An Evaluation of the Paycheck Protection Program Using Administrative Payroll Microdata*

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Abstract

The Paycheck Protection Program (PPP), a principal element of the fiscal stimulus enacted by Congress in response to the COVID-19 economic shock, is intended to assist small businesses to maintain employment and wages during the crisis. An obstacle to assessing whether the PPP achieved this goal is the absence of granular, high-frequency employment data that can precisely capture any causal effect of the PPP on employment. We use administrative data from ADP—one of the world's largest payroll processing firms—to contrast the evolution of payroll employment at PPP-eligible and PPP-ineligible firms, where eligibility is determined by industry-specific firm-size cutoffs. We estimate that the PPP boosted employment at eligible firms by 2 to 4.5 percent, with a preferred central tendency estimate of approximately 3.25 percent. Our estimates imply that the PPP increased aggregate U.S. employment by 1.4 million to 3.2 million jobs through the first week of June 2020, with a preferred central tendency estimate of about 2.3 million workers. In an alternative analysis, we identify the effect of the PPP from a set of firms for which we can observe loan take-up and obtain results at the upper end of the range of estimates. Although the evidence is supportive of a causal effect of the PPP on aggregate employment, we are careful to highlight puzzles where they occur and view our work as preliminary in nature. Future work will leverage loan-level PPP data to calibrate the relationship between eligibility, take-up, and employment.

1 Introduction

The COVID-19 viral outbreak caused economic activity in the U.S. to plunge precipitously. In response, Congress quickly enacted fiscal stimulus on an unprecedented scale. One of the key pillars of this stimulus is the provision of aid to small businesses through the Paycheck Protection Program (PPP).[1] The PPP is primarily intended to permit these businesses, many of which lack access to credit in the economically strained environment, to maintain employment and wages.

The PPP is structured as a guaranteed loan program. Qualifying firms apply to a participating private lender; once the loan is approved by the Small Business Administration (SBA), the lender must quickly distribute the funds to the firm. Significantly, the loans are forgivable if the firm meets certain criteria, including maintaining employment and wages at roughly pre-pandemic levels.

The PPP has faced widespread criticism. Many observers have contended that opacity and confusion with regard to the forgiveness rules has hampered take-up (e.g., Cowley, 2020). Others note that it is not well structured for certain industries, such as restaurants (e.g., Splitter, 2020). Researchers have documented that PPP aid has disproportionately flowed to areas relatively less economically hard hit by the virus (e.g., Granja et al., 2020). Negative publicity surrounded the fact that many relatively larger, publicly-traded firms received loans through the program (Cororaton and Rosen, 2020; Whalen, 2020). Finally, others contend that the increased flexibility introduced into the program after its introduction has reduced the likelihood it will support employment (Klein, 2020).

Taking a step back from the details of its design and implementation, however, the PPP is a stimulus program and such efforts are often judged based on the broad criteria of whether or not they are targeted, timely, and temporary (e.g., Elmendorf and Furman, 2008). The PPP is explicitly temporary and was also timely as it delivered an *extraordinarily* large amount

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[1]Other important pillars include the expansion of the scope and generosity of the Unemployment Insurance Program and the distribution of stimulus payments to households.

of stimulus—exceeding \$500 billion—over a brief two-month period.[2] The magnitude of PPP loans is equal to roughly two-thirds of the cost of the *entire* American Recovery and Reinvestment Act of 2009—the principal fiscal stimulus legislation passed in response to the Great Recession. The evidence to date suggests the PPP was certainly not perfectly targeted in terms of reaching only firms or regions in the most need; even so, it was delivered to a substantial number of small and mid-size firms, many of which were likely facing acute liquidity needs. Its efficacy is not self-evident because it depends on whether the firms receiving PPP loans would have enacted larger reductions in employment and payroll absent PPP.

This paper aims to provide an early assessment of the PPP's efficacy in sustaining employment at small firms. A significant obstacle to this assessment is the lack of publicly available, granular, high-frequency employment data. We clear this obstacle by using administrative data from ADP—one of the world's largest providers of cloud-based human capital management services—to measure weekly employment changes at the firm level through the first week of June of this year. The weekly frequency of these data allow us to observe changes in employment at precise points in time, such as the passage of the PPP program into law and the commencement of PPP loan disbursements. The granularity of the data permit us to identify which firms are likely to be eligible for PPP receipt as a function of their pre-PPP employment and industry affiliation, both of which affect eligibility.

Our preliminary analysis uses a dynamic difference-in-difference event study framework to identify the effect of PPP on employment. We focus on firms in a range below the PPP's maximum eligibility size threshold to form the treatment group. We compare them to firms in a range above the threshold, which forms the control group. To account for confounders stemming from rapidly evolving economic conditions across industries and states during the COVID crisis, our primary analysis includes three-digit NAICS-by-week and state-by-week fixed effects. Inclusions of these detailed industry, geography, and time dummies means that

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[2]As of July 17, 2020, the Small Business Administration had approved more than \$518 billion in total loans through the PPP.

we contrast firms above and below the PPP eligibility threshold within relatively narrow industry and state groups in each weekly time interval. This helps to ensure that our estimates are not confounded by industry-specific and state-specific patterns of employment deriving from the effects of lockdowns, stay-at-home orders, critical industry exemptions, and geographical differences in the path of the pandemic. We further underscore that because our primary outcome measure, the evolution of firm-level employment in the immediate time window surrounding the passage and implementation of PPP, is identified by within-firm changes in payroll employment, the analysis is immune to potentially confounding shifts in the composition of firms remaining operational during the crisis.[3]

Because we have not yet completed the process of anonymously matching administrative payroll records from ADP to administrative records on PPP take-up recently released by the Small Business Administration (SBA), our primary results contrast eligible firms to ineligible firms without accounting for take-up. Our primary analysis can thus be thought of as reduced-form estimation of the causal effect of PPP receipt on employment.[4] That said, loan-level data and survey evidence suggest that a significant majority of eligible firms—on the order of 70 percent—applied for and received a PPP loan, which is consistent with the vast cash disbursements made by the program. Future work will further utilize the firm-level PPP loan data that the SBA has recently released for loans above $150,000 to probe the relationship between eligibility and take-up across industry, firm size, and location during the duration of the PPP, including its first and second tranches.

Our results indicate that the PPP boosted employment at eligible firms. Following the passage of the CARES Act, employment at eligible firms begins rising relative to employment at ineligible firms. Through the first week of June, our estimates suggest that the program had boosted employment at eligible firms by between 2 percent to 4.5 percent, with

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[3]See, e.g., Baek et al. (2020), Bick and Blandin (2020), Cho et al. (2020), Coibion et al. (2020), Goolsbee and Syverson (2020), and Murray and Olivares (2020) for analyses of the impact of COVID-19 and the shutdowns on employment.

[4]Were suitable data available, we would use PPP eligibility as an instrumental variable for PPP take-up, which would allow us to estimate the effect of the PPP treatment on firms treated that were treated PPP. Absent firm-level data on take-up, our reduced-form models correspond to intent-to-treat estimates.

a preferred estimate of roughly 3.25 percent. The upper range of this effect, once scaled by the estimated take-up rate, is 7.5 percent, which is below a rough upper bound on the likely treatment effect on employment that we calculate using a subset of about 1,500 firms that we can identify as having received a loan from the SBA loan-level data. Under the perhaps strong assumption that our results can be generalized to the entire population of PPP eligible firms, our preferred estimate implies that the PPP increased aggregate U.S. payroll employment by about 2.3 million workers through the first week of June 2020.

Our results should be read as preliminary in three respects. First, we have not completed the matching of administrative payroll data to PPP take-up data, so we cannot yet assess whether the research design based upon employer eligibility accurately discriminates between firms that likely did and generally did not receive PPP loans. The complicated rules governing PPP eligibility left firms some maneuvering room as to how they met the size eligibility criteria, and it is plausible that whatever criteria firms chose to apply were accepted by the Small Business Administration and used to determine loan allocations. We accordingly present several sensitivity exercises to probe the robustness of the findings to (slightly) different ways of classifying eligibility.

Second, while the casual effects that we estimate are statistically significant, they are consistent with a reasonably broad range of outcomes. Our median point estimate implies that PPP raised payroll employment by 3.25 percent, measured by either headcount or hours. Depending on the width of the firm size window drawn around the eligibility threshold, however, we obtain estimates as large as 4.5 percent (using firms within 50 workers of the threshold) and as small as 2.0 percent (using firms within 250 workers of the threshold). This range of point estimates may reflect heterogeneity in either treatment effects or take-up rates (or both) among firms of different sizes. When our administrative match process is complete, we will be able to better adjudicate this ambiguity.

Finally, we detect one timing anomaly when focusing on the subset of firms that is immediately above and below the eligibility qualification threshold. Specifically, for firms within

a 100-employee (though not 50-employee) band of the eligibility threshold, the treatment effect appears to commence slightly before the passage of PPP, though it builds further from there. These deviations are negligible in aggregate, and may in fact be explained by the prominent pre-announcement of the not-yet-passed PPP policy by high-ranking Senators, as we discuss below. Our future work will probe this modest puzzle.

We highlight these uncertainties because of the high stakes surrounding the question, particularly given that the U.S. Congress is currently considering extending or modifying the PPP. We believe that the evidence that the PPP program raised aggregate U.S. employment is compelling (and would not report the findings otherwise). Nonetheless, we expect to refine both the analysis and interpretation as more and better data become available.

Our research is most closely related to the recent working paper by Chetty et al. (2020). These authors use the eligibility size threshold to identify the effect of the PPP program on employment, as we do here. In contrast to our findings, they conclude that PPP "had little impact on employment at small businesses." Two differences between Chetty et al. (2020) and our work may explain the seemingly discrepant conclusions. The first is differences in sample frames. Chetty et al. (2020) use data from the financial management application Earnin to capture employment of very low-wage workers; Earnin workers have median wages roughly equal to the 10th percentile of national wages in their industry. It's plausible that demand for workers in the lowest paid occupations—many of whom would likely be employed in food services, janitorial services, and housekeeping—was simply too negatively affected by the COVID crisis for the PPP to be a relevant stopgap option. In contrast, and as we discuss below, the ADP data used in this analysis offer a broad (though not perfectly representative) cross-section of U.S. private-sector payroll employment. A second difference between our analysis and that in Chetty et al. (2020) is precision. Though standard errors for the PPP analysis are not reported in Chetty et al. (2020), the visual summary of evidence reported in their paper does not appear to rule out causal effects on the order of those we report here, suggesting that the differences in our conclusions may reflect (in part) differences

in precision rather than magnitudes. Our future work will further reconcile these differences.

Our work is also related to Granja et al. (2020), who study the economic effects of the PPP using bank-driven differences in regional participation in the first round of the program. These authors do not find evidence that the first round of PPP loans had a substantial effect on local economic outcomes. A key difference between Granja et al. (2020) and the present paper is that we study firm-level outcomes whereas Granja et al. (2020) analyze outcomes at aggregated geographies such as counties. Understanding why these differing approaches yield different conclusions is an important item for inquiry.

Finally, recent work by Bartik et al. (2020) provides a preliminary analysis of the PPP using state variation in receipt of PPP loans along with data from the CPS and Homebase. These authors find evidence that the states with higher PPP loan approvals experienced smaller declines in employment and faster rehiring. As Bartik et al. (2020) stress, these findings leave open the question of causality since state-level PPP take-up may in part be driven by state-level economic conditions. For example, firms in less adversely impacted states might find it more advantageous to take PPP loans since they intend to maintain employment regardless. Our paper seeks to address this confounder by contrasting eligible versus ineligible employers within the same states and industries.

The paper proceeds as follows. Section 2 gives background details on the PPP. Section 3 presents the data used in our analysis. Section 4 presents graphical evidence. Section 5 presents the research design. Section 6 presents the results. Section 7 discusses the implications of our estimates for aggregte employment. Section 8 concludes.

2   The Paycheck Protection Program

In response to the unfolding economic crisis, legislators passed the Coronavirus Aid, Relief, and Economic Security (CARES) Act on March 27, 2020, which established the PPP. The CARES Act provided an initial appropriation of $350 billion towards PPP loans and the

subsequent Paycheck Protection Program and Health Care Enhancement Act, which passed on April 24th, added an additional $320 billion in appropriations.

PPP loans are designed to provide funds to small businesses to maintain their employment and wage rates similar to pre-crisis levels. Significantly, if the business meets a number of requirements, the loans are forgiven. Any business is eligible for the PPP if it meets the SBA's small business size standard. While this is typically defined as 500 or fewer employees on average over a year, it can be higher or lower depending on industry.[5] For the PPP, the size cutoff is defined as $\max\{500, c_{SBA}\}$, where c_{SBA} is the industry-specific threshold. For example, the threshold for businesses in the Couriers and Express Delivery Services industry is 1,500 rather than 500. Additionally, sole proprietors, independent contractors, and other self-employed individuals are eligible for PPP loans.

Businesses are permitted to draw loans worth up to 10 weeks of payroll costs up to a maximum size of $10 million dollars. Payroll costs include wage and salary compensation of all workers up to an annual rate of $100,000, as well as paid leave, health insurance costs, other benefit costs, and state and local taxes. Businesses are allowed some flexibility in determining their pre-crisis employment. They may choose to calculate average employment (including both full- and part-time employees) over the previous 12 months, over the 2019 calendar year, or, for seasonal employers, a comparable seasonal period from 2019.[6]

In order to receive loan forgiveness, firms must meet several criteria. The specific rules on forgiveness have evolved since the passage of the CARES Act, however, and there has been significant confusion among businesses and analysts over the specifics of the rules. We describe the current rules which are relevant for a business applying for forgiveness, and we note where these rules have evolved since businesses may have made PPP participation decisions based on earlier, preliminary versions of the rules.[7] First, the firm must have payroll

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[5]Businesses can also qualify for the PPP if their annual receipts are lower than a given threshold. For the purposes of this paper, we ignore this alternative revenue cutoff since we do not have data on annual receipts.

[6]Businesses not in operation in the comparable period in 2019 may choose the period between January 1, 2020 and February 29, 2020.

[7]The Paycheck Protection Program Flexibility Act, passed on June 4th but applied retroactively to

expenses over the 24 weeks after receiving the funds that are at least 60 percent as large as the loans. Second, the firm must have qualifying expenses—which include payroll expenses, utilities, rent, and mortgage payments—over the 24 weeks that are at least as large as the loans. Third, businesses must keep their average level of full-time equivalent employment over the 24-week window at least as high as it was prior to the crisis. Fourth, businesses must keep the wage rate of each employee at not less than 75 percent of its pre-crisis level. Loan forgiveness may be partial if one or more of these criteria are not met.

PPP loans are likely to prove financially attractive for a large number of firms. Many firms should be able to receive at least partial forgiveness. For example, since the requirement to spend 60 percent of the loan value of payroll is measured over 24 weeks, whereas the loan size is equal to $2\frac{1}{2}$ months (10 weeks) of payroll expenses, firms need only maintain average payroll expenses at one-quarter of their pre-COVID levels to meet this requirement. Several exceptions relax the forgiveness rules further. One notable example is that the third and fourth criteria (maintenance of employment and wage levels) are relaxed for businesses that either reduced payrolls between February 15th and April 26th or were unable to operate at the same level of business activity due to compliance with guidance from federal officials.[8] Additionally, firms' ability to qualify for loan forgiveness is not impaired if workers refuse a good-faith offer of employment. Even if borrowers are required to repay some fraction of PPP loans, the terms are relatively favorable. The first installment of the loan is deferred for six months and the interest rate is only one percent, which is much lower than the six to eight percent that is typical of the SBA's 7(a) loan program.

Table 1 conveys the scale of the PPP using data from the Census Bureau from 2017,

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previously-approved loans, extends the window over which loan proceeds can be spent to qualify for forgiveness from 8 weeks to 24 weeks and reduces the required share of the loan spent on payroll from 75 percent to 60 percent for purposes of forgiveness. The effects of the Flexibility Act on firm behavior is ambiguous. On the one hand, many firms received loans well before the Flexibility Act was passed and may have made decisions under the original rules. On the other hand, firms may have used the more flexible rules to spend additional funds on fixed obligations rather than payrolls, thus reducing the impact of the PPP on employment.

[8]Despite the third and fourth criteria being relaxed, firms must have payroll expenditures of at least 60 percent of the value of the loan to qualify for forgiveness which precludes a strategy of laying off workers until the very end of the window.

the latest year available. The PPP's \$520 billion in loans is roughly equal to $2\frac{1}{2}$ months of payroll *for all private-sector small businesses* supporting nearly 60.5 million employees as of 2017.[9]

2.1 PPP Take-up

Although the program was established in the CARES Act at the end of March, businesses could not start applying for loans until April 3rd. Businesses seeking PPP loaans apply through a participating lender that performs most of the verification prior to submitting the loan to the SBA for final approval. Once approved by SBA, the lender is required to disburse the loaned funds to the business within 10 days.[10]

The first tranche of the program, totalling \$350 billion, was fully approved by SBA as of April 16th. On April 27th, banks began accepting applications for the second tranche of appropriated funds. Since the middle of June, loan applications and approvals have slowed down. In total, almost 4.9 million PPP loans have been approved to date, for a total of \$518 billion in PPP aid disbursed.[11] Loan-level data recently released by the Small Business Administration provide some guidance on the take-up of PPP loans by firm size, which we compare to the distribution of firm size from the Business Employment Dynamics (BED) program of the Bureau of Labor Statistics (BLS) for 2019Q1 (the latest date available).[12] The top panel of Figure 1 shows the number of firms and the bottom panel shows the number of employees by firm size that received PPP loans compared to the BLS data on total firms.

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[9]This estimate of potential payrolls is an underestimate for a number of reasons, including that, in some industries, businesses with more than 500 employees could still qualify for PPP loans. We discuss these pointes below.

[10]Originally, some lenders were making an initial partial disbursement within 10 days but not making the full disbursement until later in order to delay the forgiveness reference period. However, at the end of April, guidance was issued that the full funds must be disbursed within 10 days of the loan being approved.

[11]At the end of June, the deadline for requesting a loan was extended from the end of June to the beginning of August.

[12]One important caveat is that firm size is missing or reported as zero for about 18 percent of loans reported in the data released by the SBA, and 13.5 percent for loans over \$150,000 for which firm identifiers are available. Thus, scaling the number of loans up by these fractions suggests that perhaps an additional 2,000 loans were made to firms between 250-499 covering an additional 860,000 employees. The missing or zero values for "jobs retained" appears to be uncorrelated with loan size for loans above \$150,000, as well as the state or industry of the firm receiving the loan.

Across the size distribution below 500 employees, between 62 percent and 85 percent of firms received PPP, and between 62 percent and 85 percent of employees were at firms that received PPP loans.[13] Below, when we exploit the eligibility threshold that is typically 500 employees, we will concentrate on PPP take-up just below 500, the histogram of which we show in Figure 2, which shows that about 6,000 loans were taken out by firms between 250-299, and about 2,000-3,500 loans were taken out by firms between 300-499. As a fraction of the total number of firms, between 62 percent to 72 percent of firms with 250-499 employees received PPP loans.[14]

Figure 3 examines the timing of the approvals of these loans by size of the firm. Over 85 percent of all PPP loans were approved by the end of the first week of May. The speed at which loans were granted varied with the size of businesses. By the middle of April, the SBA had already approved 70 percent of the eventual total number of loans granted to firms between 249 and 499 employees. In contrast, loans to smaller businesses did not reach 70 percent of their eventual total until early May.

Since the SBA approved the loans but did not disburse loan funds, the PPP loan-level data do not include information on the precise date that funds were disbursed.[15] In order to gauge the timing of disbursements, we examine the Census Bureau's *Small Business Pulse Survey*. Figure 4 plots the percent of respondents that requested and received a PPP loan over time.[16] In the last week of April—the first week that the survey was conducted—over 70 percent of firms had requested a PPP loan but only 40 percent of firms (57 percent of applicants) had received a PPP loan by the beginning of May. Over the next three weeks,

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[13]We use the BED data on firm size rather than the Census data because the firm size definition used by the BED is more appropriate to calculate take-up rates. The BED defines firms as a set of establishments with a common federal tax identification number (EIN) whereas the Census uses a concept of an enterprise which might group together multiple EINs. Since each EIN could potentially receive a PPP loan, a count of firms by EIN appears to be more appropriate as the denominator in the take-up rate calculation.

[14]This take-up rate is consistent with the results of the Census Bureau's *Small Business Pulse Survey*.

[15]Although banks were required to disburse funds within 10 days of approval, the lag may have varied over time, particularly early in the program when many banks were setting up the technical process for disbursements.

[16]The Census Bureau only surveyed small employer firms for the *Pulse Survey*, excluding non-employers such as independent contractors and other self-employed businesses, which are eligible for the PPP.

this gap shrank considerably. By the end of May, more than 90 percent of firms that had requested PPP assistance reported receiving it. Thus, although almost all PPP loans were approved by late April, a substantial portion of disbursements was not made until May.

3   ADP Data

We measure employment using anonymized and aggregated payroll data from ADP, which processes payrolls for over 26 million individual workers in the United States per month. Our ADP data are organized as a linked employer-employee panel. The raw weekly files contain de-identified information about each worker that received pay during that week at a given employer. In principle, we can observe a worker's employment status at a weekly frequency. However, most firms pay their workers on a biweekly, semimonthly, or monthly basis. Since we cannot precisely observe when a hire or separation occurred within a pay period, we simply count workers as employed for the duration of any pay period as long as they received any payment. This employment concept is the same one used by the BLS's *Current Employment Statistics* (CES) as well as by other papers using ADP data. Our panel starts the week of February 2, 2020 and currently extends through the week starting May 31st and ending June 6th.[17]

Critically for our purposes, ADP data also enumerate each firm's employment and industry affiliation. There is some ambiguity of interpretation when a firm stops appearing in the ADP payroll data, however. This could mean that the firm has permanently shut down, that it has temporarily suspended operations, or that it has continued operations without ADP's payroll services. We conservatively treat these sample exits as closures, meaning that we set employment to zero for firms that exit the sample for any reason.

The representativeness of the ADP data has been documented carefully in the literature.

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[17]Weekly data in the ADP are subject to substantial revisions due to the variability in pay periods across workers, and these revisions allow us to properly measure employment statuses for workers of all pay frequencies at each point in time. Without any data on workers who are paid monthly, the data for June are not yet reliably available.

Grigsby et al. (2019) show that the ADP data are broadly representative with respect to firm size, average wage level, demographics of workers, hourly versus salaried status, and frequency of pay. Cajner et al. (2020a) and Cajner et al. (2018) show that a closely-related firm-level dataset from ADP is also broadly representative with respect to industry composition, firm size, and geography, and that the aggregate employment dynamics in the ADP data mirror the business cycle-frequency dynamics in the official data over the Great Recession and the subsequent recovery. Cajner et al. (2020b) show that, among other things, indexes derived from the ADP data essentially matched the dynamics of the Bureau of Labor Statistics' monthly CES data since the beginning of the pandemic-induced recession. The ADP data track the contour of the COVID-related decline and recovery, moving in parallel with the CES data.

4 A Preliminary Look at the Data

We present a preliminary look at the weekly ADP data as an introduction to the empirical design in the following section. Firms are eligible for PPP loans if their employment (roughly speaking) in the prior year is either less than 500 or less than an SBA-specific size threshold (not less than 500). Our methodology will exploit this threshold rule to contrast employment outcomes at firms that are above versus below the SBA's industry-specific employment thresholds.

Figure 5 plots the evolution of firm-level employment by PPP eligibility; the top panel plots employment indexed to a firm's average level of employment in February for two size classes: 251-500 (in blue) and 501-750 (in red).[18] The results are consistent with the PPP having raised employment at eligible firms: employment declines symmetrically across firm size through the beginning of the crisis into April, falling by about 14 percent in both size classes. Once the PPP is in operation, however, the trajectories of these firms diverge, with

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[18]Firm size is assigned if average employment in 2019 and employment in February 2020 are within a particular bin. Firms in industries that have higher thresholds than 500 are excluded.

employment stabilizing more quickly and ending up around 2 percent higher in the firms that would likely be eligible for PPP. The bottom panel of Figure 5 provides further detail by including firms that are further away from the PPP eligibility threshold; the results reinforce the pattern seen in the first panel, with employment at firms between 101-250 employees maintaining nearly 4 percent higher employment levels than those 751-1,000 employees.

These simple figures are consistent with the hypothesis that the PPP program boosted employment at firms that were eligible to receive the loans compared to those that were likely not. A few caveats apply, however. First, not all size-eligible firms (those with employment below 500) applied for or received PPP loans. Therefore, the difference in employment outcomes for firms below and above 500 is likely to be *attenuated* relative to the causal effect of the program on firms that received it by dint of eligibility. Second, the divergence in employment above and below the eligibility cutoff could, of course, reflect factors other than the PPP. One particular concern is that larger firms concentrate in industries that were more affected by the COVID-related shutdowns. To address this concern, our primary empirical estimates will exploit variation in eligibility for PPP *within* relatively fine industry-by-week bins. Third, the cutoff for PPP loans is higher than 500 for a number of industries, a feature of the PPP-eligibility cutoff that we will explicitly incorporate into our empirical analysis below. (Firms in these industries are excluded from Figure 5.) We detail our estimation framework next.

5   Methodology

Our empirical strategy exploits the PPP eligibility size thresholds to identify the effect of the program on employment and other outcomes. In the spirit of Figure 5, we compare the outcomes of firms above and below the industry-specific eligibility threshold using an event study, or dynamic, difference-in-difference (DD) approach.

Because we do not observe loan receipt, our estimates instead contrast eligible versus

ineligible firms and thus constitute intent-to-treat effects. They will understate the causal effect of treatment on the treated to the degree that take-up is less then one-hundred percent among eligible firms, as we know that it is. A related challenge for inference is that firms seeking PPP benefits had some latitude as to how to define their own size, meaning that firms near the threshold may have systematically used a measure of firm size that rendered them eligible. This would also induce downward bias in our treatment effect estimate by placing some treated firms into our control group. Future work will use the loan-receipt data to address these issues.[19] The estimates from a sub-sample of firms where we observe loan take-up can be viewed as more directly capturing the effect of receiving a PPP loan—though in this case, the uptake of PPP loans is not quasi-experimentally identified. This alternative approach is discussed in Section 6.3 below.

A practical challenge to implementing our research design is accurately assigning firms to PPP eligibility status. The PPP allows firms some flexibility in choosing a window over which to define average employment for the purposes of meeting the threshold, including calendar year 2019, the trailing 12-month average prior to application, or various 12-week periods for seasonal firms. Since we do not have access to the precise data or rule used by firms for eligibility, we define PPP eligibility several ways: applying the industry-specific threshold to the monthly average of payroll employment for calendar year 2019 for all firms in our sample (thus requiring that we have at least 15 months of pre-PPP data for each included firm); applying the industry-specific threshold both to 2019 average employment and to February 2020 employment and excluding firms that exceed the threshold by one metric but not the other; and applying exclusively the February 2020 employment threshold to all firms.

In applying these classification rules, we are cognizant that mean reversion in firm size could potentially lead to spurious inference since both assignment to PPP eligibility and our outcome measure of primary interest are functions of firm size. Specifically, PPP eligibility

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[19]In particular, we will instrument loan receipt with the eligibility threshold as measured in the ADP data.

is based on firm-level employment, and the outcome variable is the (proportional) change in a firm's employment. To illustrate the issue this creates, consider two firms that both employ 500 workers, the assumed industry specific threshold for these firms in an average month. Hypothetically, one firm experiences a temporary 10 percent rise in employment in early 2020, causing it to be classified as PPP-ineligible for purposes of our analysis, while the other experiences a temporary 10 percent fall in employment in early 2020, causing it to be classified as PPP-eligible. In the ensuing months, both revert to their steady-state size of 500 employees. Because each was assigned to eligibility status based on its temporarily elevated or depressed employment level, mean reversion would make it appear that treatment caused the (temporarily) smaller firm to grow and the (temporarily) larger firm to shrink.

To avoid this pitfall, we focus on 2019 average employment as our key firm size measure since short-term employment fluctuations will tend to average out over the course of a year. In our preferred specification, we also exclude firms whose average 2019 employment was below 500 workers but whose February 2020 employment was above 500 workers or vice versa. These firms will tend to violate the pre-trend assumption embedded in the difference-in-difference methodology and exacerbate the mean reversion problem. We also experiment with using exclusively 2019 average employment or exclusively February 2020 employment as our classification variable. As documented below, our core findings prove robust to these choices.[20]

Operationally, we apply the following difference-in-difference event study specification to estimate the relationship between PPP eligibility and employment:

$$y_{it} = \alpha + \lambda PPP_i + \theta_{jt} + \theta_{st} + \sum_{t \in T} \beta_t (PPP_i \times \theta_t) + \varepsilon_{it} \tag{1}$$

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[20]The issue of mean reversion also presents a trade-off in the analysis between focusing on firms closest to the threshold, where eligible and ineligible firms are near-comparable in size, and focusing on firms further from the threshold, where mean reversion is unlikely to affect inference.. Mean reversion presents a potential confound only for firms that are sufficiently close to the threshold that temporary employment fluctuations may plausibly affect classification. For firms that are substantially above or below 500 employees, such fluctuations are unlikely to affect classification—so that mean reversion, if present, will not be correlated with assignment. We accordingly present a variety of estimates that include both narrow and broad contrasts of firms according to their distance from the eligibility threshold.

where y_{it} is total employment for firm i at week t indexed to equal 1 in February of 2020, θ_{jt} is a vector of NAICS 3-digit industry j–by–week t fixed effects, θ_{st} is a set of state s–by–week t fixed effects, θ_t is an overall time dummy for each week t, and PPP_i is an indicator variable equaling one if firm i is eligible for the PPP program based on the industry-specific size threshold (a time-invariant characteristic). Week t spans the period from the week of February 2nd through February 8th to the week of May 31st through June 6th (i.e., $T = \{2/2, 2/9, ..., 5/24, 5/31\}$)—covering the period prior to the crisis, the passage of the CARES Act (March 27th), and through the period when the PPP program was in effect. Standard errors are clustered at the NAICS 3-digit industry level. We weight the regressions by firm size in February 2020 such that the results can be interpreted as the effect of the PPP on mean employment (as opposed to employment at the average firm).

The time-varying β_t vector is the parameter of interest; it traces out the treatment effect of PPP eligibility. The treatment effect is likely to vary over time, both because receipt of PPP loans gradually ramps up over the period we examine and because it may take time for firms to bring workers back onto payroll. The industry-week fixed effects in the model control for time-varying shocks common to firms within a given industry. The state-week fixed effects control for time-varying shocks common to all firms in a state. Both of these sets of fixed effects are important for the estimation because industries were hit differently by the pandemic and because states imposed different social distancing rules and did so at different times.[21]

The identifying assumption of the model is that, absent the PPP, firms below the size-eligbility threshold would have experienced comparable employment growth or contraction to firms above the threshold, conditional on the covariates. Underlying trends in firm employment not due to the PPP, particularly those induced by social distancing policies and the broader economic downturn, are the most likely violation of this assumption. We address these potential violations of the identifying assumption in three principal ways. First,

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[21]In the Appendix, we present results with industry-state-week fixed effects.

the pre-CARES Act portion of the β_t vector provides a partial check against differential employment trends correlated with PPP eligibility. If PPP eligibility is not confouned with underlying trends, there should be no trend in the β_t vector in the pre-CARES Act period. Second, as discussed above, the inclusion of industry-week and state-week fixed effects controls for time-varying shocks associated with COVID-19 at both the industry and state level. Third, in order to render the treatment and control groups as comparable as possible, we limit the estimation sample to firms in various windows around the threshold, from between 50 to 250 workers.

As an initial check on the comparability of firms above and below the eligibility threshold, we present in Table 2 summary statistics for firms above and below their industry-specific thresholds. The rows of this table report average firm size, the share of employment that is female at firms that are above and below the cutoff, the fraction of employment that is hourly, the average workweek, average weekly pay per worker, and the average hourly wage rate. The first two columns of the table compare firms with employment levels that are within 250 workers above or below the PPP threshold, and the second two compare firms that are within 100 workers above or below the threshold. These informal comparisons show that firms above and below the eligibility threshold appear comparable prior to the crisis. We will formalize these comparisons in the next release of this paper.

6   Results

This section presents results in a series of four-panel figures arranged according to the size of the firm-size window above and below the eligibility threshold used for the contrast. Each panel presents estimates of the β_t vector for the different size windows, with the top-left panel showing the results for a window of ±250 employees from the SBA's industry-specific eligibility threshold, the top-right showing a window of ±150, the bottom-left showing a window of ±100, and the bottom-right showing a window of ±50. The shaded region in each

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panel corresponds to the 95 percent confidence interval around the point estimates.

6.1 Employment

The results in Figure 6 uniformly show a positive treatment effect of PPP eligibility on firm employment. Starting with the top-left panel, firms with up to 250 employees below the eligibility threshold perform remarkably similarly to firms with up to 250 employees above the eligibility threshold prior to PPP, with pre-trend point estimates consistently around zero. Once the PPP commences in the first week of April 2020, employment moves relatively higher at eligible firms, rising by about 2 percent through the beginning of May and remaining roughly stable thereafter.

Narrowing the firm-size window around the eligibility threshold yields somewhat larger point estimates, though the standard errors increase as the sample size falls. The top-right panel in Figure 6, which includes firms within 150 employees of the eligibility threshold, estimates a 3 percent relative employment gain at eligible firms by mid-May. The bottom panels of the figure, reporting results for firms within 100 and 50 employees of the eligibility threshold, show a highly comparable pattern, but with treatment effect estimates topping 4 percent by mid-May.

The flat pre-trends evident in Figure 6 suggest that the treatment and control groups were evolving similarly in the pre-PPP period and are supportive of a causal interpretation of the post-reform treatment effect estimates. That said, when the window is set to firms with employees within 100 of the eligibility threshold, the treatment effect point estimate moves up from zero during the week of the passage of the CARES Act. It is possible that this reflects anticipation of PPP implementation. Indeed, the β_t estimate immediately to the left of the CARES line in the figure captures employment in the week of March 22 to 28 as a whole. The CARES Act was passed by the Senate on March 25 and passed by the House and signed into law on March 27. Additionally, in the week prior to its passage by the Senate, there was widespread anticipation of and reporting on an SBA loan program for

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small businesses under 500 employees.[22] It is therefore possible that business owners below the threshold held off paring back on payrolls in anticipation of the loan program. Further, there is a clear jump upward in the treatment effect vector after PPP loans commence. This pre-treatment jump using the ±100 employee size window is the one anomalous finding in our analysis. We flag it for the sake of caution.

In Figure 6, the PPP effects as of the first week of June range from about 2 percent to about 4.5 percent. The estimates may vary for several reasons, including differential loan take-up by firm size and treatment effect heterogeneity by firm size. Using administrative data on PPP take-up, our ongoing work will adjudicate between treatment effect heterogeneity versus take-up heterogeneity as causes of the different effect sizes obtained when applying different firm size thresholds. Given this range of estimates, we take 3.25 percent as a preferred estimate, equal to the median point estimate in early June in Figure 6.

Appendix Figure A.1 replicates Figure 6 utilizing specifications that replace the industry-week and state-week fixed effects with a full set of industry-state-week fixed effects. These specifications are highly saturated and it is therefore notable that the point estimates are generally similar to those from the less saturated specifications. Although as expected they are less precisely estimated, they remain distinguishable from zero in most cases.

As an additional robustness test, Appendix Figure A.2 replicates Figure 6 while assigning PPP treatment and control status based solely on each firm's average employment measured over 2019. Appendix Figure A.3 does the same as Appendix Figure A.2 but uses each firm's employment as measured in February of 2020 instead of average 2019 employment. (In contrast, our primary results assign PPP status using *both* of these firm size measures.) Using either set of alternative classification criteria, these estimates are similar to our primary models in Figure 6.

As another check on our identification strategy, we perform a placebo test that exploits the fact that the size eligibility threshold for PPP loans varied across industries. While most

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[22]For example, both an *Washington Post* article on March 18th and a Tweet from Senator Marco Rubio on March 17th discuss the 500 firm size threshold.

industries had a threshold of 500, some industries had a higher threshold. We therefore do not expect to find a "treatment" effect at the 500 employee threshold for firms in these industries. These results are shown in Figure 7. To implement this placebo test, we start by limiting the sample to firms in industries with eligibility thresholds above 500 (the next largest threshold above 500 is 750). We then estimate equation (1) with $PPP_i = 1$ for firms with firm size less than or equal to 500. Put differently, we use the 500 employee threshold as the eligibility requirement for treatment in industries where the actual eligibility threshold is at least 750 employees. Reassuringly, the placebo treatment effect is estimated to be near zero in both the pre- and post-PPP period, which increases confidence in the validity of our research design.[23]

6.2 Total Hours and Total Wage Bill

Figures 8 and 9 estimate equation (1) with total hours and the total wage bill as the dependent variable, respectively. The estimates for total hours in Figure 8 show roughly the same pattern and magnitude as the treatment effect for employment from Figure 6 (which is reproduced in Figure 8 in red for easy comparability). This similarity suggests that the effect of PPP on employment was largely on the extensive margin of employment rather than the intensive margin of hours adjustment.[24]

Figure 9 plots the treatment effect of PPP eligibility on a firm's total wage bill, and these results show roughly the same pattern as employment. However, the estimated wage bill treatment effect appears to be slightly larger than the employment effect at the end of the sample period (approximately 3 percent for the former and 2 percent for the latter in the top-left panels of Figures 9 and 6, respectively). This indicates that PPP-eligible firms

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[23]In the placebo check, firms between 251 and 500 serve as the placebo treatment group, and firms that are between 501 and 750 serve as the control. The minimum actual PPP eligibility threshold for firms with a non-500 threshold is 750.

[24]The ADP measure of hours refers to hours paid rather than hours worked. It is therefore possible that firms reported that they were paying workers for the same hours, but, potentially for reasons related to shutdown orders, did not require work schedules of the same length.

may have retained relatively higher-paid employees towards the end of the sample.[25]

6.3   Preliminary Loan-Level Results

Our intent-to-treat estimates above make no use of information on PPP take-up. To gain initial insight into employment trends during the crisis among firms that received PPP loans, we have processed a subset of the PPP loan data released by the SBA on July 6, 2020. These data provide the names and addresses of all firms that received loans of \$150,000 or more. In this section, we present preliminary findings using the matched subset of PPP loan recipient firms. In particular, we contrast the evolution of employment at known PPP-recipient firms with the evolution of employment at firms that are above the PPP size-eligibility threshold. In order to match a firm from the SBA loan data to the ADP data, we first match firms in the loan data to their "DUNS" number—a business identifier provided by Dun & Bradstreet—through a string matching process on firm name and street address. Because string matching is computationally intensive and error-prone, we start by limiting the sample to firms whose reported size is within 250 employees of their industry-specific PPP eligibility cutoffs. To date, we have been able to match roughly 1,500 firms in the loan data to their DUNS numbers. In a second step, we anonymously match these firms with PPP loans to the same DUNS numbers in the ADP data.[26]

Using the anonymously matched SBA-PPP-ADP sample, we estimate the analogue of our baseline difference-in-difference specification. Here, we use only firms that we know received a PPP loan as the treatment group.[27] The control group remains the set of firms that are at most 250 employees above the eligibility threshold, as with our main models in Figure 6.

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[25]The PPP allows firms to cut wages for each employee by 25 percent without suffering a penalty for loan forgiveness. Nevertheless, wages do not appear to trend downward at PPP-eligible relative to PPP-ineligible firms, suggesting that PPP recipients may have infrequently exercised the option to implement large wage cuts.

[26]For reasons of protecting the anonymity of firms in the ADP data, we are not able to disclose the number of matches in the ADP data out of this subset of firms.

[27]That is, the only difference in the treatment group for this specification compared to the upper left panel of Figure 6 is that the treatment group is a subset of verified PPP recipients as opposed to all eligible firms within 250 of the maximum firm size threshold.

Firms that received a PPP loan exhibit significant relative employment growth following implementation of PPP relative to firms that were ineligible to receive a loan, as shown in Figure 10. In the pre-PPP period, there is no evidence of a violation of the parallel trends assumption with this set of firms: the point estimates hover near zero throughout the pre-CARES period. After PPP loans were disbursed, employment at PPP-receiving firms steadily moves upward relative to the comparison ineligible firms. Through the first week of June, PPP recipient firms increased their employment levels by 7.5 percent relative to ineligible firms.

Because these estimates are based on a subset of firms that *elected* to take a PPP loan, they are not identified by quasi-experimental variation. To the extent that firms that took PPP loans were those that intended to maintain headcounts during the crisis (perhaps because they were not adversely impacted), these estimates may overstate the causal effect of the PPP on employment.[28] To overcome this endogeneity concern, our future work will exploit the size-eligibility criteria to instrument for PPP loan receipt, thus resolving the endogeneity and mismeasurement issues simultaneously.

7   Discussion

As noted earlier, our primary models reported in Figure 6 are intent-to-treat estimates and reflect the effect of *eligibility* for PPP loans on employment. To benchmark what these estimates imply about the effect of treatment on the treated, we can scale up our intent-to-treat estimates from Figure 6 using an estimate of the take-up rate among eligible firms (and assuming implicitly that there is no take-up among ineligible firms). If we denote γ as the fraction of the eligible population that receives a PPP loan (the take-up rate), then a simple adjustment gives a Wald estimate of the treatment-on-the-treated: $\delta_t = \beta_t/\gamma$.

In Section 2.1, we estimated that γ is between 62 percent and 72 percent for firms with

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[28]The bias could potentially go in the other direction: if firms that received PPP loans were most in need of liquidity to survive, the PPP-taker sample would be adversely selected, and our estimates would tend to understate the positive effect of PPP on employment.

250-499 employees. Our intent-to-treat (ITT) estimates at the end of our estimation period ranged from about 2 percent to 4.5 percent of employment, implying a range of treatment-on-the-treated estimates of: $\delta_t \in [2.75\%, 7.25\%]$. The upper range of these estimates is comparable to the point estimate of 7.5 percent in Figure 10, obtained using the matched take-up sample. However, there is reason to suspect that the point estimate from the matched sample could be upward biased due to self-selection. If we treat that point estimate as a likely upper bound on the causal effect of PPP receipt, it suggests that our scaled ITT estimates are substantial in economic magnitude but not so large as to exceed the plausible upper bound seen in Figure 10.

7.1 Aggregate Effects

Armed with a range for the effect of PPP on employment between 2.5 percent and 7.25 percent, it is straightforward to estimate the implied effect of the PPP on total payroll employment:

$$\text{Total Payroll Effect}_t = \delta_t \times \gamma \times N, \tag{2}$$

where N is the number of employees at PPP-eligible firms. Using the Census Bureau's *Statistics of U.S. Businesses*, we estimate that roughly 70 million employees worked for a business eligible for a PPP loan in the beginning of 2020.[29] Using the range of coefficients, we estimate that the PPP raised employment in the aggregate by between 1.36 million and 3.20 million. Our preferred central tendency employment treatment effect estimate of 3.25

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[29]In particular, we calculate total payrolls in firms with less than 500 employees in the *Statistics of U.S. Businesses* (SUSB) data, about 60.5 million. Additionally, likely all employees in NAICS 72 are in firms that are eligible, so we add the number of employees in this sector at firms over 500 to the total (about 5.5 million). We further scale up this number by an additional 3 percent, corresponding to the growth in private payrolls between December 2017 (the last year of the SUSB data) and December 2019 in the BLS's *Current Employment Statistics* data. One complicating factor is that the SBA's size thresholds above 500 vary within two-digit NAICS industries, which is the finest level of firm size detail provided in the SUSB data. We estimate that around 3 million employees work in two-digit NAICS sectors at businesses for which some fraction of the sub-sectors have a threshold above 500 employees but below the relaxed threshold. Unfortunately, we cannot determine precisely how many of these 3 million employees work in the specific sub-sector making them eligible for PPP. Thus, in total, we estimate that between 68.1 and 71.2 million employees work for businesses eligible for PPP loans.

percent yields an aggregate employment effect of about 2.31 million workers.

There is an important caveat to the above calculation. Our treatment effect estimates represent *local* treatment effects around the eligibility threshold. However, the PPP may have left a markedly different imprint on firms away from the eligibility threshold. For example, smaller firms may have been relatively more cash constrained prior to the crisis and, as a result, PPP funds may have caused relatively more jobs to be retained in these firms. Alternatively, these firms may have been sufficiently vulnerable during the crisis that PPP was insufficient to keep them operational. We will be able to better benchmark the generalizability of our treatment effect estimates to the full population of PPP eligible firms as the matched PPP loan receipt data become available for our full sample.

Noting that the PPP has so far disbursed $518 billion in aid, our benchmark estimates imply that each job supported by the PPP cost between $162K and $381K through May 2020, with our preferred employment estimate implying a cost of $224K per job supported. While this is a substantial cost per job supported, it would be premature to offer a cost-benefit analysis of the PPP at this time. The long-run economic effect of the PPP will depend, in substantial part, on the evolution of employment at treated versus untreated employers over the longer run. PPP may, for example, have preserved valuable intangible capital, which would have positive long-run economic effects that are not detectable this early in the recovery process. An important and challenging set of questions is whether jobs and businesses supported by PPP will persist after the program ends; whether those businesses would have persisted absent PPP; and, had they been allowed to fail, whether new jobs and businesses would have rapidly emerged to replace them. Future work will seek to address these questions using outcome data over a longer time span.

8   Conclusion

This paper utilizes administrative data on employment from the payroll processing firm ADP in order to provide a preliminary assessment of the PPP's effect on employment at small firms. Using a dynamic difference-in-difference event study framework, we estimate that through the end of May the PPP increased the level of employment at eligible firms by between 2 percent and 4.5 percent. These estimates imply that the PPP boosted the level of private employment in the U.S. by between 1.4 and 3.2 million, with a mid-point of 2.3 million. Going forward, we will leverage the PPP loan-level data recently released by the SBA to refine and extend our approach.

Table 1: Firms With Fewer Than 500 Employees, 2017

	Firms	Employment	$2\frac{1}{2}$ Months Payroll ($)
Total Private Sector	5,976,761	60,556,081	521,449,419
Agriculture, Forestry & Fishing	22,535	136,591	1,124,746
Mining & Oil & Gas Extraction	18,720	244,367	3,707,711
Construction	700,393	5,373,702	59,522,179
Manufacturing	244,098	5,039,772	47,835,647
Trade, Transportation & Utilities	1,129,034	10,736,588	91,535,076
Information	78,430	984,379	14,433,836
Financial Activities	544,763	3,361,539	45,126,926
Professional & Business	1,170,857	9,368,738	108,232,178
Education & Health	742,837	10,630,121	81,539,312
Leisure & Hospitality	666,730	9,971,192	40,272,986
Other Services	695,268	4,697,878	28,058,288

Source: Census Bureau, *Statistics of U.S. Businesses.*

Table 2: Summary Statistics as of February 2020

	PPP Threshold ±250		PPP Threshold ±100	
	0-249 Below	1-250 Above	0-99 Below	1-100 Above
Employment	389.8	653.4	472.9	579.1
% Female	46.2	46.4	46.1	48.5
% Hourly	62.5	64.1	63.0	63.0
Weekly Hours Per Worker	36.8	37.4	37.3	37.2
Weekly Earnings Per Worker ($)	1,271.8	1,277.3	1,278.6	1,278.8
Hourly Wage Per Worker ($)	37.8	36.9	37.7	37.5
Sectors (%):				
Manufacturing	7.8	9.0	8.7	8.2
Wholesale Trade	8.2	9.0	8.1	10.4
Retail Trade	6.4	8.1	6.2	8.4
Financial Activities	9.1	9.1	9.3	8.0
Professional & Business	17.4	17.0	17.2	15.9
Education & Health	18.9	17.9	20.2	18.3
Leisure & Hospitality	6.6	6.9	6.4	6.7
Other	25.7	22.9	24.0	24.2

Note: Employment, weekly hours, weekly earnings, and hourly wage represent firm-level means for each column. Data are weighted by each firm's employment as of February 2020. Samples reflect firms that were present in the ADP data for all 12 months of 2019.
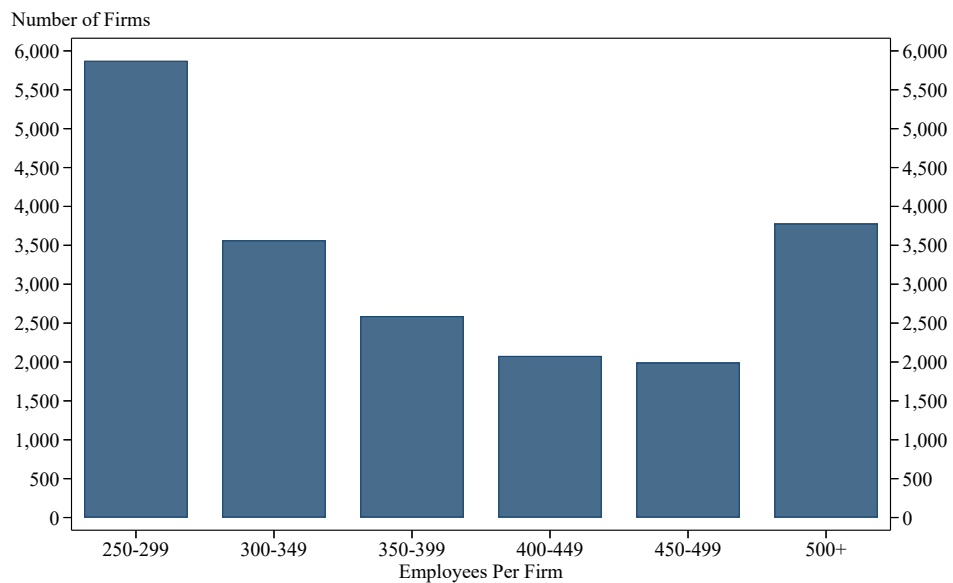Source: Authors' analysis of ADP data.

Figure 1: Distribution of PPP Loans by Firm Size, 1-499

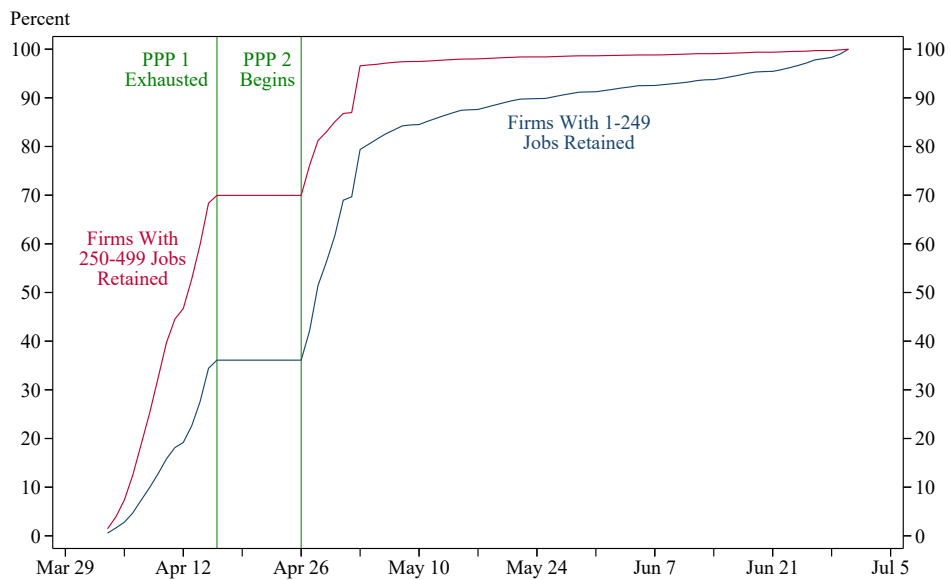Number of Firms (Thousands)

Number of Employees (Thousands)

Note: Data reflect PPP recipients that reported a positive number of jobs retained.
Source: Authors' analysis of SBA loan-level data release; Bureau of Labor Statistics, *Business Employment Dynamics*.

## Figure 2: Distribution of PPP Loans by Firm Size, 250+

Number of Firms

Note: Data reflect PPP recipients that reported a positive number of jobs retained. Firm size is top-coded at 500 workers.
Source: Authors' analysis of SBA loan-level data release.

## Figure 3: Cumulative Distribution of PPP Loan Approvals by Date

Percent

Note: Data reflect PPP recipients of loans of at least $150,000 that reported a positive number of jobs retained.
Source: Authors' analysis of SBA loan-level data release.

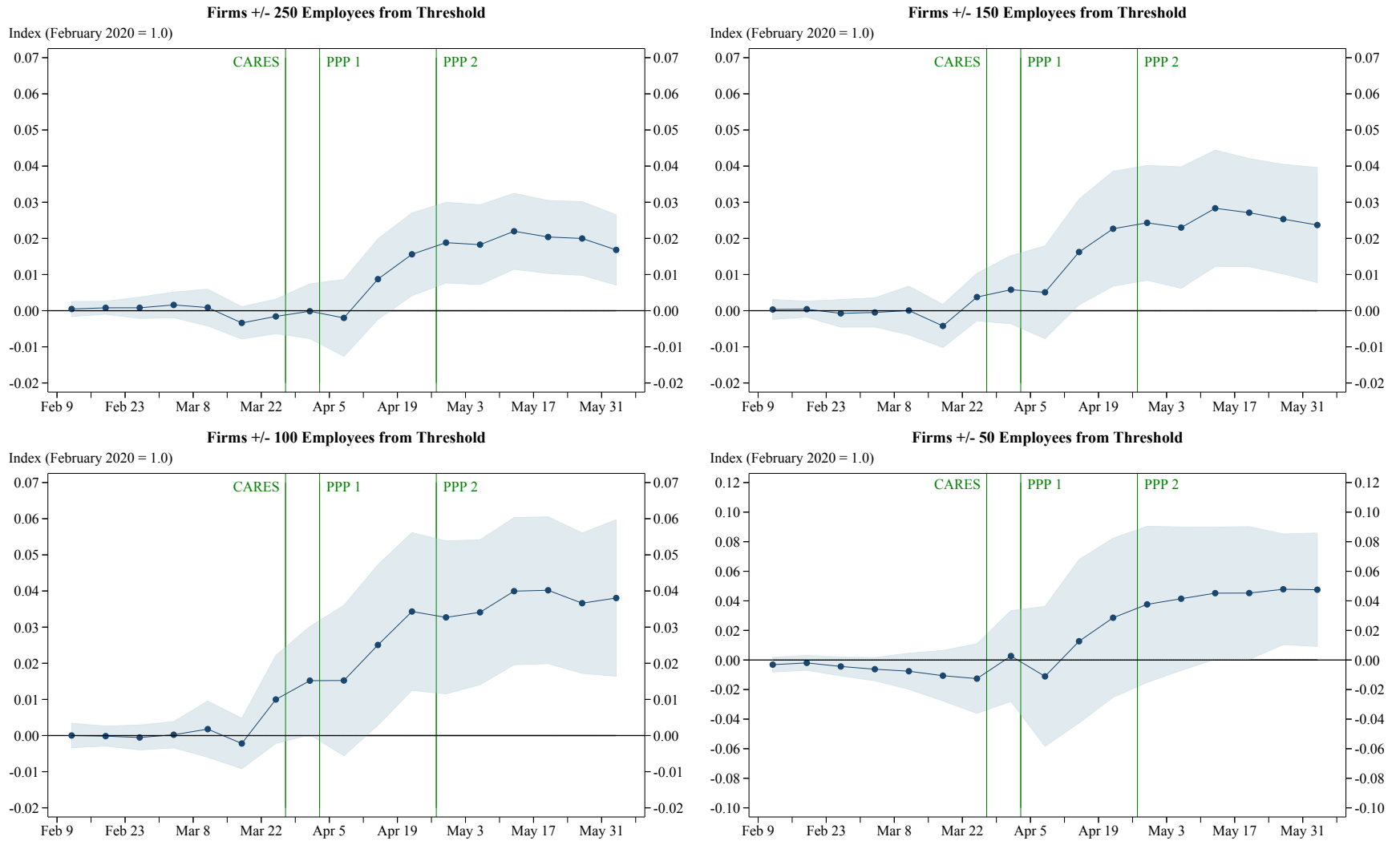**Figure 4: Reported Request and Receipt of Financial Assistance Through the Paycheck Protection Program**

Percent of Survey Respondents

Requested Financial Assistance

Received Financial Assistance
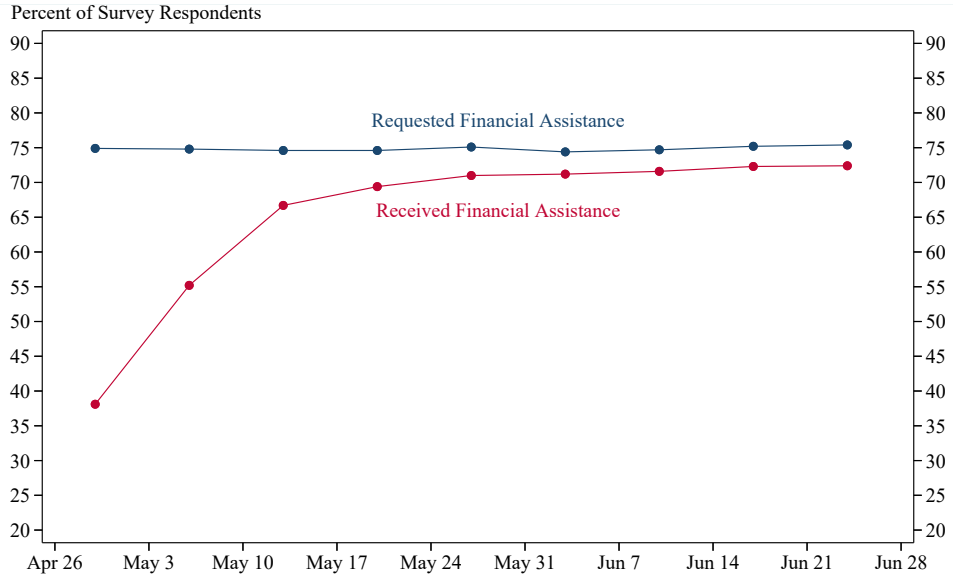
Source: Census Bureau, *Small Business Pulse Survey*.

Figure 5: Employment by Firm Size for Industries With PPP Eligibility at 500 Workers

Index (February 2020 = 1.0)

Index (February 2020 = 1.0)
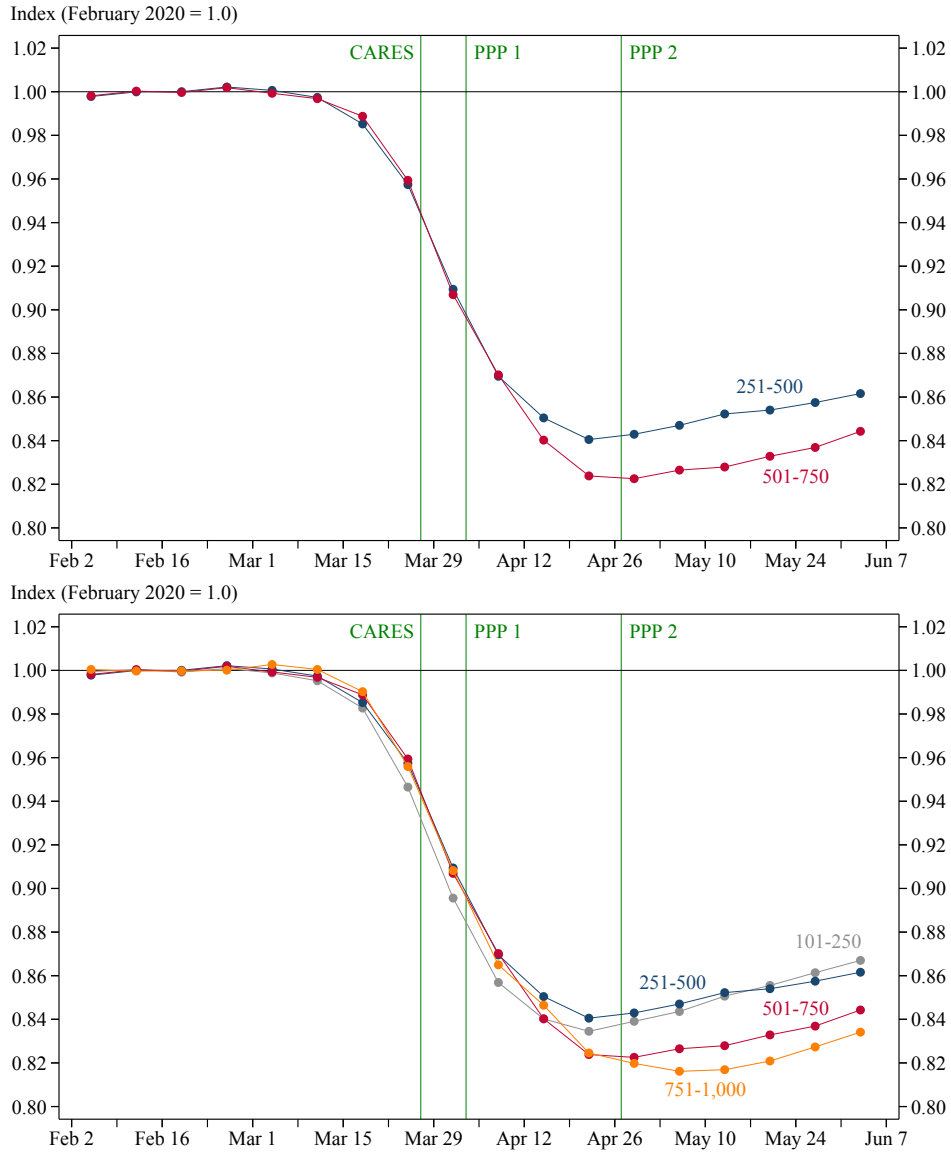
Note: Each series represents average employment for firms with that particular range of workers in both 2019 and February 2020. Data are weighted by each firm's employment as of February 2020. Sample reflects firms that were present in the ADP data for all 12 months of 2019.
Source: Authors' analysis of ADP data.

Figure 6: Effect of PPP Eligibility on Employment

Firms +/- 250 Employees from Threshold

Index (February 2020 = 1.0)

CARES PPP 1 PPP 2

Firms +/- 150 Employees from Threshold

Index (February 2020 = 1.0)

CARES PPP 1 PPP 2

Firms +/- 100 Employees from Threshold

Index (February 2020 = 1.0)

CARES PPP 1 PPP 2

Firms +/- 50 Employees from Threshold

Index (February 2020 = 1.0)

CARES PPP 1 PPP 2

Note: Each firm's size is determined using employment in both 2019 and February 2020. Regressions are weighted by firm size as of February 2020 and include controls for state-by-week and industry-by-week effects. Standard errors are clustered at the 3-digit NAICS industry level. Sample reflects firms that were present in the ADP data for all 12 months of 2019.
Source: Authors' analysis of ADP data.

Figure 7: Placebo Effect of Having 251-500 Workers on Employment for Firms With PPP Eligibility Above 500
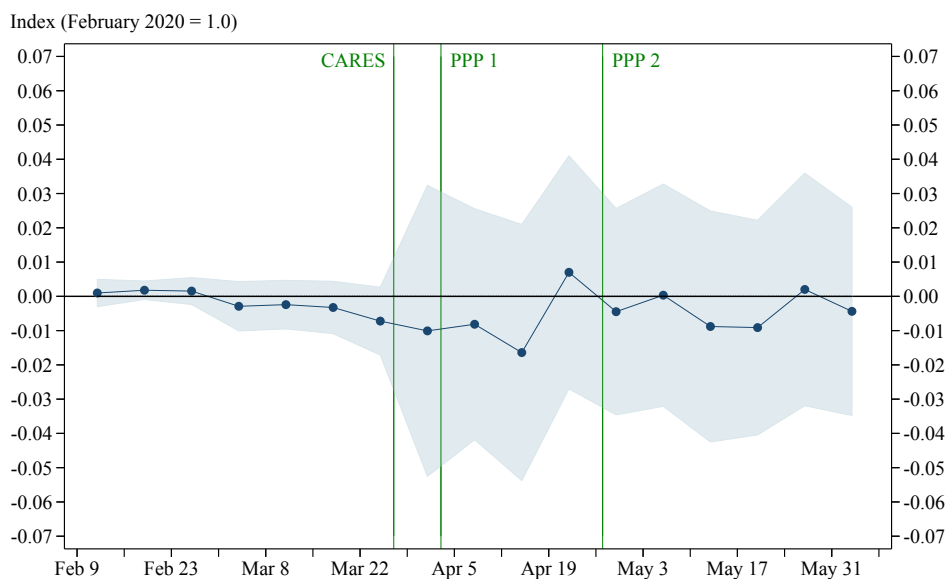
Index (February 2020 = 1.0)

Note: Each firm's size is determined using employment in both 2019 and February 2020. Regressions are weighted by firm size as of February 2020 and include controls for state-by-week and industry-by-week effects. Standard errors are clustered at the 3-digit NAICS industry level. Sample reflects firms that were present in the ADP data for all 12 months of 2019.
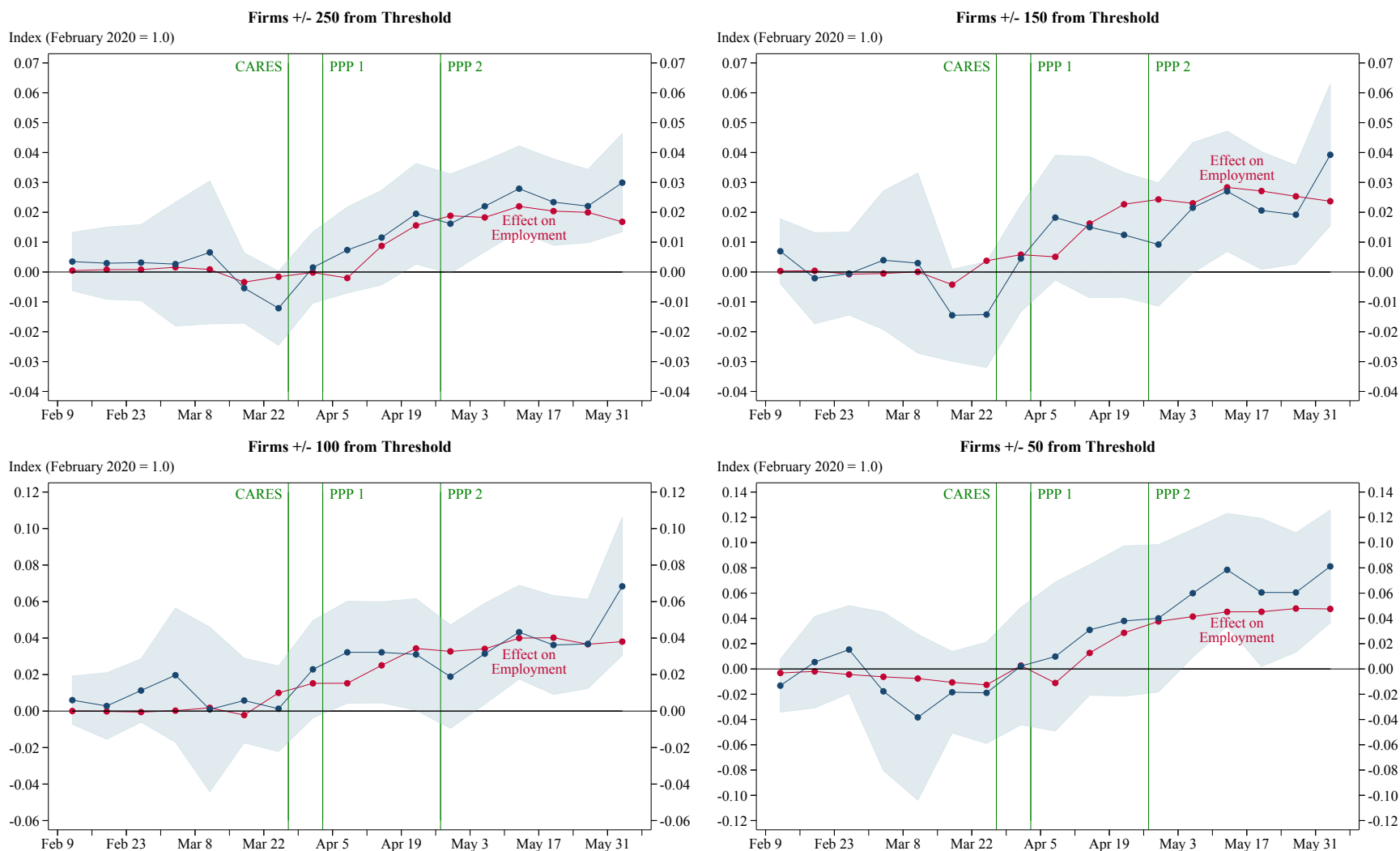Source: Authors' analysis of ADP data.

Figure 8: Effect of PPP Eligibility on Total Hours
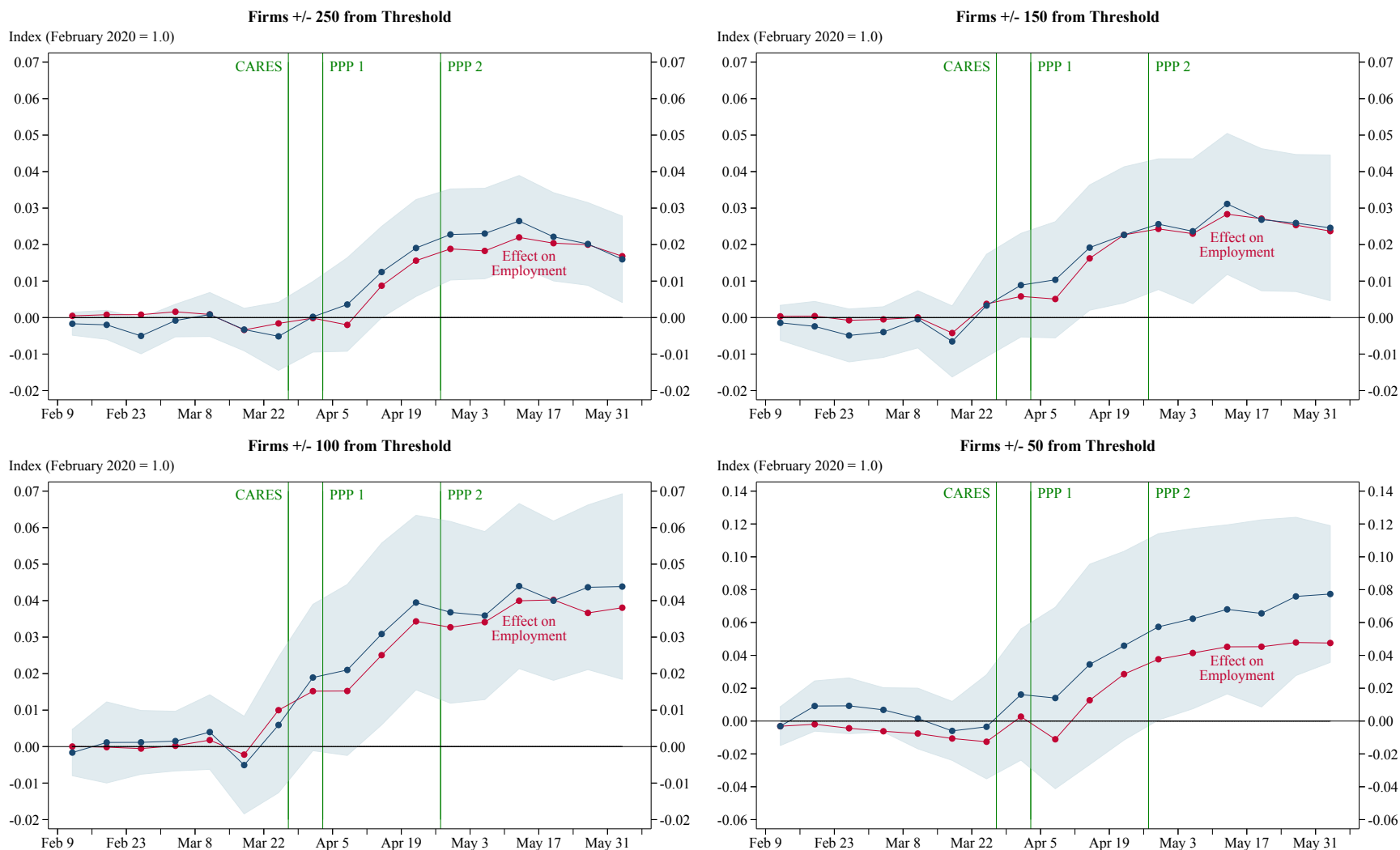
Note: Coefficients for total hours depicted in blue, and coefficients for employment depicted in red (equivalent to Figure 6). Worker-level hours data are winsorized at the top and bottom 1 percent of weekly observations. Each firm's size is determined using employment in both 2019 and February 2020. Regressions are weighted by firm size as of February 2020 and include controls for state-by-week and industry-by-week effects. Standard errors are clustered at the 3-digit NAICS industry level. Sample reflects firms that were present in the ADP data for all 12 months of 2019.

Source: Authors' analysis of ADP data.

Figure 9: Effect of PPP Eligibility on Total Wage Bill

Firms +/- 250 from Threshold

Index (February 2020 = 1.0)

Firms +/- 150 from Threshold

Index (February 2020 = 1.0)

Firms +/- 100 from Threshold

Index (February 2020 = 1.0)

Firms +/- 50 from Threshold

Index (February 2020 = 1.0)

Note: Coefficients for total wage bill depicted in blue, and coefficients for employment depicted in red (equivalent to Figure 6). Worker-level earnings data are winsorized at the top and bottom 1 percent of weekly observations. Each firm's size is determined using employment in both 2019 and February 2020. Regressions are weighted by firm size as of February 2020 and include controls for state-by-week and industry-by-week effects. Standard errors are clustered at the 3-digit NAICS industry level. Sample reflects firms that were present in the ADP data for all 12 months of 2019.
Source: Authors' analysis of ADP data.

Figure 10: Effect of PPP Receipt on Employment for Firms ±250 from Threshold

Index (February 2020 = 1.0)
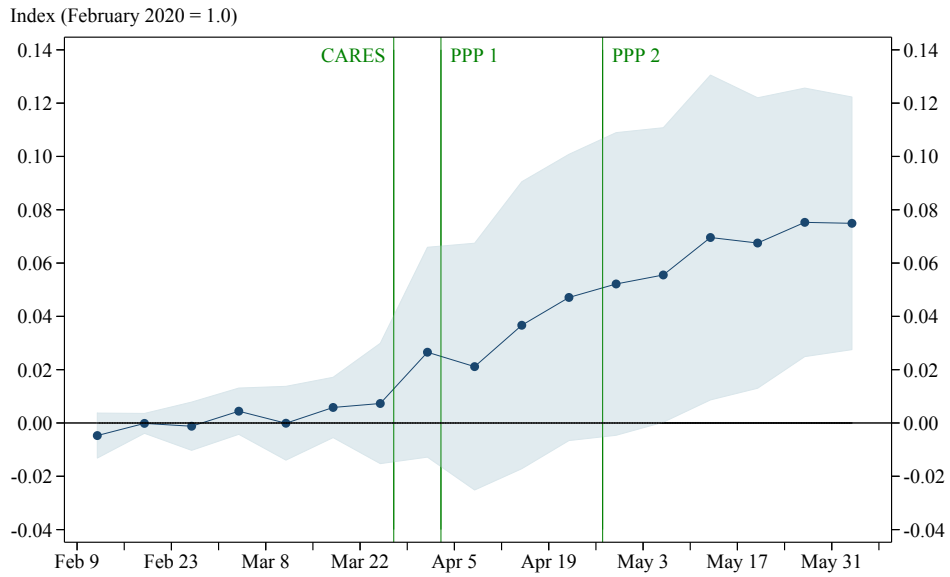
Note: Treatment group includes a subset of PPP recipients as identified in the SBA loan-level data release. Each firm's size is determined using employment in both 2019 and February 2020. Regressions are weighted by firm size as of February 2020 and include controls for state-by-week and industry-by-week effects. Standard errors are clustered at the 3-digit NAICS industry level. Sample reflects firms that were present in the ADP data for all 12 months of 2019.
Source: Authors' analysis of ADP data and SBA loan-level data release.

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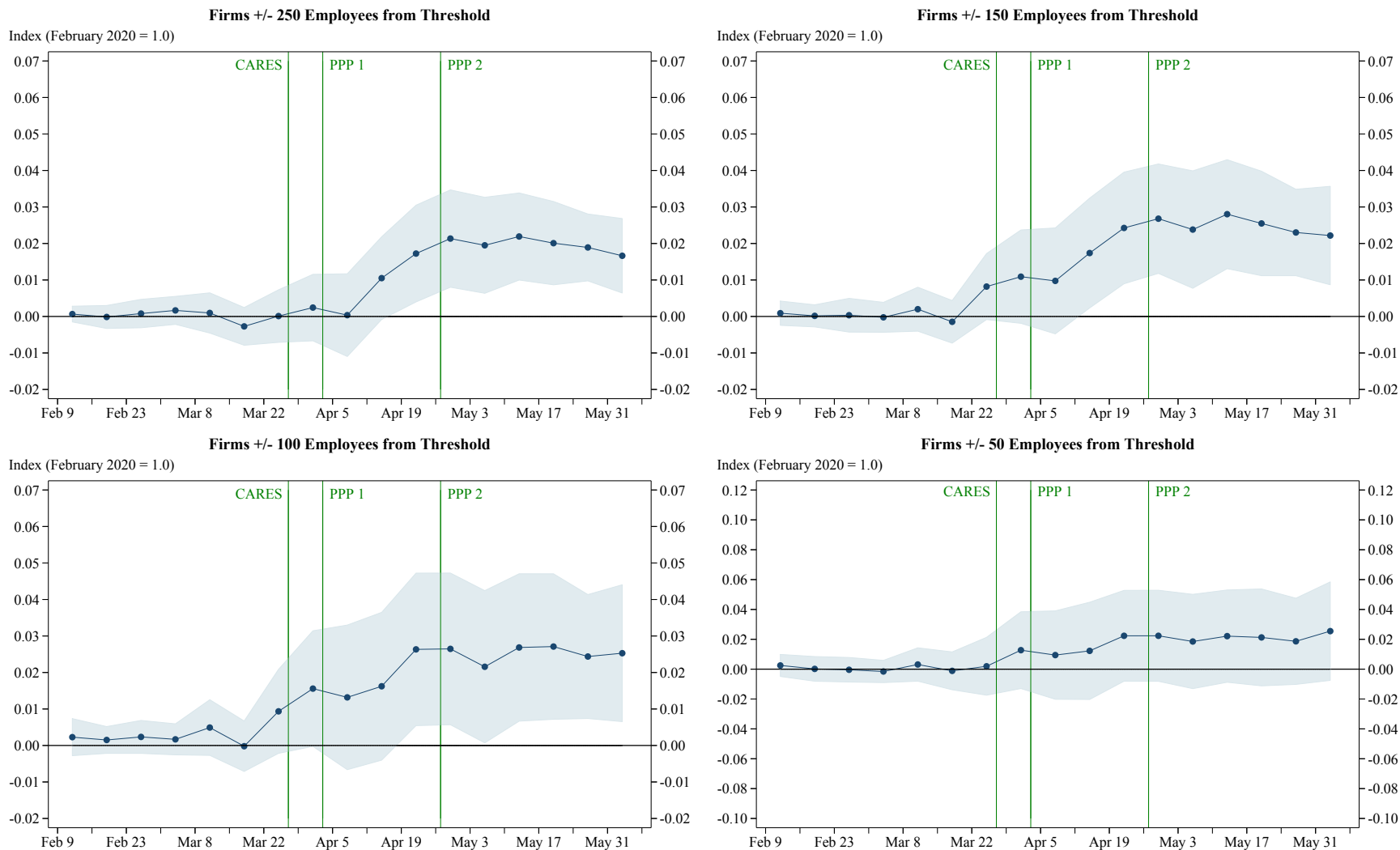
A   Appendix: Robustness Analysis

Figure A.1: Effect of PPP Eligibility on Employment With State-by-Industry-by-Week Effects
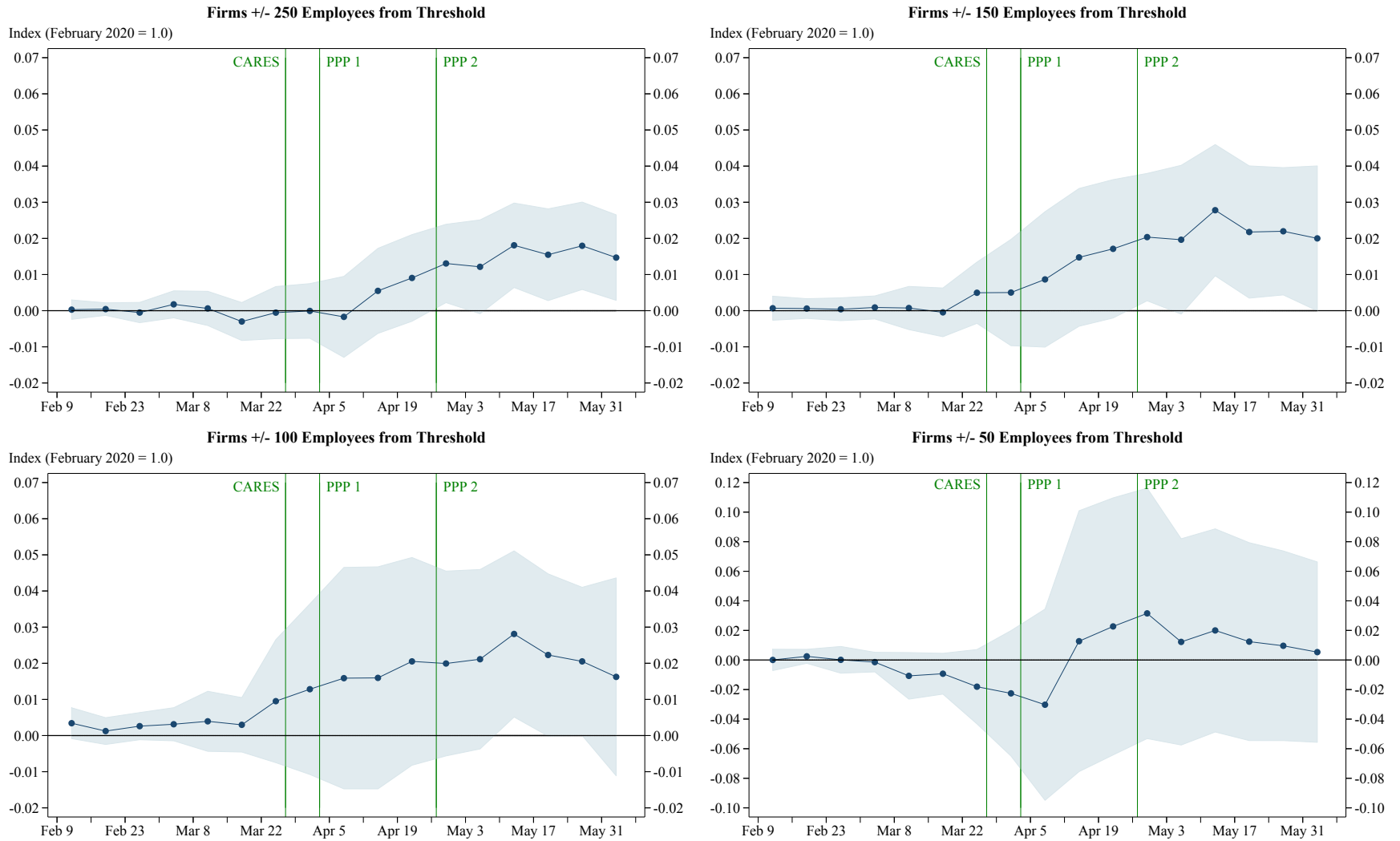
Note: Each firm's size is determined using employment in both 2019 and February 2020. Regressions are weighted by firm size as of February 2020 and include controls for state-by-industry-by-week effects. Standard errors are clustered at the 3-digit NAICS industry level. Sample reflects firms that were present in the ADP data for all 12 months of 2019.

Source: Authors' analysis of ADP data.

Figure A.2: Effect of PPP Eligibility on Employment Based on Firm Size as of 2019

Note: Each firm's size is determined using employment in 2019. Regressions are weighted by firm size as of February 2020 and include controls for state-by-week and industry-by-week effects. Standard errors are clustered at the 3-digit NAICS industry level. Sample reflects firms that were present in the ADP data for all 12 months of 2019.
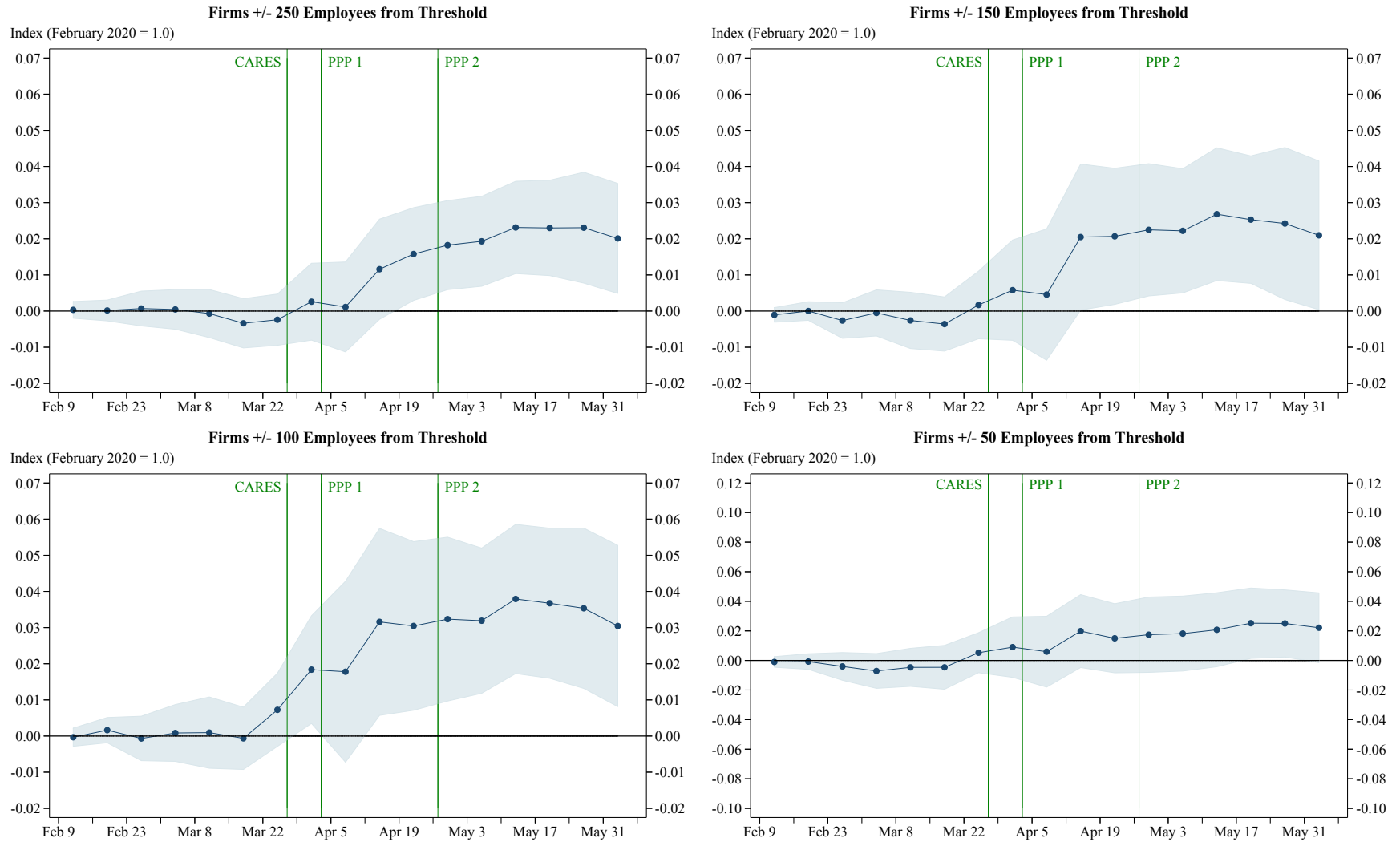Source: Authors' analysis of ADP data.

Figure A.3: Effect of PPP Eligibility on Employment Based on Firm Size as of February 2020

Firms +/- 250 Employees from Threshold

Index (February 2020 = 1.0)

Firms +/- 150 Employees from Threshold

Index (February 2020 = 1.0)

Firms +/- 100 Employees from Threshold

Index (February 2020 = 1.0)

Firms +/- 50 Employees from Threshold

Index (February 2020 = 1.0)

Note: Each firm's size is determined using employment in February 2020. Regressions are weighted by firm size as of February 2020 and include controls for state-by-week and industry-by-week effects. Standard errors are clustered at the 3-digit NAICS industry level. Sample reflects firms that were present in the ADP data for all 12 months of 2019. Source: Authors' analysis of ADP data.

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