 HERE]

315 Table 3 provides a breakdown of summary statistics based on whether a brewery  
316 receives (i) first-round funding only, (ii) second-round funding only, (iii) both rounds of  
317 funding, or (iv) no funding. Of the 8,946 breweries in the dataset, over half received some

---

<sup>14</sup> Most observations that remained unmatched consisted of cideries, wineries, and distilleries that were incorrectly coded into NAICS 312120 as well as pubs or restaurants that do not qualify as breweries. Other businesses coded in NAICS 312120 did not engage in alcohol production or distribution. Additionally, several observations that were coded into NAICS code 312120 do not fit the Brewers Association's definition of a brewery (e.g., kombucha brewers not registered with the Brewers Association). The most notable group excluded from analysis are breweries in planning or proprietor brewers. These groups were not included in our universe of breweries from the Brewers Association, and so they are excluded from analysis. While this may be seen as a limitation, these observations accounted for less than 20% of the unmatched observations, or 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. We unfortunately did not have data on number of jobs from the Brewers Association over time, which means we are unable to overserve changes in employment as an outcome variable in our analysis.

318 form of PPP funding: 23% receive first-round funding only, 6% receive second-round  
319 funding only, and 27% receive both rounds of funding; the remaining 44% receive no PPP  
320 funding.

321 [TABLE 3 HERE]

322 Examining key outcome variables (Panel A in Table 3), we see differences in  
323 operational status and changes in YoY production volume across groups. Businesses that  
324 received both rounds of funding are most likely to be open as of July 2021 (98%), while  
325 breweries that had receive no PPP funding have the lowest probability of remaining in  
326 business (92%). For changes in YoY production volume, the average brewery sees a 12.5%  
327 decline in production from 2019 to 2020. However, on average, the decline is smaller for  
328 breweries that received first-round PPP funding (-10% YoY) compared to breweries that do  
329 not (-15% YoY).

330 There is also variation in county-level variables such as the total number of COVID-  
331 19 cases as of April 3, 2020 (the first day of PPP funding), which support the use of county-  
332 level fixed effects. Interestingly, breweries that received first-round PPP funding have a  
333 below-average number of total confirmed COVID-19 cases as of April 3, 2020 (the first day  
334 of the PPP funding); similarly for December 31, 2020. This finding is in line with Granja et al.  
335 (2020), suggesting that the banks involved in distributing PPP loans were more likely to do  
336 so in areas that were not as adversely impacted by COVID-19.

337 Further demonstrating differences across our comparison groups, Figure 3 plots  
338 2018 – 2020 production levels. The sample is limited to breweries that are open in July 2021,  
339 implying that the remainder of this section should be interpreted as YoY production volume

340 changes conditional upon remaining in operation. With this condition, along with missing  
341 data and the removal of statistical outliers, data are available for 4,257 breweries.<sup>16</sup>

342 [FIGURE 3 HERE]

343 Breweries across each group demonstrate, on average, increasing production from  
344 2018 to 2019, ranging from a YoY increase of +1-8%. Figure 3 suggests that larger (eligible)  
345 operations were more likely to receive first-round funds. Breweries that receive first-round  
346 funding, on average, produce higher quantities of beer from 2018-2020 than those that did  
347 not. The graph also reflects the change in loan eligibility for second-round funding, which  
348 targeted smaller firms that experienced substantial revenue decreases in 2020. Lastly, the  
349 group with the smallest average production did not receive any PPP funding.

350

#### 351 **4. Probability of business survival**

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

---

<sup>16</sup> Specifically, we remove (i) observations that are missing data in 2018, 2019, and/or 2020; (ii) breweries that experienced greater than a 100% increase in YoY production from 2018-2019 and/or 2019-2020; and (iii) outliers that significantly skew the average. We remove breweries that were listed as producing 1 bbl of beer per year, as this may be evident of an error in the industry production dataset where “1” signals an indicator of having produced in the corresponding year. Additionally, we remove breweries producing above the 99<sup>th</sup> percentile of annual production in 2018. The 99<sup>th</sup> percentile was chosen based on the distribution of the 2018 production data. Specifically, 99% of our sample produces at or below 66,669 barrels of beer per year, while the remaining 1% of observations ranges from 66,784 to 2,175,784 barrels per year. Similar statistics held for the 2019 and 2020 data, with 99<sup>th</sup> percentiles of 55,660 and 50,084 bbls per year, respectively. As such, we use the 2018 data as our production cutoff point.

358 of the marginal effect for the average observation (Wooldridge, 2010).

359         The left-hand side variable is a binary variable equal to one if the brewery is in  
360 operation in July 2021; zero otherwise. The primary explanatory variables of interest are  
361 indicator variables specifying whether a given brewery received a first-round loan, a second-  
362 round loan, or both a first- and a second-round loan. We hypothesize that receiving a single  
363 PPP loan will lead to a higher probability of survival (Hubbard and Strain, 2020), while  
364 receiving both rounds of PPP funding will further increase the likelihood of survival but at a  
365 decreasing rate.

366         The study also analyzes the relationship between business survival and the brewery  
367 segment, controls for important brewery-specific variables, and includes county-level fixed  
368 effects to capture unobserved heterogeneity.<sup>17</sup> We hypothesize that COVID-19 will  
369 disproportionately impact brewpubs as their reliance on food and draught beer sales may  
370 have made them more vulnerable to declines in consumer foot traffic. Other segments, such  
371 as regional breweries and taprooms, could more easily pivot to alternative packaging  
372 methods and distribution channels. Brewery-specific variables include 2019 brewery  
373 production, whether the brewery is a primary or secondary location, and whether the  
374 brewery received a loan from the 2021 Restaurant Revitalization Fund (RRF) program.<sup>18</sup>

---

<sup>17</sup> We also consider the inclusion of state-level control variables. However, during estimation procedures, their inclusion did not improve our explanatory power, produced point estimates that were identical in magnitude to our preferred specification, and may be inappropriate given the inclusion of county-level fixed effects.

<sup>18</sup> We may 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, we control for whether a brewery received an RRF loan. Note that the distribution of RRF loans comes immediately before our 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 our data on temporary and permanently closed breweries in July 2021, we would only observe that these breweries were open in July 2021, not seeing that they were temporarily closed weeks before. We attempt to overcome this shortcoming through the inclusion of a control variable for breweries that received an RRF loan in regression analysis.

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

378 [TABLE 4 HERE]

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

389 As a robustness check, we also estimate a penalized logistic regression, which  
390 accounts for rare events and forces predictions into the zero-one, binary response range  
391 (Firth, 1993). The results are fairly consistent with that of the LPM, where the main effects  
392 of PPP retain their sign and statistical significance. However, the coefficient for receiving  
393 both rounds of funding loses its statistical significance, though it retains its negative sign.  
394 Concerning the industry segmentation, the results of the penalized logistic regression also  
395 suggest that brewpubs are more likely to close, while the coefficient for microbreweries is  
396 not statistically different from zero. These results are available in the Appendix  
397 accompanying this manuscript.

398           There are two primary limitations to our empirical estimation. First, there is likely an  
399 issue of self-selection into the treatment, where breweries that applied for and received PPP  
400 could have different characteristics than those breweries that did not. For example, the  
401 literature suggests there were selection issues related to the size of the firm and whether the  
402 firm had a pre-existing relationship with a bank (Granja et al., 2020). Secondly, our reliance  
403 on a cross-sectional analysis fails to capture the temporal dimension of loan dispersion and  
404 brewery closures. We acknowledge these limitations and discuss them in greater detail in  
405 Section 7 of the manuscript.

406

## 407 **5. Changes in annual production**

408 With their reliance on on-premise consumption, we anticipate that most breweries  
409 experience a decrease in annual production from 2019 to 2020 (Scott, 2021; Watson, 2020a).  
410 According to Watson (2020a), the majority of breweries halted or slowed production by late  
411 March 2020, and most breweries anticipated having to make layoffs. However, once a  
412 brewery receives a PPP loan, there is an immediate incentive to retain pre-pandemic  
413 employment and compensation levels to qualify for loan forgiveness. There are a finite  
414 number of jobs in a brewery, most of which are directly involved in beer production and  
415 packaging. Thus, breweries would struggle to reallocate labor if production stagnated.

416           Craft beer can maintain quality in cold storage for up to five months (Sierra Nevada  
417 Brewing Company, 2022). Thus, after receiving a PPP loan, a brewery can retain staff and  
418 adjust production based on future expectations despite short-term revenue decreases.  
419 However, for breweries that do not receive PPP, or for breweries that are waiting to be  
420 approved, there is no such incentive. This could then lead to further delays in production,

421 translating to more substantial declines in YoY production. As such, we hypothesize that a  
422 brewery that receives a first-round PPP loan will, on average, experience a smaller decline  
423 in production in 2020 compared to those that do not receive first round funds.

424 To test this hypothesis, we regress the change in YoY production from 2019 – 2020  
425 on a vector of explanatory variables using traditional ordinary least squares. The key  
426 explanatory variable is an indicator variable that specifies whether a brewery received first-  
427 round PPP funding (first or second tranche). Attention is only given to the first-round loan  
428 because these funds were available as early as April 2020 while second-round funds (third  
429 tranche) were not available until January 2021. Thus, second-round funds have no bearing  
430 on 2020 production levels. As was done when predicting a firm’s operational status, we also  
431 include brewery segment and firm- and county-specific controls.

432 Using 2019 and 2020 production data for active breweries, we analyze how YoY  
433 performance varied as a function of PPP funding. The sample consists of 5,555 breweries,  
434 and the results can be interpreted as the relationship between receiving first-round funding  
435 on YoY production conditional upon remaining in operation.<sup>19</sup> Table 5 presents these results.

436 [TABLE 5 HERE]

437 The positive point estimate on the treatment indicator suggests that, on average,  
438 breweries that receive a first-round PPP loan see a smaller decrease in YoY production than  
439 breweries that do not. Naïve regression analysis suggests a decline that is 3.5 percentage  
440 points smaller for first-round loan recipients. This translates to an average decline in

---

<sup>19</sup> We also ran the described specification including breweries that were closed as of July 2021. Unsurprisingly, results were more pronounced when we include breweries that closed since these breweries saw drastic declines in YoY production. As a result, we believe our approach to be the conservative empirical decision and dampens our estimated results.

441 production of 9.4% YoY compared to a 12.9% YoY decrease for those that do not receive  
442 first-round funding. With fixed effects, the magnitude of the point estimate increases from  
443 3.5 to 4.3 percentage points, meaning the relationship becomes more pronounced after the  
444 inclusion of important control variables.

445 While these results may suffer from self-selection into the treatment group and other  
446 potential confounding effects, our results suggest a positive correlation between PPP funding  
447 and relative performance.

448

## 449 **6. Quasi-experiment**

### 450 *6.1 Loan timing and YoY performance*

451 It is important to consider how the timing of loan approval could impact changes in YoY  
452 production. We assess whether the timing of the loan approval impacts 2020 performance  
453 by exploiting the natural break between the first and second tranche of PPP funding (Doniger  
454 and Kay, 2022). Specifically, we develop a quasi-experiment that compares the YoY  
455 performance of breweries that received first round funding in the last seven days of the first  
456 tranche (April 10 – 16, 2020) to breweries that received funding in the first seven days of the  
457 second tranche (April 27 - May 3, 2020).

458 Based on the rationale that a brewery has an incentive to retain employees once they  
459 receive a PPP loan—which could shift production decisions—we anticipate the period  
460 between the first and second tranche of funding to be a critical window in determining YoY  
461 performance. Specifically, we hypothesize that firms that receive first tranche funding will  
462 experience smaller declines in YoY production than firms that had to wait until second

463 tranche funding became available. If true, this would suggest that the timing of loan approval  
464 impacts a small business's YoY performance.

465 To motivate our framework, first recall that the first round of PPP funding consisted  
466 of two tranches, with the first tranche from April 3 – 16, 2020, and the second tranche from  
467 April 27 – August 8, 2020. Bartik, Cullen, et al. (2020) surveyed small businesses between  
468 April 25 – 27, 2020 regarding their decision to apply for PPP funding. Critically, their data  
469 collection occurred after the first tranche funding expired but before the second tranche  
470 funding was distributed. Of the nearly 4,000 small businesses in their sample that applied  
471 for first tranche funding, 25% of applications were approved, 24% were denied, and the  
472 remaining 51% were still pending. In other words, businesses with pending applications  
473 submitted their loan application before the first tranche of funding expired, yet their  
474 application was not approved (nor denied) until after the second tranche of funding was  
475 available.

476 While we lack the data on loan *submission* dates, Figure 2 shows that 78% of the  
477 approved second tranche loans come within the first seven days of SBA resuming loan  
478 approvals. This suggests a backlog of loan applications as first tranche funding expired but a  
479 rapid decline in PPP loan demand a week after second tranche funding resumed. It is then  
480 reasonable to expect that the majority of loan recipients that receive second tranche funding  
481 between April 27 – May 3, 2020 submitted their PPP loan application when first tranche  
482 funding was still available.

483 Our quasi-experiment restricts attention to breweries that received funding between  
484 April 10 – 16, 2020 and April 27 – May 3, 2020.<sup>20</sup> Under the identifying assumptions that  
485 businesses who receive funding before the structural break and after the structural break  
486 are similar and that the delay in approval did not affect loan demand, we are confident in our  
487 ability to assess the role of loan approval timing in the two weeks between tranches. These  
488 assumptions were validated in Doniger and Kay (2020).

489 The quasi-experimental group consists of 1,346 observations: 720 observations with  
490 first tranche funding and 626 observations with second tranche funding. Figure 4 shows the  
491 average production levels over time for our two groups.

492 [FIGURE 4 HERE]

493 Breweries that receive funding in the last seven days of the first tranche are larger  
494 than those that receive funding in the first seven days of the second tranche of PPP funding.  
495 In aggregate, both groups experience growth from 2018 to 2019. The group that receives  
496 first tranche funding experiences, on average, an 8.2% increase in production over this time  
497 period whereas the group that receives second tranche funding experiences a 6.0% growth  
498 rate. The difference between groups is exacerbated when comparing all first tranche loan  
499 recipients (April 3 – April 17, 2020) against all second tranche loan recipients (April 27 –  
500 August 8, 2020). Thus, while there appears to be inherent differences between the two

---

<sup>20</sup> We also restrict attention to breweries with production data from 2018 – 2020 to explore pre-trends We begin with the sample of 5,555 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). We also impose an upper-bound restriction on YoY production from 2018-2019 to mirror the restriction imposed on 2019-2020 YoY production changes. Lastly, we remove outliers that significantly skew our sample means by excluding breweries that produced below the 5<sup>th</sup> percentile ( $\leq 100$  bbls) and above the 95<sup>th</sup> percentile ( $\geq 7,757$  bbls) in 2018. Then, given the quasi-experimental setting, we only analyze observations with loan approval dates between April 10 – 16, 2020 or April 27 – May 3, 2020.

501 groups, analyzing this shorter window around the program’s structural break provides the  
502 best opportunity to understand the role of loan approval timing on performance.

503 Table 6 presents the results of the quasi-experiment where we regress the change in  
504 YoY production on a treatment indicator indicating whether the brewery receives first  
505 tranche funding between April 10 – 16, 2020; zero otherwise (i.e., April 27 – May 3, 2020).  
506 Given that each business in the quasi-experimental group receives PPP funding, we control  
507 for the loan approval amount, and we also include brewery-specific and county-level  
508 controls.<sup>21</sup>

509 [TABLE 6 HERE]

510 Results suggest that the breweries receiving first tranche funding between April 10 –  
511 16, 2020 experience a decline in YoY production that is 2-3 percentage points smaller than  
512 breweries that received second tranche funding two weeks later. These findings are robust  
513 to the inclusion of brewery and county-specific controls. Intuitively, these results are  
514 appealing as we can consider a brewery’s decision to adjust beer production based on  
515 whether they have received PPP funding. Watson (2020a; 2020b) suggests breweries shifted  
516 production schedules in March and April 2020. The decision to delay production between  
517 April 17 – 26, 2020 (i.e., the gap between tranches) is particularly attractive for breweries  
518 that do not receive first-tranche PPP funding. These breweries had experienced a decline in  
519 foot traffic and sales without governmental support. Therefore, breweries waiting for PPP  
520 funding may find it more economical to temporarily shut down or halt production until PPP

---

<sup>21</sup> County-level fixed effects are excluded given the sample size and diminished explanatory power. We also run the model presented in Table 6 with county-level fixed effects, and the magnitude of the point estimate is similar (0.025), though it loses statistical significance. By including the county-level FIPS codes in our regression, we are significantly reducing our explanatory power and increasing our standard errors, leading to lower t-statistics. The inclusion of county-level fixed effects here may also not be appropriate given that of the 1,346 observations across 577 counties, 321 counties (56%) are represented by a single observation.

521 funding arrives. But for breweries that did receive first tranche funding, they can use the loan  
522 proceeds to pay staff and adjust production despite the short-term revenue decrease. This  
523 framework would suggest that, amongst firms that received PPP funding, the period between  
524 tranches is critical in determining YoY performance. Put differently, the timing of loan  
525 approval mattered to YoY production outcomes.

526

## 527 *6.2. Propensity score matching*

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

536 In the quasi-experimental setting, we compare the change in YoY production for  
537 breweries that receive funding between April 10 – 16, 2020 (treatment) to breweries that  
538 receive funding between April 27 – May 3, 2020 (control).<sup>22</sup> We first run a probit model that  
539 predicts the probability of treatment as a function of: (i) county-level COVID-19 cases as of  
540 April 3, 2020; (ii) 2019 brewery production; (iii) the change in YoY production from 2018 to  
541 2019; (iv) the loan amount approved; and (v) the number of jobs reported in the PPP loan

---

<sup>22</sup> A more detailed overview of the propensity score methodology and results are provided in the Appendix accompanying this manuscript.



563 stratification matching; and the ten percent level for the nearest neighbor matching. Notice,  
564 however, that the point estimate and standard errors for the nearest neighbor matching are  
565 similar to the stratification method. The loss in statistical significance comes from the  
566 nearest neighbor method using only 351 (56%) of the 624 control group observations,  
567 placing more weight on the same observations and reducing the degrees of freedom in  
568 statistical analysis.

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

572

### 573 *6.3 Longer-run production changes*

574 The short-run relationship between PPP funding and changes in 2019-2020 production is  
575 this study's primary contribution. From a policy perspective, however, it is also important to  
576 explore the longer-run relationship between PPP funding and recovery. With 2021  
577 production data now available for a subset of observations, we provide a brief, exploratory  
578 assessment of how receiving a first-round PPP loan relates to brewery production from 2019  
579 – 2021.

580         Using the quasi-experimental sample, Figure 4 suggests that amongst this group there  
581 is a short-term benefit to receiving the PPP funding earlier (as discussed previously).  
582 However, the benefit appears to dissipate once we are a year removed from the shock. In  
583 other words, breweries that receive first tranche funding see a decline in 2019-2020 YoY  
584 production that was approximately three percentage points smaller than breweries that  
585 received second tranche funding. But when considering the overall change in production

586 from 2019 – 2021, however, both groups appear to have recovered to pre-pandemic  
587 production levels, on average.

588 It is critical to once again stress that these insights are exploratory. We can accurately  
589 construct a quasi-experiment that assesses the short-term impacts of PPP (Doniger and Kay,  
590 2022), but more work is needed to understand longer-term impacts. The statistics presented  
591 here do not account for important covariates or address additional confounders that may  
592 have arisen over the calendar year. Moreover, there are likely to be heterogeneous effects in  
593 longer-term production recovery, particularly when considering brewery size, the reduction  
594 in YoY gross receipts, etc., which are beyond the scope of analysis in this article. Quantifying  
595 the long-term effect of the program on performance should be an emphasis of future work.

596

## 597 **7. Limitations**

598 We identify two central limitations to our study. First, our analysis is limited by data  
599 availability. Specifically, we rely on a cross-sectional dataset, whereas a panel structure that  
600 accounts for temporal variation in closure dates would enable a more compelling causal  
601 interpretation for our LPM results. Unfortunately, we lack closure dates for all breweries  
602 classified as either temporarily or permanently closed in our dataset. It is also probable that  
603 active breweries were temporarily closed at some point during the pandemic (Cajner et al.,  
604 2020), and others may have adjusted their hours of operation to account for decreased  
605 consumer foot traffic (Watson, 2020c). Future research that accounts for the time of business  
606 closures across the life span of the PPP could better isolate the effect of receiving a PPP loan  
607 on operational status. Also, within the SBA dataset on PPP loan recipients, we observe only  
608 the loan approval date and not the date when the loan application was submitted. It is

609 reasonable to suggest that all loan applicants would have preferred earlier to later funding,  
610 and it is well established that demand for first-tranche PPP funding far exceeded the  
611 available supply. Yet, in the context of the quasi-experiment, we cannot definitively say that  
612 all loans approved in the first seven days of the second tranche had the same application date  
613 as those approved in the last seven days of the first tranche. If data on PPP loan application  
614 submission dates are made available, researchers could use that information to further  
615 address the pitfalls and unintended consequences stemming from the first-come, first-  
616 served design of the loan program.

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

627         With these limitations, it is plausible to question whether the breweries that received  
628 PPP funding would have survived without PPP. Given the different production levels and  
629 growth rates between those that receive PPP funding and those that did not, it is also possible  
630 that the breweries that experienced smaller declines in production were in a better position  
631 to adapt to production shocks from COVID-19 irrespective of PPP funding. Thus, while the

632 results suggest a positive relationship between PPP funding and small business  
633 performance, questions remain about the efficiency and equality of the loan distribution  
634 mechanism as well as the program's causal impacts.

635

## 636 **8. Discussion and implications**

637 The *I Can't Go Anywhere But Here IPA* by Proclamation Ale Company and *Zoom Casual IPA* by  
638 Denver Beer Company are just two of the COVID-19-inspired beverages created by small,  
639 independent breweries that have thus far survived the pandemic. However, not all small  
640 businesses were fortunate enough to outlast the early economic turmoil generated by the  
641 pandemic. Analysis suggests that the number of business owners in the United States fell by  
642 22% from February to April 2020 (Fairlie, 2020), and business closures were 25-33% higher  
643 in 2020 than in pre-COVID trends (Crane et al., 2020). As such, it is critical to explore whether  
644 the federal policies that provided economic relief to small businesses hit their mark.

645         The results suggest that receiving a PPP loan is associated with a higher probability  
646 of business survival and smaller declines in YoY production volume. These results are in line  
647 with previous findings on the PPP, where studies have suggested that PPP funding has led to  
648 a higher probability of survival (Bartlett III and Morse, 2020; Hubbard and Strain 2020),  
649 better employment outcomes (Bartik, Cullen, et al., 2020; Doniger and Kay, 2021), and  
650 smaller reductions in revenue (Li, 2021). More generally, our findings also coincide with the  
651 notion that sales for the hospitality and accommodation industries decreased substantially  
652 during the COVID-19 pandemic (Fairlie and Fossen, 2021b).

653         Industry reports support these findings, too. The craft beer industry experienced a  
654 9.3% decrease in volume, a 22% loss in dollar sales, and a 1.6 percentage point decline in

655 market share from 2019 to 2020 (Brewers Association, 2022d; Scott, 2020; 2021). Industry  
656 reports and anecdotal accounts have also highlighted the disproportionate effect the  
657 pandemic has had on brewpubs (Brewers Association, 2022d; Watson, 2022). Despite these  
658 statistics and the widespread concern from craft brewers at the start of the pandemic  
659 (Watson, 2020a; 2020b), brewery closures have been lower than expected (Brewers  
660 Association, 2022d). This ability to weather the storm is likely attributable to innovation,  
661 entrepreneurship, and government support (Fairlie, 2013; Watson, 2022).

662 Even within a single industry, different market segments may have been  
663 disproportionately impacted by the pandemic. In the context of craft beer, brewpubs closed  
664 at higher rates and experienced a steeper falloff in YoY production volume from 2019 to  
665 2020. This result is likely indicative of their inability to pivot to alternative packaging  
666 channels and distribution methods due to either financial or technological constraints  
667 (Watson, 2022).<sup>24</sup> Of course, the COVID-19 pandemic is a once-in-a-century outbreak and the  
668 speed at which the economic damages were felt made planning and preparation for this  
669 crisis particularly difficult. While most businesses were forced to adjust their business to the

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<sup>24</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. Further, 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 their original business model.

670 new environment, some businesses within an industry could have been more vulnerable to  
671 the shock given to their pre-pandemic business model.

672 The quasi-experiment also provides evidence that the timing of the loan approval  
673 mattered. Results to regression analysis and propensity score matching suggest at the causal  
674 effect of breweries that receive late first tranche PPP funding, on average, performing better  
675 in 2020 than those breweries that received early second tranche funding. If the timing of  
676 loan approval contributes to YoY performance, then this further raises concern over the first-  
677 come, first-served style of the loan program. In the quasi-experiment, firms that received  
678 first tranche funding were, on average, larger and located in counties with below-average  
679 COVID-19 cases in April 2020. This finding also holds when exploring the recipients of PPP  
680 loans more generally. In sacrificing targeting for timeliness (Autor et al., 2022b), the program  
681 disproportionately assisted businesses that had preexisting relationships with a bank  
682 (Bartik, Cullen, et al., 2020; Granja et al., 2020), supporting larger firms over small businesses  
683 (Humphries et al., 2020), and contributing to equality issues (Atkins et al., 2021; Autor et al.,  
684 2022b; Fairlie and Fossen, 2021a).

685 To our knowledge, we are the first to merge a verified industry dataset with the SBA  
686 data on PPP loan recipients. In doing so, we provide a methodological overview and speak to  
687 the challenges associated with achieving our objectives. COVID-19 was declared a national  
688 emergency on March 13, 2020, the CARES Act (Public Law 116-136) was passed on March  
689 27, 2020, and the first-PPP loan recipients were approved on April 3, 2020. The quick  
690 turnaround was imperative to small businesses, but bureaucratic shortcomings make it  
691 challenging to analyze the effectiveness of the program. For instance, each loan applicant had  
692 to list their “Borrower Name” on the PPP loan application. Yet, in some instances, the

693 borrower would list their name or their official company name rather than their trading  
694 name (i.e., *doing-business-as* name). This inconsistency meant imperfect information in the  
695 merging process, which then required the manual merging of data sources based on  
696 addresses and analysis of a company's trademarks.<sup>25</sup> Juxtaposing the PPP application with  
697 the Economic Injury Disaster Loan (EIDL) program application, EIDL applicants are required  
698 to specify both the legal name of the business and the trading name (if different from the  
699 legal name). If PPP loan applicants were asked to provide this information, it would have  
700 enabled a much cleaner merging procedure. Clarification, consistency, and the collection of  
701 all pertinent information across loan applications are critical for future loan programs to  
702 improve the functionality of governmental data.

703         Researchers analyzing the economic impact of the PPP must be cognizant of the  
704 delicacies of the NAICS code classification system and the presence of potentially fraudulent  
705 observations. While our attention is on the craft breweries—an industry that has its own six-  
706 digit NAICS code—we necessarily analyzed observations across three different NAICS codes.  
707 If we limited attention to the six-digit NAICS code for breweries (312120), we would have  
708 captured just 63% of our total matched PPP loan observations—severally underestimating  
709 the number of loan recipients. There were also several instances where breweries applied  
710 for both rounds of funding through the same bank yet were coded in different NAICS codes  
711 across the two applications (i.e., coded in NAICS 312120: Breweries in the first round and  
712 coded with 722410: Drinking places in the second round). Observations were also

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<sup>25</sup> Given the number of craft breweries in the United States, our manual matching procedures was practical. For a larger industry, such as matching across an industry dataset of all full-service restaurants, would be feasible, but more time consuming. However, the extra attention to remove improperly coded observations based on NAICS codes as well as potentially fraudulent observations allows for a more accurate representation of the impact of the PPP.

713 incorrectly into our population of interest (e.g., several wineries and distilleries were coded  
714 as breweries when each has its own NAICS code). Moreover, Beggs and Harvison (2022) and  
715 Griffin et al. (2022) suggest that the loan program was susceptible to fraudulent claims, and  
716 so researchers must be aware of their potential presence in the data. By addressing  
717 shortcomings related to the borrower name listed on the PPP loan application, matching  
718 across all pertinent NAICS codes, and removing incorrectly coded or potentially fraudulent  
719 observations, our methodology allows for a more accurate representation of PPP loan  
720 recipients by industry. This was only possible because of the externally verified universe of  
721 businesses that we received from the Brewers Association.

722

## 723 **9. Conclusion**

724 The PPP was established to incentivize small businesses to keep employees on payroll and  
725 to provide them some relief from economic damages from the COVID-19 pandemic. Using  
726 data from the Brewers Association and SBA, we explore the role of PPP funding on small  
727 business performance. Breweries that receive PPP funding are more likely to remain in  
728 operation and experience a smaller decrease in YoY production. Further, through a quasi-  
729 experiment that exploits a natural break in the loan program, we demonstrate that the timing  
730 of loan approval likely affected YoY performance. While we lack a full causal interpretation,  
731 our analysis provides support for a positive correlation between PPP funding and small  
732 business performance.

733 Several avenues remain for future research. While previous studies have explored the  
734 employment effects of the PPP (e.g., Autor et al., 2022a; Chetty et al., 2020; Hubbard and  
735 Strain, 2020), future work should link PPP and employment outcomes with YoY performance

736 or sales data to better understand the dynamic relationship between outcomes. The stated  
737 objective of the PPP was to keep workers on payroll, but in this study, we evaluate  
738 performance based on changes in annual production: a secondary policy outcome, but a  
739 primary concern for small businesses. The current analysis is limited by data availability,  
740 and future studies that causally link receiving PPP funding to employment and production  
741 outcomes would significantly improve our understanding of the program's effectiveness.  
742 Additionally, researchers have explored equality concerns over the distribution of PPP  
743 funding, but much remains unknown about the short- and long-term effects of the first-come,  
744 first-served approach of the loan program. For example, researchers could examine network  
745 effects in the PPP loan program across time, exploring PPP loan clustering and addressing  
746 the role of social networks. Lastly, future work should examine the impact of COVID-19 and  
747 the PPP on new businesses or businesses in planning. This line of research could provide  
748 critical insights into the roles of economic circumstances, government support, and  
749 entrepreneurship on new business performance during COVID-19.

750         The PPP provided support to small businesses across the country, and we are only  
751 beginning to answer the question of whether it hits its mark. Questions remain regarding the  
752 loan program's equality, efficiency, and causal impact, but as more researchers explore this  
753 line of research, we will gain a much clearer insight into the impact of the PPP on small  
754 businesses.

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## Tables and Figures

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

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

Note: The maximum loan amount for the 2<sup>nd</sup> round of funding was calculated as 2.5x the average monthly payroll for most businesses. However, businesses in accommodations and food services were allowed to use 3.5x the average monthly payroll.

**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%)
<b>Total</b>	<b>8,946</b>	<b>8,506</b>	<b>141 (1.6%)</b>	<b>299 (3.3%)</b>	<b>440 (4.9%)</b>

Note: The Small Business Administration began dispersing PPP loans on April 3, 2020. All closures up to April 3, 2020 are excluded from analysis, and so our 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.

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

Variable	Population	PPP funding				p-value <sup>a</sup>
		1 <sup>st</sup> round only	2 <sup>nd</sup> round only	Both rounds	None	
<b>Number of breweries</b>	<b>8,946</b>	<b>2,086</b>	<b>513</b>	<b>2,403</b>	<b>3,944</b>	---
<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, we restrict attention to observations that saw between a -100% and +100% change in YoY production from 2019 to 2020 to exclude outliers. In total, we analyze data from 5,877 observations, and the number of observations by group is as follows: 1<sup>st</sup> round only (1,526), 2<sup>nd</sup> round only (387), both rounds (1,886), and none (2,078).

<sup>c</sup> The number of observations for the ERS Amenities Score varies due to limitations in data availability. For example, data were not available for Alaska and Hawaii. Data were available for 8,842 observations, and the number of observations by group as are follows: 1<sup>st</sup> round only (2,059), 2<sup>nd</sup> round only (507), both rounds (2,369), and none (3,907).

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

<b>Variable</b>	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>
<i>PPP Funding</i>			
<i>FirstRoundPPP</i>	0.035*** (0.006)	0.035*** (0.007)	0.050*** (0.011)
<i>SecondRoundPPP</i>	0.051*** (0.008)	0.053*** (0.010)	0.074*** (0.014)
<i>BothRoundsPPP</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)
<b>N</b>	<b>8,946</b>	<b>8,946</b>	<b>5,877</b>
County-level fixed effects	No	Yes	Yes
Firm-level controls	No	No	Yes
R <sup>2</sup>	0.01	0.17	0.23

<sup>a</sup> Superscript \*\*\*, \*\*, and \* denote statistical significance at the one, five, and ten percent level, respectively.

Observations in specification (3) decrease from 8,946 to 5,877 due to data limitations and data outliers in the brewery production data.

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

<b>Variable</b>	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>
<i>FirstRoundPPP</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)
<b>N</b>		<b>5,555</b>	
County-level fixed effects	No	Yes	Yes
Firm-level controls	No	No	Yes
R <sup>2</sup>	0.00	0.29	0.33

<sup>a</sup> Superscript \*\*\*, \*\*, and \* denote statistical significance at the one, five, and ten percent level, respectively.

**Table 6.** Quasi-experimental results on change in brewery annual 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)

<b>Variable</b>	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>
<i>Early (April 10 – 16, 2020)</i>	0.027** (0.012)	0.036*** (0.012)	0.034*** (0.012)	0.030** (0.012)
<i>log(PPPFunds)</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)
<b>N</b>	<b>1,346</b>			
County-level controls	No	No	Yes	Yes
Firm-level controls	No	No	No	Yes
R <sup>2</sup>	0.00	0.02	0.02	0.09

<sup>a</sup>Superscript \*\*\*, \*\*, and \* denote statistical significance at the one, five, and ten percent level, respectively.

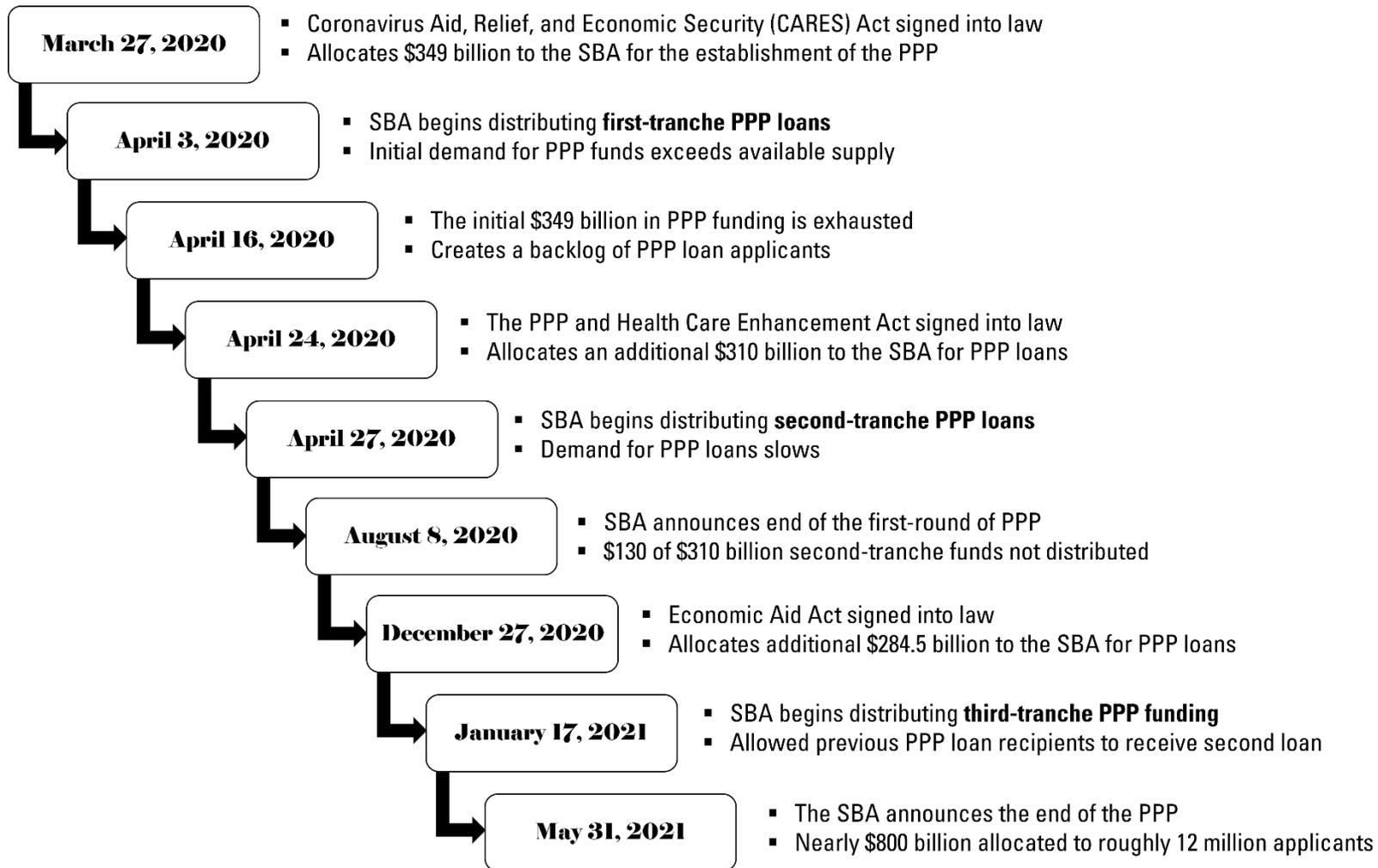
**Table 7.** Propensity score matching results

<b>Method</b>	<b># of observations used</b>		<b>ATT</b>	<b>Std. error</b>	<b>t-statistic <sup>a</sup></b>
	<b>Treatment</b>	<b>Control</b>			
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 one, five, and ten percent level, respectively.

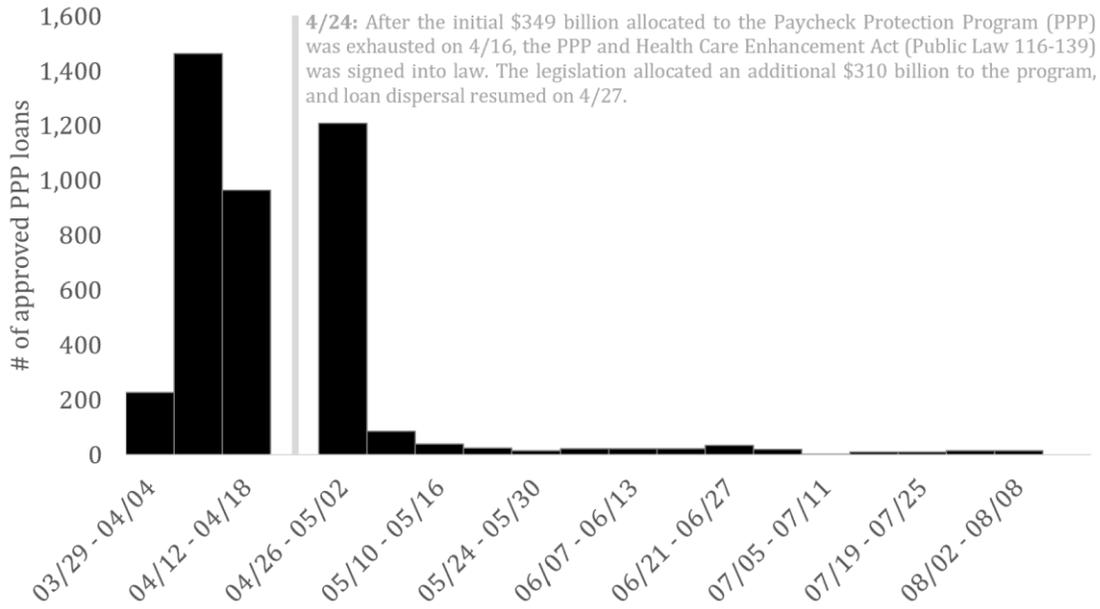
<sup>b</sup> Results presented use one-nearest neighbor matching procedures. When using  $k$ -nearest neighbor with  $k = \{2, 3, 4, 5\}$ , results suggest an ATT of similar magnitude with statistical significance that varies at the one, five, and ten percent level.

# PPP Timeline: Key Dates

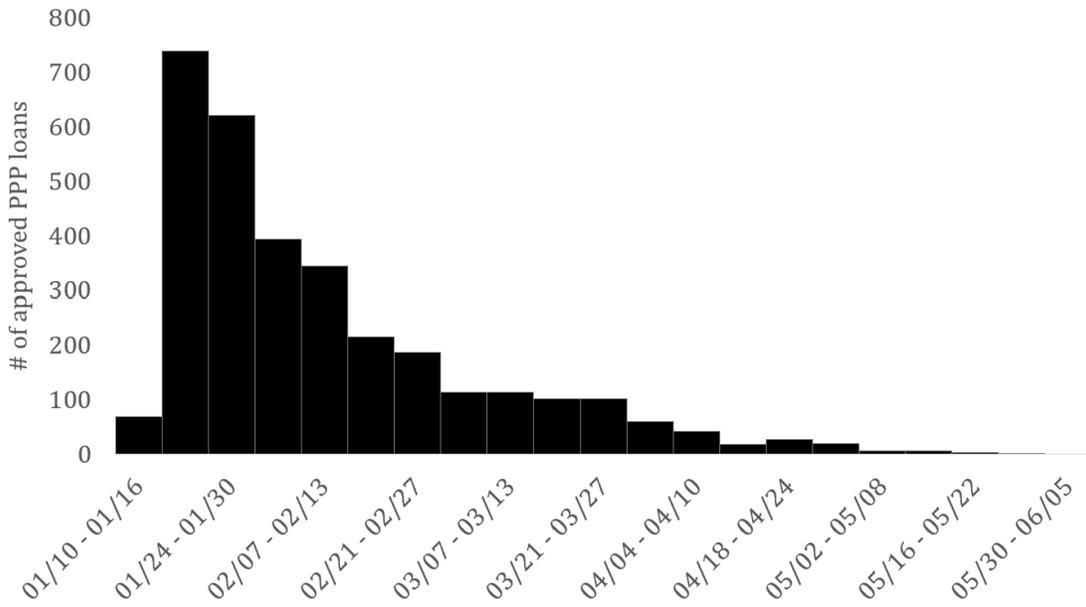


**Figure 1.** Timeline of key dates in the Paycheck Protection Program (PPP)

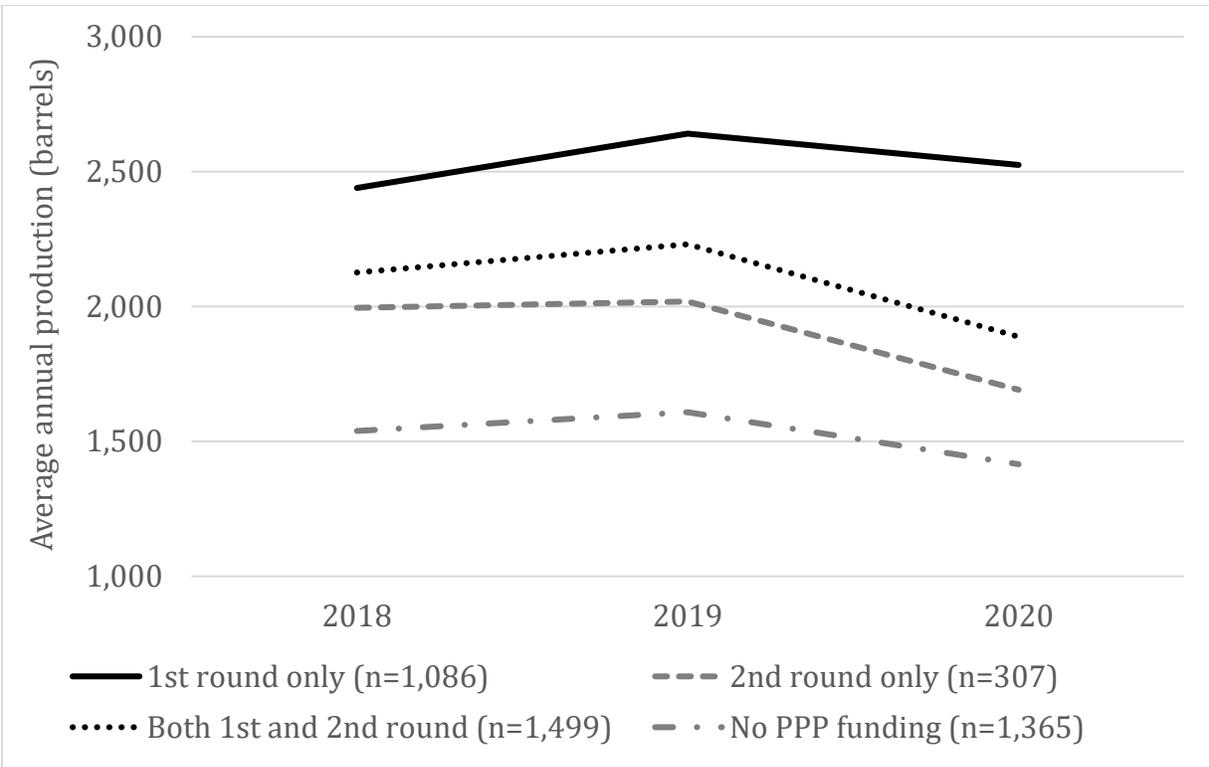
*Panel A. PPP approved and distributed loans: April 3, 2020, to August 8, 2020*



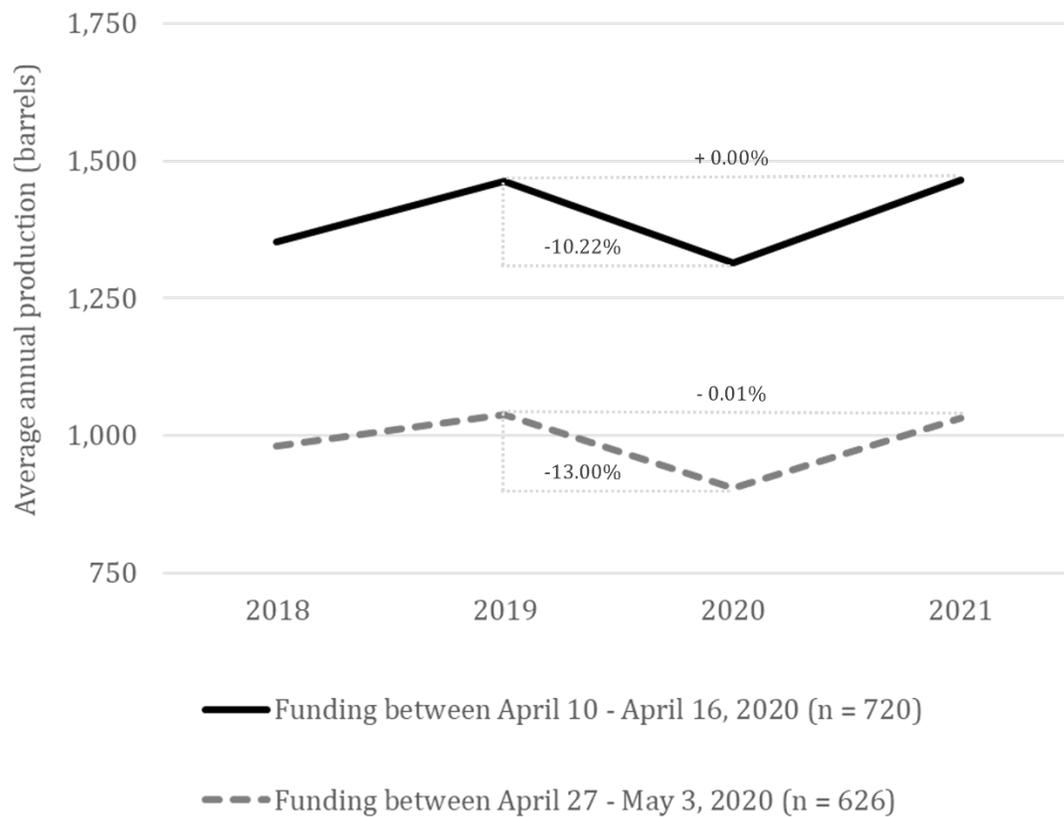
*Panel B. PPP approved and distributed loans: January 15, 2021, to May 31, 2021*



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



**Figure 3.** Average annual production (barrels/year) by PPP funding, 2018-2020 (n = 4,257)



Note: 2021 production data are only available for 1,262 of the 1,346 breweries included in the quasi-experiment. Of these 1,262 breweries, 677 received funding between April 10 - April 16, 2020, and 585 received funding between April 27 - May 3, 2020.

**Figure 4.** Average annual production (barrels/year) of breweries that received PPP funding between April 10 - 16, 2020, and April 27 - May 3, 2020 (n = 1,346)