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Daryl Chan April 8th, 2022

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An abstract of
a thesis submitted to the Faculty of Emory College of Arts and Sciences
of Emory University in partial fulfillment
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Bachelor of Arts with Honors

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Abstract

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What happens when governments rely on self-targeted relief programs to mitigate an economic fallout? I study the Paycheck Protection Program (PPP), a large and unprecedented small business loan program enacted as a response to the COVID-19 crisis in the U.S. with the goal of preserving jobs. The program was self-targeted by nature and small businesses regardless of need can apply. This paper assesses the extent to which governments can rely on firms to self-select into these programs based on the government's objective of preserving jobs. I show using a theoretical model that firm optimal behaviour is asymmetric to government objective, and the design of the PPP does not skew to firms that would layoff the most employees. Empirical analysis shows some evidence of self-targeting by firms in the early days of the program, but the effect was marginal and eventually neutralized as the pandemic progressed. I estimate that only 30% of total grants provided to businesses reached the government's desired objective and allowed for full employment restoration, while at least 17% of grants had close to no effect on employment. With the need of delivering aid to businesses quickly in mind, this paper suggests that the efficiency of PPP would greatly increase with some "low-cost" targeting based on need and the implementation of an ordeal mechanism to discourage resilient firms from applying.

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Contents

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1 Introduction

The Coronavirus pandemic (COVID-19) created one of the worst global economic crisis in the U.S. since the Great Depression (Wheelock). The swift and massive shock of the pandemic and shutdown measures to contain it led to an unprecedented decrease in economic activity and employment rate, virtually affecting all businesses. Following the declaration of national emergency in March 2020, revenues of small businesses declined by roughly 40% (Kim et al. (2020)), and shortly after, unemployment rate reached 14.8% - the highest rate observed since data collection began in 1948 (Con). In response, the U.S. federal government and Federal Reserve deployed an array for fiscal and monetary policies that were unprecedented in its size, scope and speed. Legislation passed by Congress over the course of the pandemic led to nearly \$5.8 trillion in fiscal support to the U.S. economy, which was equivalent to around 28 percent of U.S. GDP[1].

This paper studies one of the programs within the Coronavirus Aid, Relief, and Economic Security (CARES) Act, the Paycheck Protection Program (PPP), which provided Small Business Administration (SBA) backed, forgivable loans to small businesses to help them keep their workforce employed during the COVID-19 crisis. This program was seen to be instrumental in delivering a swift recovery to the economy, especially since over 99.7% of all businesses in U.S. are considered to be small businesses, and they employ approximately half of private sector workforce (SBA). The PPP deployed over \$953 billion in two phases of the program, equivalent to 4.6% of U.S. GDP, making it one of the largest firm-based fiscal policies in U.S. history. The PPP was created as a backstop to the rapid increase in unemployment rate at the start of the pandemic and attempted to incentivize firms to maintain employment levels by offering forgivable loans if they did so.

Many economists noted the importance of timing of stimulus during a recession, especially given the unique economic situation that caused by the COVID-19 pandemic, in which many businesses are forced to shut down. If the government did not act quickly and decisively, the long term economic damage would've been way more costly. This was reflected in the U.S. government, when Congress passed the CARES Act relatively quickly and with unanimity from both parties despite its hefty \$ 2.2 trillion price tag, indicating the severity of the global pandemic and the need for emergency spending, as viewed by lawmakers. The Congressional Budget Office estimated that the CARES Act "will increase federal deficits by about \$ 1.7 trillion over the 2020—2030 period." It is therefore important to study the policies within the bill and analyze whether efficiency was compromised in favor of speed of deployment.

[1]Total includes the roughly \$3 trillion from the spring 2020 billsâthe Coronavirus Preparedness and Response Supplemental Appropriations Act, 2020; the Families First Coronavirus Response Act; the Coronavirus Aid, Relief, and Economic Security (CARES) Act; and the Paycheck Protection Program and Health Care Enhancement Act, inclusive of the roughly \$ 0.45 trillion in capitalization for the Fed lending facilities in the CARES Act; as well as \$ 0.9 trillion in the stimulus divisions of the Consolidated Appropriations Act, 2021, passed in late December 2020; and \$ 1.9 trillion in the American Rescue Plan Act of 2021, passed in March 2021.

To further emphasize on the importance of timing, the government went with a self-targeted approach for the program in order to ensure that aid could be delivered to small businesses quickly, whereby firms essentially self-select into the program without the need to demonstrate hardship. Any businesses that meet the requirement of a "small-business" can apply to the program by providing basic information about the business. The PPP was self-targeting in two ways: 1. Firms self-targeting when applying to the PPP, 2. Firms self-targeting when applying for loan forgiveness, whereby firms "self-report" payroll statistics in order to qualify. As a result, it is estimated that around 75% to 80% of small businesses that met the requirements applied to the PPP, with virtually all of the applications being successful. Furthermore, more than 94% of loans were converted to grants as of February 2022. The near universal uptake, and conversion to grants implies a lack of targeting by the government which means that efficiency of the program is highly uncertain. It is therefore important to weigh the benefits between the speed of the program against the potential loss of efficiency to understand whether a self-targeted program was justified.

Literature that studied the PPP has consistently showed that PPP was effective and has substantially increased employment, financial health, and survival of small businesses. However, the efficiency of the program, which weighs the marginal effect on employment against marginal dollar spent, remains in question. Granja et al. (2020) analyzes the short and medium-term employment effects of the program, and found that the effects were small compared to the program's size. This paper also found that many firms used the loans to make non-payroll fixed payments and build up savings buffers, which can account for small employment effects and likely reflects precautionary motives in the face of heightened uncertainty. This creates the hypothesis that the self-targeting design of the policy was highly inefficient, as many of the firms saved the money instead of spending it. Hubbard and Strain (2020) presents evidence that PPP has substantially increased the employment, financial health, and survival of small businesses, using data from the Dun and Bradstreet Corporation. They also use event studies and standard difference-in-difference models to estimate the effect of a small business applying for larger PPP loans and of a small business being eligible for PPP based on size. However, the authors' findings were inconclusive and believed that it was too early to make a judgment on PPP's overall success. Bartik et al. (2020) studied the PPP in the early months and noted that the targeting effectiveness of loan approval was mixed. On some dimensions, the program was effective as firms estimated to have higher treatment effects were more likely to be approved, but on the other hand, firms with less cash-on-hand were less likely to be approved, which shows discriminatory behaviour from banks. However, the study was set in the early months of the PPP, and using data from nearly two years on since the PPP started, it is shown that more than 99% of firms that requested a loan from PPP ultimately received one, which means, even if there was discriminatory behaviour by banks, its effects are marginal.

This paper joins the growing literature exploring the economic impact and policy response following the COVID-19 pandemic. In this paper, I analyze the efficiency of a self-targeted program in targeting the most distressed businesses, and discuss whether the design of the PPP can be improved without compromising its speed. In 1.1, I provide an overview of the program, to provide an understanding of the history of the PPP and the detailed mechanics of the program. Next, I build a theoretical model in 2.1 to understand economic incentives of a firm in light of the PPP, to understand how optimal decision by firms relate to optimal allocation in the eyes of the government, which is to direct funds to save jobs. I find that there would be suboptimal allocation if firms were to profit maximize, and that firms that were unaffected by the pandemic would still apply to the PPP, and the most cash-cosntrained firms, which are the most vulnerable in terms of bankruptcy, would not be able to receive a grant. In Data, I use data from the Small Business Pulse Survey and Small Business Administration to analyze the economic condition of firms that applied to the PPP and firms that had their loans forgiven. I show that firms showed positive self-targeting behaviour at the start of the program, but post-loan data showed that such effect was neutralized as the program went on, and that the distress levels of a sector is not indicative of whether firms in that sector have applied to the PPP, or have their loans forgiven. In 3.1.2, I give a best case scenario estimate of the distribution funds in the PPP, and show that only 30% of grants given to small businesses reached the government's desired objective and allowed for full employment restoration, and at least 17% of grants had close to no employment effect. Finally, in 4, I offer potential alternatives or design changes to the PPP that would have increased efficiency of the program. I note that the government could pursue strategies that were used in other countries like "low-cost" targeting to discriminate firms by need, and the implementation of a ordeal mechanism to discourage resilient firms from applying.

1.1 Basics of the Paycheck Protection Program

The Paycheck Protection Program (PPP) began on April 3rd, 2020 as part of the CARES Act as a temporary source of liquidity for small businesses, authorizing $349 billion in forgivable loans to help small businesses pay their employees and additional fixed expenses during the COVID19 pandemic. Firms applied for support through banks and the Small Business Administration (SBA) was responsible for overseeing the program and processing loan guarantees and forgiveness. A motivation for using the banking system (including FinTech) as a conduit for providing liquidity to firms is that, because nearly all small businesses have pre-existing relationships with banks, this connection could be used to ensure timely transmission of funds. The lending program was generally targeted toward small businesses of 500 or fewer employees. Although the initial round of funding was exhausted on April 16th, a second round of $320 billion in PPP funding was passed by Congress as part of the fourth COVID-19 aid bill. On December 21, 2020, the House and the Senate passed the Consolidated Appropriations Act, 2021, which includes a Phase 2 Paycheck Protection Program which added a further $284.5 billion in funding for PPP loans, and it allowed certain entities to apply for a second draw of a PPP loan.

The terms of the loan were the same for all businesses. The maximum amount of a PPP loan is the lesser of 2.5 times the average monthly payroll costs or $10 million. The average monthly payroll is based on prior year's payroll after subtracting the portion of compensation to individual employees that exceeds $100,000. The interest rate on all loans is 1% and their

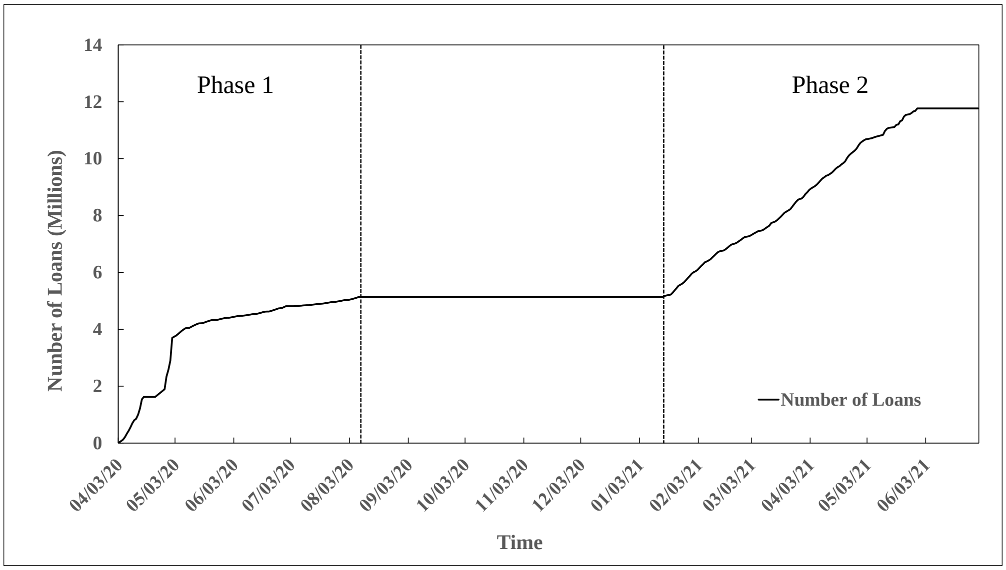


Figure 1: Number of loans over time[2]

maturity is two years, which can be viewed as the lowest cost of debt for small businesses. Under SBA's interpretation of the initial bill, the PPP loans can be forgiven (essentially turned into a grant) if two conditions are met. First, proceeds must be used to cover payroll costs, mortgage interest, rent, and utility costs over the eight-week period following the provision of the loan, but not more than 25% of the loan forgiveness amount may be attributable to non-payroll costs. Second, employee counts and compensation levels must be maintained. If companies cut pay or employment levels, loans may not be forgiven. However, if companies lay off workers or cut compensation between February 15th and April 26th, but subsequently restore their employment levels and employee compensation, their standing can be restored. Congress expanded PPP on June 3rd, allowing more flexible terms for loan forgiveness. The updates to the PPP expanded the duration from eight weeks to twenty-four and extended the deadline to rehire workers until the end of the year. This change effectively gave small businesses more time to use program funds and rehire workers. Additionally, the minimum amount of funds used for payroll while still qualifying for forgiveness was lowered from 75% to 60%. An important feature of the program is that the SBA waived its standard "credit elsewhere" test used to grant regular SBA 7(a) loans. This test determines whether

[2]Source: SBA Paycheck Protection Program Data

the borrower has the ability to obtain the requested loan funds from alternative sources and poses a significant barrier in the access to regular SBA loans. Instead, under PPP rules, applicants were only required to provide documentation of their payroll and other expenses, together with a simple two-page application process where they certify that the documents are true and that current economic uncertainty makes this loan request necessary to support ongoing operations. In sum, the PPP program was designed to be "first-come-first-serve" program with eligibility guidelines that allowed it to reach a broad spectrum of small businesses.

During the first weeks of April, demand for PPP loans outstripped supply, which was limited by statute. As shown in 1, between April 3rd and 16th, all of the initial $349 billion was disbursed, and the program stopped issuing loans for a period of time. The House and Senate passed a bill to add an additional $320 billion in funding on April 21st and 23rd, respectively, which was signed into law on the 24th. The PPP began accepting applications on April 27th for the second round of funding. While 60% of the second round funds were allocated within two weeks of initial disbursement, the remaining second round funds were disbursed slowly, with unallocated PPP funds being available in late June. By early July, more than $130 billion remained available in PPP funds. Loan disbursement remained low throughout July and August, suggesting that the second round had sufficient funds to meet demand.

The problem with a self-targeted policy like the Paycheck Protection Program is that the government cannot choose where the money goes. Understandably during the start of the pandemic, it was impossible for the government to accurately determine which population was going to be affected the most. However, it is entirely possible that businesses in good financial standing could also apply for a loan and have their loans forgiven. The aim of this paper is to understand the real effects of the Paycheck Protection Program and exactly what economical benefits it has achieved. More specifically, by understanding the distribution of firms that received a loan from the Paycheck Protection Program, I can make implications to which the program saved jobs that otherwise would've been lost as a result of the pandemic.

PPP is a novel program, and many standard intuitions about fiscal policy do not apply to it. It was not a stimulus program in the sense that its purpose was not to "stimulate" the economy; that is, it is not a program calling for a measure of the multiplier. Instead, its purpose was to preserve the productive capacity of the small-business sector and to shorten the transition to a new, post-virus equilibrium by supporting labor demand over the medium term, allowing for a more rapid economic recovery. It was not a jobs program in the sense that its goal was not exclusively to preserve employment. Instead, its goals were to maintain worker-firm attachments, particularly during the shutdown, and to ensure small business continuity. It intentionally did not attempt to exclude inframarginal recipients because the unique circumstances under which it was enacted made this impractical. In the early days of the shutdown, how could the government have known which firms were inframarginal? And given the numerous goals of the program, it's not clear how "marginal" would be defined in this context.

There was an understandable need for the government to act quickly to prevent catastrophic collapse of the economy as noted by many economists, but it is still important to understand whether the government made the right decision in the right time and whether it could have made adjustments to the policy (still within reasonable time) that addressed the recession more effectively, possibly by only helping failing businesses and thus potentially reducing the cost of the program.

2 Model

2.1 Setup

I layout a framework to understand a firm's decision model during the start of the pandemic, assuming a firm's objective is to profit maximize. I model the firm-level cash flows following Bartlett III and Morse (2020) and Joaquim and Netto (2021). I consider a continuum of firms indexed by j and define cash flow ϕ as net operating revenue r minus labor costs l and committed other costs c such that:

$$\phi_j = r_j - l_j - c_j \tag{1}$$

where operating revenue r is revenues minus cost of goods sold.

I consider a negative industry shock V_j to the industry that a firm j is in, which imposes a shock v_j that follows a normal distribution with mean V_j and standard deviation σ, such that:

$$v_j \sim \mathcal{N}(V_j, \sigma) \tag{2}$$

I look at the condition for survival of a firm which is defined as the maintenance of positive cash flows from existing cash flow position of the firm following the demand shock, such that:

$$\pi_j^{LR} := (\phi_j + \frac{\partial \phi_j}{\partial v_j}) > 0 \tag{3}$$

Taking the derivative and allowing for labor to scale with revenues or be directly impacted by the shock, I have the following condition:

$$(r_j + \frac{\partial r_j}{\partial v_j}) - (l_j + \frac{\partial l_j}{\partial v_j}) - (c_j + \frac{\partial c_j}{\partial v_j}) > 0 \tag{4}$$

which shows that the condition for a firm to survive the pandemic depends on 1) the change in net operating revenue as a result of the demand shock, 2) the change in labor costs as a result of demand shock, and 3) the change in other costs as a result of demand shock. Further looking at $\frac{\partial l_j}{\partial v_j}$, I can represent it in terms of change in net operating revenue, such that:

$$\frac{\partial l_j}{\partial v_j} = \frac{\partial l_j}{\partial r_j} * \frac{\partial r_j}{\partial v_j} \tag{5}$$

This shows that the change in labor costs depends on the optimal labor costs as a result of the change in net revenue, and also the amount of net revenue change as a result of the pandemic. Note that a firm does not have to change its labor costs, as $\frac{\partial l_j}{\partial v_j}$ only shows the optimal labor cost required to sustain the level of business during the pandemic.

I now introduce the Paycheck Protection Program to the model, which incentivizes firms to maintain its pre-pandemic payroll level, such that $\frac{\partial l_j}{\partial v_j} = 0$. Should the firm decide to apply to the Paycheck Protection Program and maintain its pre-pandemic payroll level, it can also apply to convert the loan into a grant, meaning that the firm has to weigh the benefit of receiving a PPP loan against the money it could save from reducing payroll costs. I set $a \in \{0, 1\}$ to be the decision of applying for a loan, where $a = 1$ is applying for a loan, while $a = 0$ is not applying for a loan, and $b \in \{0, 1\}$ to be a firm's decision to reduce payroll, where $b = 1$ is reducing payroll, while $b = 0$ is maintaining payroll, Therefore, a firm facing a demand shock from the pandemic will have 4 choices:

1. Apply for a PPP loan but reduce labor costs (a=1, b=1)
2. Apply for a PPP loan and maintain labor costs (a=1, b=0), meaning that it qualifies for forgiveness
3. Not apply for a PPP loan and reduce labor costs (a=0, b=1)
4. Not apply for a PPP loan but maintain labor costs (a=0, b=0)

I assume that a firm that has received a PPP loan and has maintained labor costs will also apply for loan forgiveness, because it is in its interest to do so. As a result, I set $\overline{\phi}$ to be the amount of cash a firm will have following the initial demand shock to be:

$$\overline{\phi} = \phi_j + (r_j + \frac{\partial r_j}{\partial v_j}) - (l_j + b * \frac{\partial l_j}{\partial v_j}) - (c_j + \frac{\partial c_j}{\partial v_j}) + ax_j \tag{6}$$

where x_j is the amount of money it can get from the program. I then use a firm's cash position to generate its expected perpetuity value of long-run profits of the firm (π_j^{LR}), such that:

$$\pi_j^{LR} = \overline{\phi} - ayx_j \tag{7}$$

where $y \in \{0, 1+i\}$, where $y = 0$ is when the loan is forgiven and $y = 1+i$ is the principal plus interest of the loan.

Assuming a firm's objective is to maximise long term profits, each firm will attempt to choose a and b to maximize their *expected* perpetuity value of long-run profits of the firm, such that:

$$\max_{a\in\{0,1\}, b\in\{0,1\}} E(\pi_j^{LR}) = (r_j + E(\frac{\partial r_j}{\partial v_j})) - (l_j + b * E(\frac{\partial l_j}{\partial v_j})) - (c_j + E(\frac{\partial c_j}{\partial v_j})) + (1-y)ax_j \tag{8}$$

where $E(\frac{\partial r_j}{\partial v_j})$ is the firm's expected perpetuity value of revenue impact as a result of the demand shock, $E(\frac{\partial l_j}{\partial v_j})$ is the firm's expected adjustment of perpetuity value of labor cost as a result of the demand shock, $E(\frac{\partial c_j}{\partial v_j})$ is the firm's expected adjustment of perpetuity value of fixed costs expenses. I set the variables to expected because I assume that firms will make their decisions based on their expected cost savings as a result of decreasing operating capacity. (Note that $y = 1+i$ if $a = 1$ and $b = 1$, because a firm will have to pay back the loan if it receives a PPP loan and decides to downsize.)

Now, I can model a firm's decision:

1. Apply for a PPP loan but reduce labor costs ($a = 1$, $b = 1$), knowing that they have

to pay back the loan ($y = 1 + i$):

$$E(\pi_j^{LR})_{(a=1,b=1)} = (r_j + E(\frac{\partial r_j}{\partial v_j})) - (l_j + E(\frac{\partial l_j}{\partial v_j})) - (c_j + E(\frac{\partial c_j}{\partial v_j})) - ix_j$$

2. Apply for a PPP loan and maintain labor costs ($a = 1$, $b = 0$), meaning that it qualifies for forgiveness ($y = 0$):

$$E(\pi_j^{LR})_{(a=1,b=0)} = (r_j + E(\frac{\partial r_j}{\partial v_j})) - l_j - (c_j + E(\frac{\partial c_j}{\partial v_j})) + x_j$$

3. Not apply for a PPP loan and reduce labor costs (a=0, b=1):

$$E(\pi_j^{LR})_{(a=0,b=1)} = (r_j + E(\frac{\partial r_j}{\partial v_j})) - (l_j + E(\frac{\partial l_j}{\partial v_j})) - (c_j + E(\frac{\partial c_j}{\partial v_j}))$$

4. Not apply for a PPP loan but maintain labor costs (a=0, b=0):

$$E(\pi_j^{LR})_{(a=0,b=0)} = (r_j + E(\frac{\partial r_j}{\partial v_j})) - l_j - (c_j + E(\frac{\partial c_j}{\partial v_j}))$$

I observe that Case 3 is always preferential over Case 4 unless $(\frac{\partial l_j}{\partial r_j} * E(\frac{\partial r_j}{\partial v_j})) >= 0$, which requires both $(\frac{\partial l_j}{\partial r_j})$ and $E(\frac{\partial r_j}{\partial v_j})$ both to be positive, which signifies that the firm experienced a positive demand shock. However, I observe that it is in the firm's incentive to apply for a PPP loan if it has experienced a positive demand shock, because it will maintain labor costs and qualify for a grant, which I will discuss below.

Cash Constraint

I now analyze how a firm's financial condition could affect its decision to apply to the PPP. I first assume that a firm will apply for a PPP loan ($a = 1$) if they *think* they are not going to survive the pandemic without a loan, which I label as being cash constrained, such that its beginning cash on hand is not enough to cover the expected cash outflow as a result of the pandemic, where:

$$\pi_j^{LR} := (\phi_j + \frac{\partial \phi_j}{\partial v_j}) < 0$$

where ϕ_0 is the initial cash on hand, while ϕ_1 is the expected cash outflow of the pandemic.

$$(r_i + E(\frac{\partial r_j}{\partial v_j})) - (l_j + (\frac{\partial l_j}{\partial r_j} * E(\frac{\partial r_j}{\partial v_j})) - (c_j + E(\frac{\partial c_j}{\partial v_j})) < 0$$

This means the firm has to decide whether to (case 1) reduce labor costs (downsize), or (case 2) maintain employee headcount and getting a grant. The decision would then depend if the opportunity cost of maintaining payroll level is greater than the cost of paying the loan back with interest, such that:

$$(b_i|a_i = 1) = \begin{cases} 0, & \text{if } (1+i) * x_j \geqslant -E(\frac{\partial l_j}{\partial v_j}) \\ 1, & \text{otherwise} \end{cases}$$

I assume that if

$$(1+i) * x_j = -E(\frac{\partial l_j}{\partial v_j})$$

firms would prefer maintaining payroll levels ($b = 0$).

I now assume that a firm is not cash constrained, which means it doesn't have to apply for a PPP loan in order to survive. What if a firm is not affected by the pandemic? If a firm is unaffected by the pandemic, such that $E(\frac{\partial r_j}{\partial v_j}) \geqslant 0$, we would also expect $E(\frac{\partial l_j}{\partial v_j}) \geqslant 0$, meaning it doesn't have incentive to downsize. If the firm is maintaining employment levels anyway, it is preferable to apply to the PPP if its main objective is to profit maximize.

If a firm is suffering a negative shock, the firm will then choose the option that generates the greatest long term profits for them. I observe that a firm would either maintain payroll cost and receive a grant ($a = 1$, $b = 0$), or reduce payroll cost and not applying for a loan

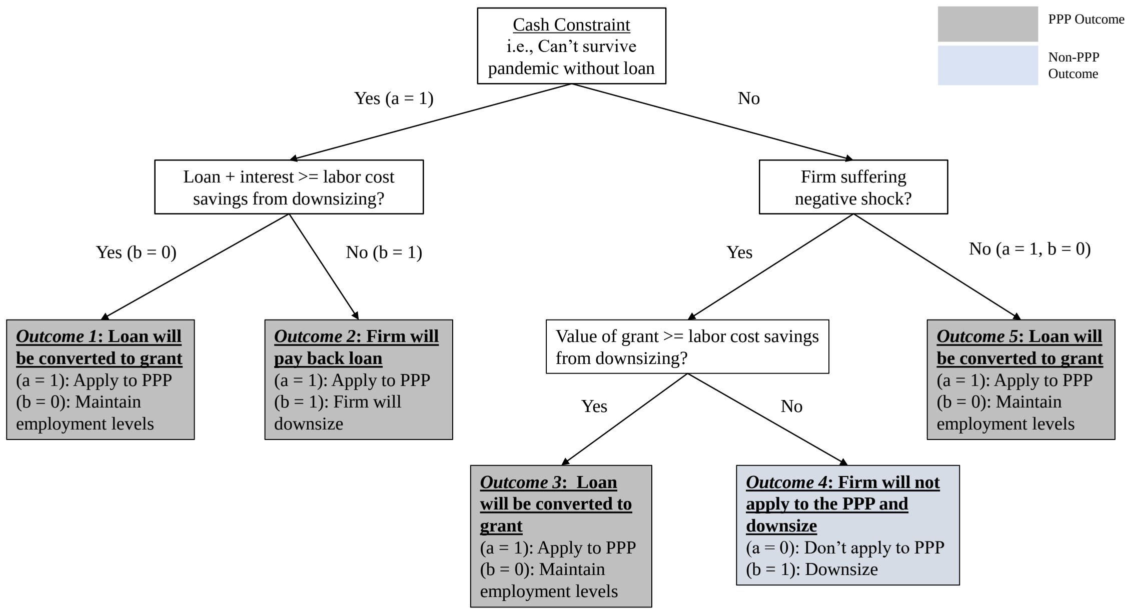


Figure 2: Firm Decision Model

$(a = 0,\, b = 1)$. I then have the following condition:

$$a_i = \begin{cases} 0 \text{ and } b_j = 1, & \text{if } x_j < -E(\frac{\partial l_j}{\partial v_j}) \\ 1 \text{ and } b_j = 0, & \text{otherwise} \end{cases}$$

I observe that a firm's decision to apply for a PPP loan would depend on the size of the grant and the amount of labor cost it can save from downsizing. This result is similar to the condition I observed with the cash-constrained firms, with the exception that the interest rate is not taken into account. This discrepancy is marginal since the interest rate of the loan is set at 1%. Ultimately, the number of jobs that the PPP can save would heavily depend on the maximum size of the loan that the government set, and also how pessimistic firms were at the start of the pandemic.

Firm Expectation

As analyzed above, firms make their decision based off of their expectations on how the shock from the pandemic will impact their perpetuity value of operating revenue, $E(\frac{\partial r_i}{\partial v_i})$. The real effects of the PPP loan program depend on whether firms made accurate assumptions with regards to how long they think the pandemic will last and the extent of real impact on their perpetuity operating revenue, which can be likened to the expected operating capacity of a firm over the pandemic. To put this in other words, if a firm thinks that the impact of the pandemic is going to last a long time, it would be more likely to downsize early on in the pandemic to save on hiring an excessive level of employees, as the amount of grant money it could get from the government wouldn't be enough to cover the extra cost of maintaining employee count.

To further analyze how a firm would determine the potential cost savings, I set that:

$$E(\frac{\partial l_j}{\partial v_j}) = \frac{\partial l_j}{\partial r_j} * E(\frac{\partial r_j}{\partial v_j}) \tag{9}$$

assuming that a firm would be aware of the optimal changes in labor cost at a given amount of revenue, $\frac{\partial l_j}{\partial r_j}$, but can only guess the impact on revenue per change in demand shock, $E(\frac{\partial r_j}{\partial v_j})$, as they are unaware of the perpetuity value of v_j. I also assume that labor cost scales proportionally to revenue, and $\frac{\partial l_j}{\partial r_j}$ can be taken as a constant.

How would a firm determine the perpetuity value of revenue impact? I assume that a firm would consider two things: the initial size of the revenue shock, $(\frac{\partial r_j}{\partial v_j})_{t=0}$, and how long it expects the pandemic to last, $E(T_j)$, such that:

$$E(\frac{\partial r_j}{\partial v_j}) = \int_{t=0}^{E(T_j)} f(t)\, dt \tag{10}$$

Assuming that the a firm's revenue recovery over time is linear, we have:

$$E(\frac{\partial r_j}{\partial v_j}) = \int_{t=0}^{E(T_j)} ((\frac{(\frac{\partial r_j}{\partial v_j})_{t=0}}{E(T_j)})t + (\frac{\partial r_j}{\partial v_j})_{t=0})\, dt \tag{11}$$

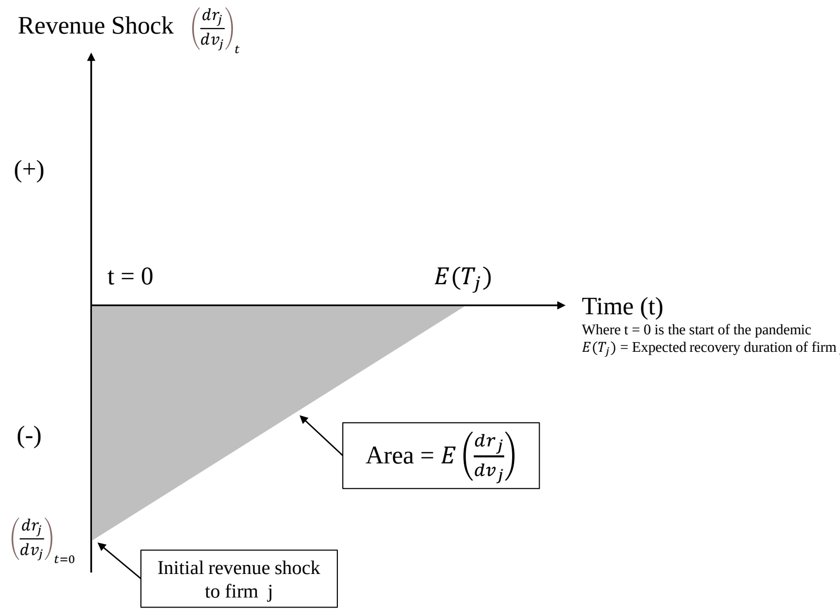


Figure 3: Expected Revenue Shock

which can be simplified to:

$$E(\frac{\partial r_j}{\partial v_j}) = \frac{\frac{\partial r_j}{\partial v_j} * E(T_j)}{2} \tag{12}$$

This derivation assumed that the recovery is linear, but due to the unique nature of a recession caused by a pandemic, the recovery curve could be wildly different. For example, if a firm is forced to close as a result of the "Non-Essential Business Closure" policy, the recovery curve would look more like a rectangle, where a firm can quickly recover to 'normal' operating levels once they are allowed to reopen. It could also be in different shapes like a logarithmic or exponential curve. Ultimately, the shape of such curve would affect whether the size of the loan set by the government would be enough to influence firms to maintain employment, which means that the government needs to take this into account.

I show in the following section that the size of the initial shock to a sub-sector is proportional to the sub-sector's expectation of recovery duration, which shows that the firm expectation of the perpetual impact of the pandemic will be exponential to the initial revenue shock that it has experienced.

I observe that if a firm overestimates the recovery duration of the recession, such that $E(T_j) > T_j$, it will lead to more firms unnecessarily downsizing and leading to more unemployment. But if firms underestimate the impact of the pandemic, such that $E(T_j) < T_j$, it will lead to more businesses maintaining employee headcount and taking a grant from the government, but would've saved more money by downsizing. Therefore, it is important to investigate firm level expectations at the start of the pandemic and in light of the PPP, what decisions they make. In the later section, I show that $E(T_j) \sim T_j$, and firms seemed to be quite good at determining the length of the pandemic.

Government Objective

As discussed in Section 1.1, the objective of the Paycheck Protection Program is to save as many jobs as possible which would otherwise have been lost as a result of the economic decline. From the government's perspective, the PPP would like to influence firm decision, such that the amount of PPP money available for a firm is greater than the cost that a firm could expect to save from downsizing:

$$x \geqslant |E(\frac{\partial l_j}{\partial v_j})| \text{ and that } E(\frac{\partial l_j}{\partial v_j}) < 0$$

Note that this equation I specify assumes that the government account for firm level expectation of the demand shock, rather than the actual demand shock of the pandemic. There are 2 things that are worthwhile to analyze: 1) the degree to which $x \geqslant |E(\frac{\partial l_j}{\partial v_j})|$, which would represent the amount of money that the federal government "overpaid" to get firms to maintain employee count and 2) the number of firms who took PPP loans that actually maintained its size, or even grew during the pandemic such that $E(\frac{\partial l_j}{\partial v_j}) \geqslant 0$, but were able to receive a grant from the PPP which would have been counterproductive since it wouldn't have downsized without the grant.

Since the size of the loan depends on the pre-pandemic level of employment, and not the size of impact that a firm faces, this policy design would be regressive as firms that suffer more are less likely to receive a fund or a loan from the government, meaning that they're less likely to restore employment. This problem is compounded by the fact that we suspect that initial shock to the business would be proportional to the expectation of recovery of the business, which means that businesses that are suffering more are exponentially less likely to recover payroll.

Secondly, under the decision model that I have built above, which assumes that firms' main objectives are to profit maximize, it may lead to an undesired outcome for the government. Firstly, I observe that firms that are not suffering a negative shock from the pandemic will still apply to PPP, even though their operations level implies that they would not downsize. It is therefore important to examine the proportion of firms at the start of the pandemic that didn't face a negative shock, and the extent to which these firms still applied to the PPP.

Moreover, I observe that the only firms that would apply to the PPP and not qualify for forgiveness are firms that are cash constraint. While it is important for the government to incentivize firms to maintain employment levels by only allowing them to convert the loan into grants if they did so, these cash constraint firms are also the most vulnerable in terms of bankruptcy. This may create "zombie firms", where firms are unable to payback the loan and will then default and cause more unemployment and potentially longer-term economical damage.

3 Empirical Evidence

3.1 Data

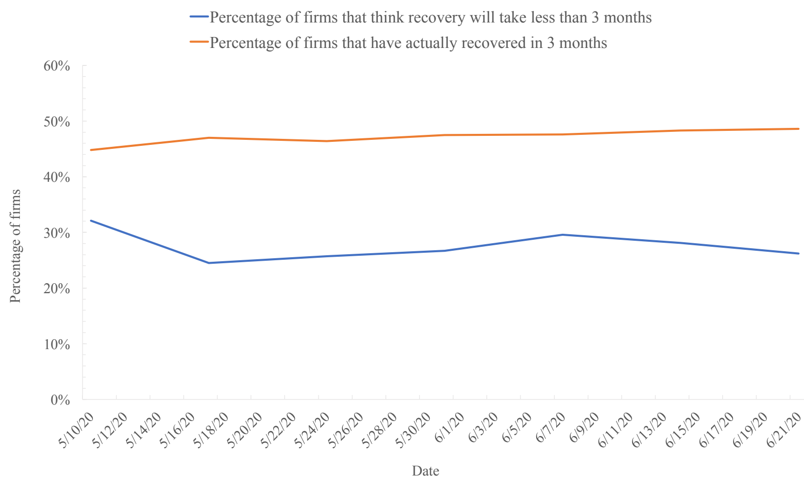
3.1.1 First Stage of Self-Targeting: Applying

We use data from the Small Business Pulse Survey, which measures the effect of changing business conditions during the Coronavirus pandemic on U.S. small businesses. The Survey was conducted in 8 phases, starting in the start of the pandemic in April 2020 until April 2022. The SBPS target population includes all single-location employer businesses with 1–499 employees and $1,000+ revenue that responded to the 2017 Economic Census and reported an email address, which means that all of these businesses qualify for the PPP. The survey divides these businesses equally across the nine weeks of each phase of the survey; about 100,000 emails are sent out each week to businesses asking them to participate in the survey. Each of the nine subsamples is used only once in each phase but are reused across phases (thus some businesses may respond in more than one phase). The response rate is about 25% and the results are re-weighted to be nationally representative using the survey weights. The data is available by sector (more specifically, NAICS-3[3]) and state for the fifty most populous Metropolitan Statistical Areas (MSAs).

Briefly looking at estimates from the survey at the start of the pandemic show that 89.9% of small businesses experienced a negative effect on operations due to the COVID-19 in the early months of the pandemic. This breaks down into 51.4% seeing a large negative effect and 38.5% a moderate negative effect. The large negative effect is especially pronounced in the Accommodation and Food Services industry where 83.5% of businesses experience a large negative effect. In terms of geography, Michigan has the highest percent of large negative effect (64.5%) and Iowa has the lowest percent (32.6%) of the 50 states. On the

[3]North American Industry Classification System

Figure 4: Firm 3-month Expectation vs Actual



other side of the distribution, the industry with the highest share of large positive effect is Retail Trade with 2.0%.

Firm Expectation Using the SBPS, I examine data of firm level expectation of the length of the pandemic at the start of the recession (May to July) which is when most of the firms would have applied for PPP, and the level of recovery three months later (August to October) and six months respectively. More specifically, I look at the percentage of firms which think that the business will take longer than 3 and 6 months to recover, and subsequently the percentage of firms that has actually recovered after 3 and 6 months respectively.

As shown in figure 4, percentage of firms that think that they would recover in 3 months

[4]Source: Small Business Pulse Survey Data, "size of shock" is an index constructed to represent the degree to which firms in a given sub-sector was negatively affected by the pandemic at the start of the pandemic, by assigning a numeric value to each of the response to the question: "Overall, how has this business been affected by the COVID-19 pandemic?", where *Large Negative Effect = 1, Moderate Negative Effect = 0.5, No effect = 0, Moderate Positive Effect = -0.5, Large Positive Effect = -1*, and weighing with the percentage of responses. The greater the index, the more firms in a given sub-sector was negatively affected by the pandemic. "Expected Time to Recovery" is index constructed to represent the degree of negative sentiment of firms in a given sub-sector at the start of the pandemic, by assigning a numeric value to each of the response to the question: "In your opinion, how much time do you think will pass before this business returns to its normal level of operations relative to one year ago?", where *Expected Recovery Duration: Never = 1, More than 6 months = 0.8, 4-6 months = 0.6, 2-3 months = 0.4, 1 month or less = 0.2, No impact = 0*, and weighing with the percentage of responses. The greater the index, the more negative the sentiment is of firms in a given sub-sector

Figure 5: Firm 6-month Expectation vs Actual

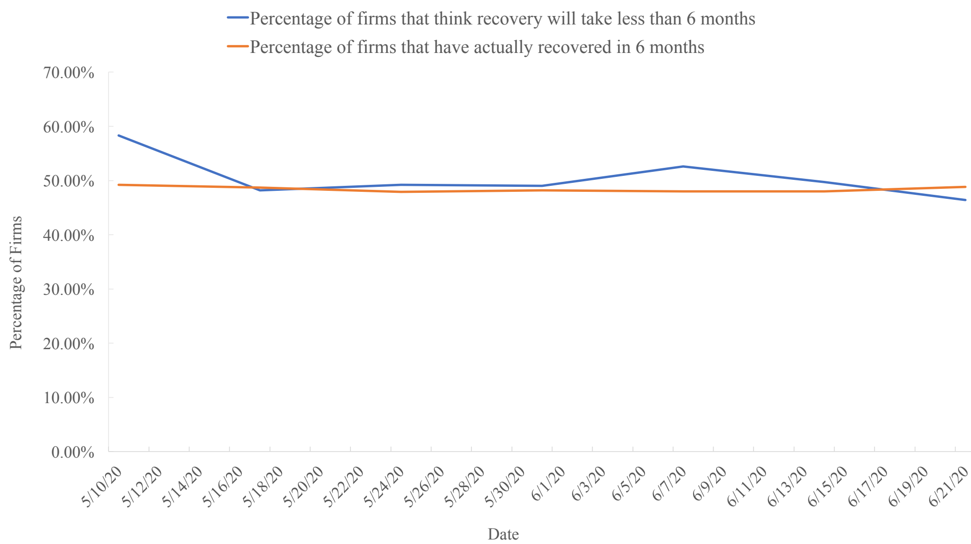
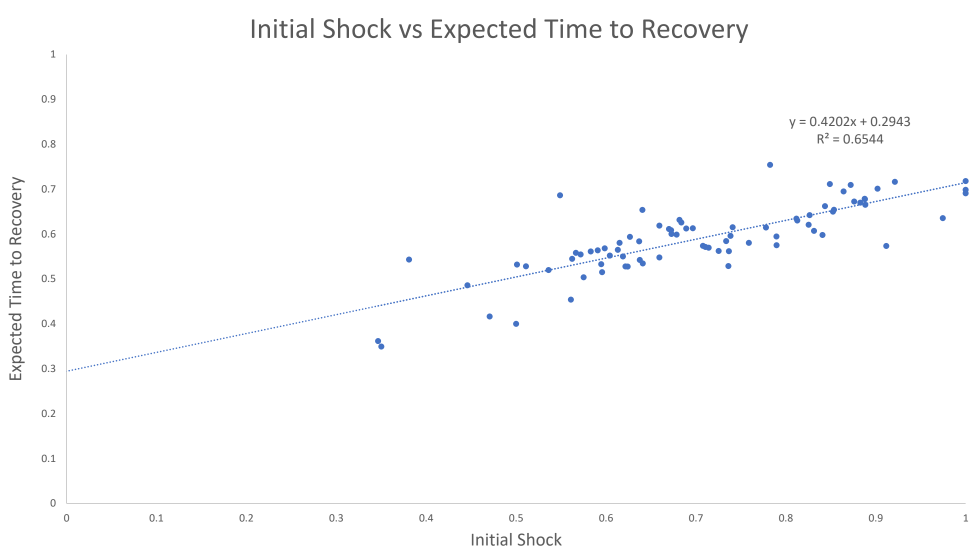


Figure 6: [4]

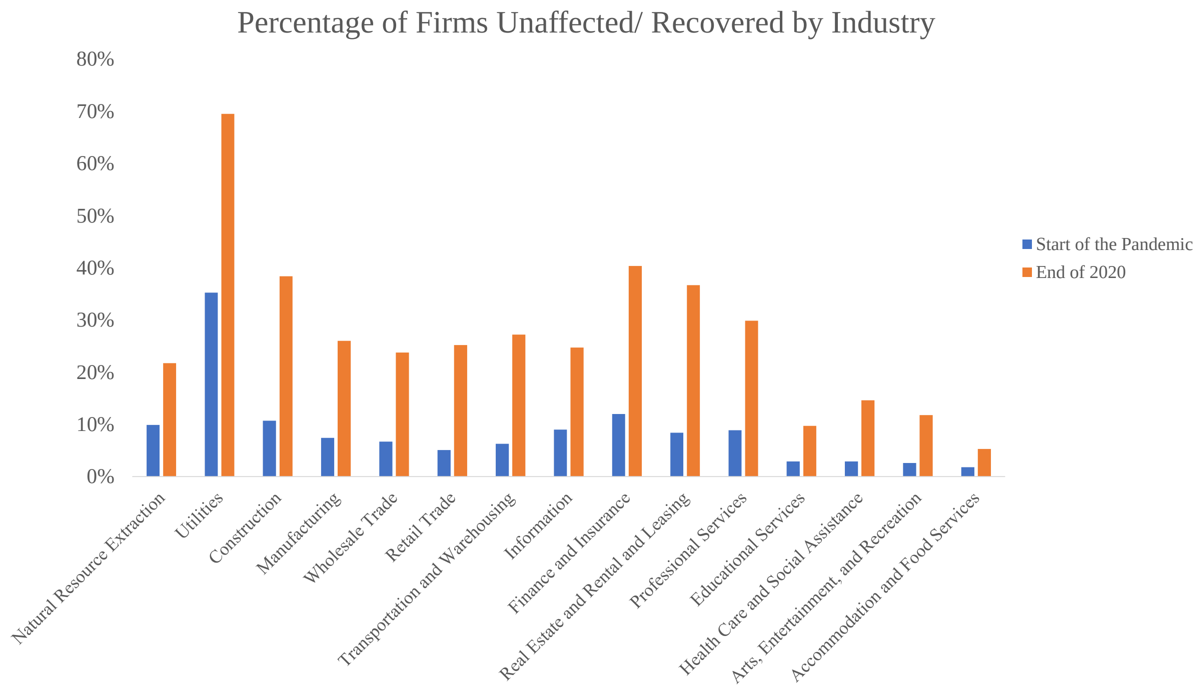


at the start of the pandemic was less than the actual recovered percentage 3 months later, which shows that firms were overly pessimistic with regards to the short term effects of the pandemic, likely due to the initial stringent business closures laws. In figure 5, I observe that the proportion of firm that believe that their business will recover in 6 months is in line with the actual proportion of firms that have recovered in 6 months. What this tells us is that firms overestimated the initial shock of the pandemic on their businesses in the short run, but were pretty accurate with the long term impacts of the pandemic. Generally speaking, I assume that $|E(\frac{\partial r_j}{\partial v_j})|$ would be slightly larger than $|\frac{\partial r_j}{\partial v_j}|$, but not significant enough to make a difference. This likely means that firms were acting "rationally" from the perspective of our model. The one limitation to this analysis is that the firms that reported that they will recover may not have been the same firms that actually recovered.

Looking at the data from April 2020 through January 2021, I see that existing small businesses experienced very sharp declines in activity, overall sentiment, and expectations early in the pandemic, and that while these later became less negative, they were still in a substantially negative range by the first week of January 2021 for particular industries. As shown in the graph below, I see that even in December 2020, nearly after a year since the pandemic started, the percentage of businesses that recovered by industry is still low. It is important to note that there is significant variation across different industries, and that the percentage of firms affected as the start of the pandemic is a good indicator of the recovery experienced by the industry.

Did firms that are not affected by the pandemic apply to the PPP? From the decision tree that I built, I assumed that firms are profit maximizers, and if they didn't suffer from the pandemic, such that $\frac{\partial r_j}{\partial v_j} > 0$, they would still apply to the PPP because they are able to able to receive a grant from the program, which would cause the PPP to be sub-optimal in the perspective of the government. However, in reality, do these firms that are unaffected still apply to the PPP? I use data from the SBPS to run a regression model that examines the percentage of businesses that were unaffected in each industry at the start

Figure 7: [5]



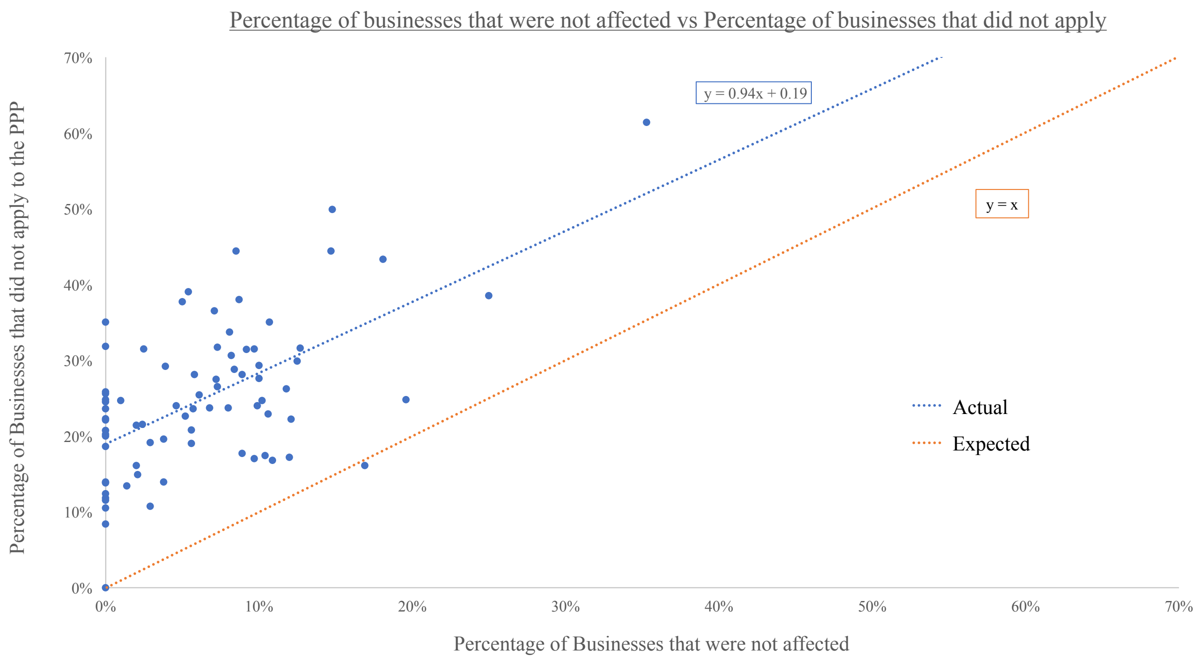
of the pandemic, and the percentage of businesses in that industry that did not apply to the PPP to identify whether there is a relationship[6].

What is shown here is that every increase in percentage of businesses in a given sub-sector that were not affected leads to an approximate one percentage increase in businesses that do not apply to the PPP, which shows that firms didn't exhibit profit maximizing behaviour in light of the PPP, but rather self-selecting behaviour as desired by the government. This is important to note because it shows that despite the PPP being untargeted, small businesses exhibited self-selecting behaviour and did not take advantage of the program. Despite so, there is still a lot variation with different industries, and such self-targeting behaviour is not consistent. A cynical explanation to this could be that firms that were unaffected did

[6]Note that there may be incentive for businesses to misreport in the survey, as firms may not want the public to know that they still applied to the PPP if they are not affected, but SBPS noted that microdata of responses will not be reported publicly, which may reduce the incentive misreport such data

[6]Source: Small Business Pulse Survey Data

Figure 8: [7]



not seek out for relief and thus were unaware of the potential benefits of the PPP to them. Furthermore, by observing the Y-intercept of the graph, I see that around 19% of the firms that are affected did not apply to the PPP. This could be attributed to 2 reasons: 1) Firms decided that the potential savings from downsizing would be greater than the value of the grant received, 2) Firms were unaware of the PPP.

Post Loan Examination

I showed that there was self-targeting behaviour at the start of the program. The question that I examine next is whether this self-targeting effects sustained as the pandemic went on. More specifically, I investigate whether the more distressed sectors by the end of December 2020 have a higher probability of having applied to the PPP. The reason why I choose the end of December 2020 was because as discussed in 3.1.1, Congress extended the deadline for restoring employment levels to December 31, 2020, in order for businesses to qualify for

[7]Source: Small Business Pulse Survey Data

loan forgiveness, which means the state of firms at this point in time would determine the effects of the PPP. As shown above, firms in different industries face vastly different levels of shocks as a result of the pandemic. Using different measures of adversity of a particular industry, such as the overall pandemic effect, current level of operating capacity, current level of business sentiment, current level of cash-on-hand, and classification of "Essential Business", I run a regression model to analyze how each variable contributes to: 1) whether a firm decides to maintain employee level, 2) apply to the PPP, 3) the success rate of a PPP application.

I use SBPS data from the end of December 2020 (specifically the week of 21st of December). More specifically, I analyze the probability that firms in a given sub-sector (NAICS3) would 1) apply to the PPP, 2) maintain its payroll, 3) successful in applying to the PPP given the adversity the sub-sector was facing by the end of December 2020, which results in the following regression models:

$$Y_{ppp} = \beta_0 + \beta_1 X_{hist} + \beta_2 X_{opcap} + \beta_3 X_{sent} + \beta_4 X_{ess} + \beta_5 X_{cash} + \epsilon$$

$$Y_{payroll} = \beta_0 + \beta_1 X_{hist} + \beta_2 X_{opcap} + \beta_3 X_{sent} + \beta_4 X_{ess} + \beta_5 X_{cash} + \epsilon$$

$$Y_{success} = \beta_0 + \beta_1 X_{hist} + \beta_2 X_{opcap} + \beta_3 X_{sent} + \beta_4 X_{ess} + \beta_5 X_{cash} + \epsilon$$

where:

- $\boldsymbol{Y_{ppp}}$ is the probability that a firm in a given sub-sector has applied to the PPP by end of December 2020.
- $\boldsymbol{Y_{payroll}}$ is the probability that a firm in a given sub-sector has restored employee headcount by the end of December 2020.
- $\boldsymbol{Y_{success}}$ is the probability that a firm in a given sub-sector received a PPP given that it applied to the PPP, which is calculated by dividing the percentage of firms that received a PPP loan in a given sub-sector by the percentage of firms that applied to a

PPP loan in a given sub-sector.

- $\boldsymbol{X_{hist}}$ is an index constructed to represent the degree to which firms in a given sub-sector was negatively affected by the pandemic at the end of December 2020, by assigning a numeric value to each of the response to the question: "Overall, how has this business been affected by the COVID-19 pandemic?", where *Large Negative Effect = 1, Moderate Negative Effect = 0.5, No effect = 0, Moderate Positive Effect = -0.5, Large Positive Effect = -1*, and weighing with the percentage of responses. The greater the index, the more firms in a given sub-sector was negatively affected by the pandemic.

- $\boldsymbol{X_{opcap}}$ is an index constructed to represent the degree to which firms' current operating capacities in a given sub-sector is reduced at the end of December 2020, by assigning a numeric value to each of the response to the question: "How would you describe this business's current operating capacity relative to its operating capacity prior to the Coronavirus pandemic? Note: Operating capacity is the maximum amount of activity this business could conduct under realistic operating conditions.", where *Decreased 50% or more = 1, Decreased less than 50% = 0.5, No change = 0, Increased less than 50% = -0.5, Increased more than 50% = -1*, and weighing with the percentage of responses. The greater the index, the more the firms in a given sub-sector are affected by the pandemic currently.

- $\boldsymbol{X_{cash}}$ is an index constructed to represent the degree of cash constraint of firms in a given sub-sector at the end of December 2020, by assigning a numeric value to each of the response to the question: "How would you describe the current availability of cash on hand for this business, including any financial assistance or loans?", where *Length of Business Operations: No cash = 1, 1-7 Days = 0.8, 1-2 Weeks = 0.6, 3-5 Weeks = 0.4, 1-2 Month = 0.2, 3 or more Months = 0*, and weighing with the percentage of responses. The greater the index, the more cash constrained firms are in a given sub-sector.

- $\boldsymbol{X_{sent}}$ is an index constructed to represent the degree of negative sentiment of firms in a given sub-sector at the end of December 2020, by assigning a numeric value to each of the response to the question: "In your opinion, how much time do you think will pass before this business returns to its normal level of operations relative to one year ago?", where *Expected Recovery Duration: Never = 1, More than 6 months = 0.8, 4-6 months = 0.6, 2-3 months = 0.4, 1 month or less = 0.2, No impact = 0*, and weighing with the percentage of responses. The greater the index, the more negative the sentiment is of firms in a given sub-sector.

- $\boldsymbol{X_{ess}}$ is whether firms in a given sub-sector is classified as "Non-Essential Business", which have implications on whether a firm was forced to close during the pandemic.

Results

Restoring Employment Levels

As shown in Regression 1 in Table 1, I observe that the degree of adversity faced by firms in a given sub-sector have significant effects on the likelihood of firms in that given sub-sector restoring employment levels, which is unsurprising considering that firms that are facing more adversity are less likely to need pre-pandemic levels of employment, and also have less financial ability to maintain employment levels. Only taking variables that are significant at a 5% level shows that only the *current* level of adversity affects the probability of restoring employment levels, more specifically, the current degree of cash constraint (X_{cash}), current degree of operating capacity reduction (X_{opcap}), and current degree of negative sentiment (X_{sent}). As expected, the higher the level of cash constraint firms in a given industry are, the greater the degree of current operating capacity reduction as compared to pre-pandemic levels, and the greater the negative sentiment there is within firms in a given industry, the more likely these firms are to not restore employee headcount.

Intuitively, this shows that firms were making the decision to restore employment levels based off of the current level of adversity, but not of overall level adversity measured over the course of the pandemic, represented by X_{hist}, and X_{ess}. It shows that even if firms were

Table 1: Regression Results

	Dependent Variable:		
	$Y_{payroll}$	Y_{ppp}	$Y_{success}$
	(1)	(2)	(3)
Intercept	0.958***	0.498***	0.990***
	(0.070)	(0.076)	(0.011)
X_{hist}	-0.000	0.237*	0.012
	(0.128)	(0.139)	(0.020)
X_{opcap}	-0.265**	-0.027	0.009
	(0.131)	(0.143)	(0.021)
X_{sent}	-0.279**	-0.038	-0.012
	(0.140)	(0.152)	(0.022)
X_{cash}	-0.638***	0.503***	-0.035
	(0.147)	(0.160)	(0.023)
X_{ess}	-0.036	0.018	0.005
	(0.036)	(0.039)	(0.006)
Observations	78	78	78
R^2	0.551	0.241	0.046
Adjusted R^2	0.520	0.189	-0.020
Residual Std. Error	0.110	0.119	0.017
F Statistic	17.695***	4.579***	0.696
Note:			*p<0.1; **p<0.05; ***p<0.01

greatly affected at the start of the pandemic, or were forced to close as a result of the "Non-Essential Business Closur" rules, as long as the current business and economic conditions are restored, such as the level of demand for their businesses (as measured by X_{opcap}) and level of cash-on-hand (as measured by X_{cash}), they will restore employment levels.

Furthermore, it is important to note that the current level of cash-on-hand is statistically the most significant and have the greatest effect on the likelihood of restoring employment levels. This shows that the PPP was an appropriate measure by the government if its objective was to restore employment levels, since the PPP provides liquidity in the form of cash to businesses. As mentioned before, I showed that firms' expectations for the effects of the pandemic were largely accurate, meaning that they would've have chosen the decision that gave them the true maximum long term profit (which can be likened to amount of cash-on-hand). Borawski and Schweitzer (2021) noted that PPP loans reached about 76 percent of US small businesses, which means that the PPP increased the cash-on-hand of over 76% of small businesses (the percentage of firms that applied to the PPP).

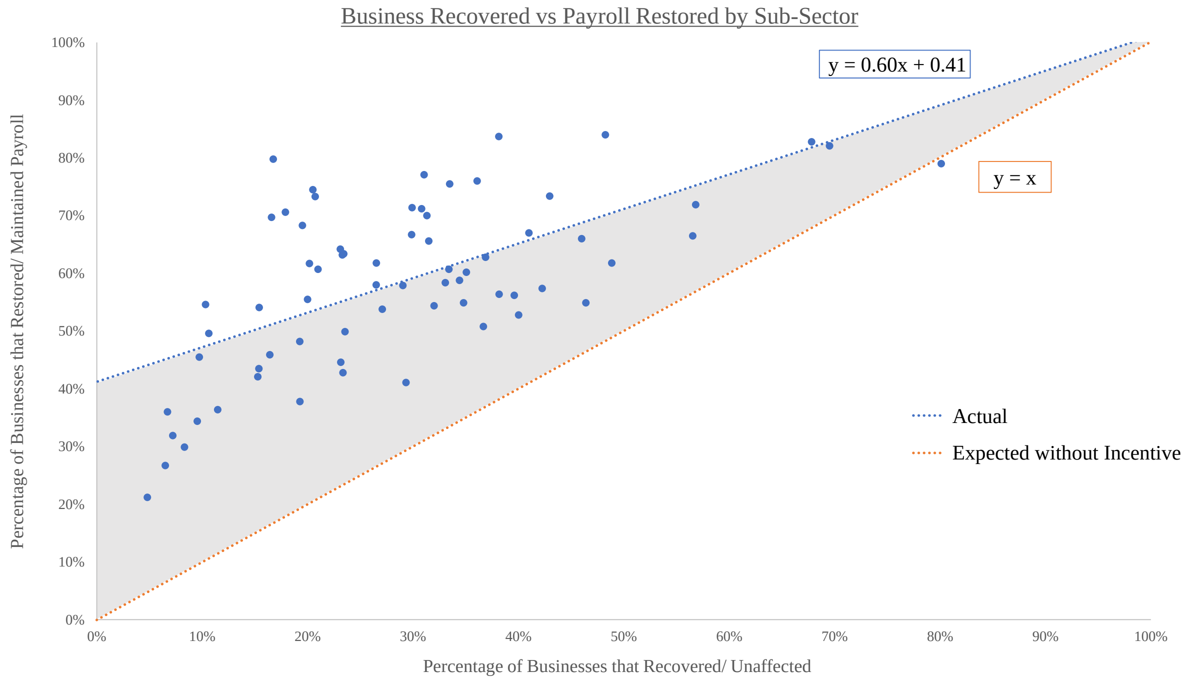
Applying to the PPP

Looking at Regression 2 in Table 1 and only taking into account variables that are statistically significant at 1% confidence level, I observe that the current level of cash constraint of firms in a given sub-sector is the only variable that affects the probability that firms have applied to the PPP. This aligns with our theoretical model that the primary driver for firms to the PPP is whether they are cash constrained or not.

What the regression model also shows is that the other metrics of distress, including current degree of operating capacity reduction, degree of negative sentiment, and overall pandemic impact have no statistical significance on the probability of whether a firm in a given industry has applied to the PPP loan or not. This means that different industries with varying levels of adversity are expected to have similar PPP application rates, which implies that firms that have applied to the PPP aren't anymore likely to have faced more adversity except for the level of cash-on-hand that they have. This is counter-intuitive, because in the previous section, we showed that firms that are unaffected at the start of the pandemic are unlikely to apply to the PPP. What this shows is that the self-targeting effects were neutralized by the end of December 2020, as firms recovered to varying degrees. Funds from the PPP did not skew towards sectors that were still distressed by the end of year 2020.

PPP Application Success Rate

Figure 9



Looking at Regression 3 in Table 1, I observe that the degree of adversity that firms in a given sub-sector face have no impact on the the success rate of a PPP application. This implies that banks were not discriminatory towards firms when they applied for a PPP loan, which contradicts findings in Bartik et al. (2020), which I suspect is due to the fact that his findings were from the early days of the PPP, while a post-loan examination would be more accurate to judge the success rate. Using this finding, I make the assumption that that firms with low levels of distress are not any more likely to be successful in receiving a PPP loan than firms with low levels of distress.

I further analyze the marginal effect between recovered businesses and employment level restoration by analyzing the probability that a firm in a given industry has recovered to pre-pandemic levels and its effect on the probability that a firm in a given industry has restored employment levels to pre-pandemic levels[8]. As expected and shown in with the

[8] I use the answer "No Impact" to the question "Expected Recovery Duration" in the SBPS as the percentage of recovered business in a given sector

"Actual" trendline, there is a strong positive correlation between the two, which is intuitive considering firms with "normal" operating capacity would require "normal" employment levels, which suggests that these firms would have hired back its employees with or without the PPP. What is interesting to note is that the gradient of the trendline is less than 1, and the y-intersect (where no firms have recovered) gives a probability of 0.41 that a firm in a given industry would still maintain employment levels.

I also show an alternative and controlled scenario depicted with the trendline "Expected without Incentive" that assumes that a business would maintain payroll levels only if it has recovered, such that y=x. This scenario would happen if firms truly profit maximized and there were no incentives (no Paycheck Protection Program) for them to maintain payroll levels. I observe that all data points except one hover above this line, which shows that there was substantial effect on employment, which can be attributed to 3 reasons: 1) The existence of PPP which incentives firms to maintain employee levels, which extent determines the success of the PPP, 2) Small businesses are hesitant to cut employment levels to avoid the risk of rehiring employees 3) Expectation that the economy will recover shortly. This shows that the PPP has substantial effects in motivating firms to maintaining employment level.

3.1.2 Second Stage of Self-Targeting: Loan Forgiveness

The next step to understand the performance of the self-targeting mechanism is to look at the loan forgiveness rate, and analyze which businesses received the grant money. This stage of self-targeting is arguably even more important than the first stage, because money given out here is in the form of grants and essentially a cash transfer.

I first reconcile data from the Small Business Pulse Survey and loan level data from the Small Business Admininstration. Overall, 94% of loans were forgiven but SBPS data shows that only around 54% of businesses actually recovered payroll [9]. I calculate the percentage of loans forgiven by subsector (NAICS3) in Phase 1 of the PPP and find that the forgiveness rate of every sub-sector is higher than the reported payroll recovery percentage as noted in the SBPS. This is troubling, as I previously noted that firms that were unaffected at the start of the pandemic are unlikely to apply to the PPP, which means that the discrepancy would be even bigger. This suggests that the SBA was likely approving forgiveness applications even when firms did not restore payroll levels. This follows findings in Beggs and Harvison (2022), which suggested that 25% of firms receiving PPP indicated they would retain more jobs in their loan application than the number of employees disclosed.

I run a regression on the probability that a firm in a given industry would have their loans forgiven: ($Y_{forgiven}$).

I see that no variables are statistically significant at 5% level, which suggests that within the firms that received a PPP loan, the adversity that firms face have no bearing on whether a firm is more likely to have their loans forgiven. This reinforces the hypothesis that there was close to no self-targeting behaviour by firms in this stage. Comparing this to $Y_{payroll}$ regression model that I have previously built, I see that that the adversity does matter for firms to decide whether to downsize or not. Since $Y_{payroll}$ includes firms that have not applied to the PPP, I can imply that there was a significant number of firms that decided to downsize and not utilize the PPP, such that $x_j < \ |E(\frac{\partial l_j}{\partial v_j}))|$. Since X_j is relative to the size of each firm and could be taken at a constant, the PPP failed to address the the firms that were most distressed such that $|E(\frac{\partial l_j}{\partial v_j})|$ was the greatest.

Using the assumption that a firm that had its loan forgiven isn't anymore likely to be more distressed than a firm that is paying back the loan, I can estimate the total amount of grants that the PPP spent on firms which would've restored employee count anyway (as

[9]The 54% number refers to all businesses including businesses that did not apply to the PPP. However, with around 80% of businesses reporting that they have received a loan from the PPP in the SBPS data, the highest percentage that the businesses that applied and restored payroll is 54% / 80%, which is around 68%, which still shows discrepancy in what we expect versus actual

	Dependent Variable:	
	$Y_{forgiven}$	$Y_{payroll}$ *(reference)*
	(1)	(2)
Intercept	0.831***	0.958***
	(0.034)	(0.070)
X_{cash}	-0.079*	-0.638***
	(0.073)	(0.147)
X_{ess}	0.004	0.036
	(0.018)	(0.036)
X_{hist}	-0.017	-0.000
	(0.063)	(0.128)
X_{opcap}	-0.066	-0.265**
	(0.065)	(0.131)
X_{sent}	0.044	-0.279**
	(0.069)	(0.140)
Observations	78	78
R^2	0.072	0.551
Adjusted R^2	0.008	0.520
Residual Std. Error	0.054(df = 72)	0.110(df = 72)
F Statistic	1.125** (df = 5.0; 72.0)	17.695*** (df = 5.0; 72.0)
Note:		*p<0.1; **p<0.05; ***p<0.01

a result of restoration of business) during Phase 1 of the PPP. By looking at each loan that was forgiven and the subsector of each firm, I can use the probability that the firm in that given subsector has restored business levels at the end of December 2020, minus the initial probability of firms that were not affected (assuming they didn't apply to the program) to give a best case estimate of the amount of grant that PPP gave to firms that would've restored employee levels anyway, such that:

$$A_j = \sum_{n=1}^{n=i} \Gamma_j * \lambda_j * \delta_j$$

$$B_j = \sum_{n=1}^{n=i} \Gamma_j * \lambda_j * (1 - \delta_j)$$

- $\boldsymbol{A_j}$ is the total amount of grant given to firms in a given subsector that would've restored employee headcount regardless of the loan or not in Phase 1 of the PPP
- $\boldsymbol{B_j}$ is the total amount of grant given to firms in a given subsector that have not fully recovered yet but still maintained payroll in Phase 1 of the PPP
- $\boldsymbol{\Gamma_j}$ is the total amount of loan given to a subsector in Phase 1
- $\boldsymbol{\lambda_j}$ is the probability that a firm in a given subsector has maintained payroll given that it applied to the PPP, which is given by the probability that it maintained payroll by the end of 2020 - the probability that a firm in a given subsector was unaffected at the start of the PPP (assuming that it wouldn't apply to the PPP)
- $\boldsymbol{\delta_j}$ is the probability that a firm in a given subsector that has applied to the PPP have recovered by the end of 2020, which is given by probability that it is unaffected by the end of 2020 - the probability that it was unaffected at the start of the pandemic

Results

As of late 2021, 94% of PPP loans issued in 2020 had applied for forgiveness and virtually all such applications had been approved by the SBA (SBA). This shows that there was limited self-targeting during this second stage. I estimate that in the first phase of the PPP, only 30% of grants given to businesses had the full effect of influencing firms to restore employment, and 17% of grants were given to businesses that would've recovered employment levels anyway. For the rest of the loans, I concede the fact that there may have been partial effect of employment restoration, but effects were certainly not full and not optimal. Furthermore, this estimate is a best case scenario in which firms that were unaffected at the start of the pandemic didn't apply, which means that the results would be potentially worse if firms actually did.

4 Discussion

I study the distributional consequences of PPP, in which the government relies on a self-targeting mechanism to distribute aid to businesses at the start of the COVID-19 pandemic. I show that the PPP funds do not particularly flow to firms that had the highest employment effects, and there was a high cost of also funding firms that did not need it. All in all, this paper provides evidence that the self-targeting mechanism failed on multiple dimensions, and offers potential strategies that the government could have employed to improve the efficiency of the program.

I first study firm level decision during Phase 1 of the Paycheck Protection Program. I show using a theoretical model that firms' primary condition for applying to the PPP is its level of cash constraint, which is verified by empirical data. This may seem to be positive effect at first glance, but I consider two scenarios in which this will lead to suboptimal allocation in the eyes of the government. First, cash constraint firms are more likely to downsize, which means that government's desired objective of saving jobs would not be achieved even when a loan is given to these businesses. Second, as studied in Acharya et al. (2021), lending to cash constrained firms would increase the likelihood of the creation of zombie firms, whereby firms would still default on their loans, meaning a loss of allocative efficiency.

Next, I show with empirical evidence that despite initial self-targeting behaviour at the start of the program, the effects of the self-targeting were eventually neutralized. I show that subsectors that were more affected by the end of 2020 weren't anymore likely to have utilized the PPP. I show that the inefficiency cannot be solely attributed to firm greediness - there is evidence to show that firms that are not affected by the pandemic showed restraint and didn't apply to the PPP, however, examining the post-loan state of firms, I show that firms were not good at predicting whether they were in need of a loan, as a firm's distress level halfway through the pandemic is not indicative of whether it utilized the PPP.

A bright side to this is I find that firms weren't being discriminated by banks when applying to the PPP, such that subsectors that were facing more adversity weren't any less likely to receive a loan if they applied. This is a positive result in the eyes of the government that private actors (in this case, the banks) aligned with the government's objective of distributing funds fairly. This is likely because banks bear no risk in distributing funds, as the SBA guarantees all loans. Banks, by approving loans, can build relationships with small businesses which in turn are more likely to use them in the future.

One interesting developing in the PPP is the government extended the deadline for employment restoration to the end of 2020 which allowed them to apply for loan forgiveness, which gave firms ample of time to recover. I show that firms recovered to varying degrees over this period, and many firms would've recovered by the end of 2020 and restored employment anyway. I show that subsectors that had higher adversity aren't any more likely to have received forgiveness, and the fact that over 94% of loans being converted to grants mean that there was close to no self-targeting in this stage of the PPP. I note that the forgiveness rate in the PPP is higher than the reported payroll restoration percentage in the SPBS in virtually every sector, which suggests that the SBA was forgiving more loans than it should have. This can be attributed to 2 reasons: 1) The PPP forgiveness application is too relaxed 2) Fraudulent behaviour as noted by Beggs and Harvison (2022) whereby all numbers are self-reported by firms and firms indicated that they retained more jobs than they actually did.

The government attempts to mitigate this problem by creating a second draw PPP loan for firms if they can demonstrate at least a 25% reduction in gross receipts between comparable quarters of 2019 and 2020. This second draw loans have the same terms as the first loan and incentivizes firms to maintain employment levels even if their operation is reduced, which means that the impact of the second draw phase of the PPP would have a higher impact/ efficiency.

The PPP might have improved if it followed other countries' strategies, for example, the Bounce Back Loan program in the UK, which used a more targeted approach by requiring businesses to demonstrate need. As noted by Autor et al. (2022), "The United States chose to administer emergency aid using a fire hose rather than a fire extinguisher, with the predictable consequence that virtually the entire small business sector was doused with money. This approach may have been necessary, but it was because the U.S. lacked viable alternatives. By building administrative capacity in the years ahead, the United States could more target, calibrate, and deploy its emergency business response systems when most needed." It may seem that self-targeted approach was necessary, but I offer some potential solutions.

An alternative to the PPP is to increase the barrier for loan application or forgiveness, or the implementation of an "ordeal mechanism" as noted by Alatas et al. (2013), where firms with lower treatment effects would have a higher cost of applying than firms with higher treatment effects. Instead of allowing all firms that have maintained employee count to be able to qualify for loan forgiveness, the government could mandate that a business that has maintained employment level must show a 25% reduction in gross receipts (same as the rule for second draw PPP loan) in order to qualify for loan forgiveness, or even to apply to the PPP in the first place. This would be a "low-cost" strategy for the government because it would bear extra effort from the business, but not on the administration. It is also more difficult to forge such receipts as opposed to "self-reporting", which was used in the PPP, and the cost bore on firms that attempt to commit fraud would be high. This would disincentivize firms that are not cash constraint and not facing a reduction in operation to apply to the PPP or for forgiveness. This would also prevent fewer "zombie firms" from applying to the program, such that firms that were struggling pre-pandemic and weren't affected by the pandemic would not be able to apply.

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