# Unexpected Corporate Bond Demand and the Impact on Firm Acquisition Activity*

April Meehl Shannon Sledz

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**Abstract**

We analyze firms' financing decisions of mergers and acquisitions (M&A). We develop a quantitative model of the M&A market that features acquirers and targets, who have access to costly external financing to fund M&A and investment. Due to the tax advantage of debt, acquirers prefer to finance M&A using debt over equity. We then use the model to understand the transmission of the Corporate Credit Facilities (CCFs), the first ever Federal Reserve bond stimulus program, to firm level decisions around M&A. We find that CCFs relax the borrowing constraints of acquirers, making acquisitions cheaper. In particular, CCFs increase the likelihood of cash acquisitions only if the acquirer starts with low levels of cash. Building a novel dataset, we then test our model prediction. Using a difference-in-differences approach on firm-level credit ratings, we find support of our model prediction in the data — the CCFs did not impact firm acquisition behavior as many firms had elevated levels of cash.

*Keywords: Mergers and acquisitions, unconventional monetary policy, corporate liquidity, corporate bonds*

*April Meehl, Office of Financial Research. Contact: aprilmeehl@gmail.com and Shannon Sledz, University of Wisconsin-Madison. Contact: ssledz@wisc.edu. For the helpful advice, support, and insights, we thank Dean Corbae, Oliver Levine, Mark Rempel, Kerry Siani, Hamed Mahmudi, and Candance Jens. We also thank the students and faculty at the finance seminar in the Department of Finance at the University of Wisconsin - Madison. The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors and do not necessarily reflect the views or the official positions of the U.S. Department of the Treasury.

# 1 Introduction

Mergers and acquisitions (M&As) are one of the most complex and largest forms of firm-level investment (Bessler et al. (2011)). The total valuation of the M&A market has grown to a whopping $3.9 trillion in recent years (Rempel (2020)). Furthermore, the number of M&A deals completed in cash has steadily increased since the early 2000s due to a speed advantage in the execution of the deals (Rempel (2020)). However, the extensive literature on M&A does not provide a complete understanding of the heterogeneity in firm financing decisions to raise cash for acquisitions. At the aggregate level, several studies (Harford (2004), Acharya and Steffen (2020), Gulen et al. (2022)) have shown that the credit conditions in debt markets influences M&A activity. On the other hand, other studies have shown that equity markets matter more for M&A activity (Amihud et al. (1990), Morellec and Zhdanov (2008)). In this paper, we aim to bridge this gap in the literature. In particular, we address the following questions: 1) Under what conditions do firms finance cash deals by issuing equity versus debt? 2) How does a one-time unexpected shock in corporate debt markets impact firm-level acquisitions?

To answer these questions, we develop a quantitative model of the acquisition market that features costly external financing as in Hennessy and Whited (2005). We extend this model to incorporate an acquisition market similar to David (2021) where acquirers and targets randomly meet in the acquisition market and decide optimally on merging. Acquirers have access to both debt and equity markets to fund investments and M&A deals, but targets only have access to the equity market. Both types of firms invest in risky projects with uncertain returns. The model captures rich choices in capital structure across equity, investment, and capital. Along this dimension, the model suggests that acquirers tend to increase their capital investment and borrowing as the probability of meeting targets increases.

We then use this model to make key predictions about firms' M&A behavior under two scenarios. In the first scenario, we simulate an aggregate downturn with a one-time unexpected aggregate shock to firms' returns on investment. Under the second scenario, we replicate the Corporate Credit Facilities (CCFs), an unexpected central bank bond market stimulus, by relaxing firms' borrowing constraints. Three key predictions come from simulating these scenarios separately and jointly. The first is that acquirers finance acquisitions in cash and issue more debt in order to facilitate all-cash deals. The second is that the CCFs' relaxation of firms' borrowing allowed firms to increase access to capital. The third is that at the time of an aggregate downtown, M&As are less profitable and acquirers only take advantage of increased credit market access if they have low levels of cash. While providing insights to firms' financing decisions around M&A, we also view the predictions from our model as a way to understand how unconventional monetary policy can transmit to the real economy.

The model predictions speak to the important literature that understands the real effects of unconventional central bank stabilization policies. As the Federal Reserve has set precedence for intervening in the corporate bond markets, we use the CCFs as a natural experiment to test our model predictions in the data. We build a novel dataset consisting of firm-level financials, credit ratings, bond issuance activity, and acquisition activity. To test the CCFs' effect on acquisition activity, we conduct a difference-in-difference analysis of acquisition likelihood by firms with credit ratings at the time of the announcement of the CCFs. We then identify those firms whose bonds were eligible for purchase by the Federal Reserve based on credit rating and study a second difference-in-difference analysis with this threshold. Finally, we determine which firms issued bonds after the CCF announcement and study their acquisition likelihoods before and after that announcement. We find that all firms are significantly less likely to acquire after the announcement of the CCFs, most likely due to the macroeconomic conditions following the start of the COVID-19 pandemic. However, we find no significant difference between the likelihood of acquisition by firms with credit ratings versus firms without after the announcement compared to before.

We find that the empirical predictions support the theoretical predictions from the model in our CCFs simulation. Our model demonstrates that such an intervention can increase the likelihood of cash acquisitions. However, there is no effect if the firms already have substantial cash at the start of the intervention. Ultimately, central bank bond market stimulus programs alter firms with credit ratings' effective access to external financing, thus changing their capital structure and financing decisions. This finding is important for policy makers to understand the real effects of central bank interventions around the world.

The rest of the paper is as follows. A brief literature review is provided in Section 2. Section 3 describes the stylized model in detail and Section 4 highlights tradeoffs associated with cash acquisitions. Then Section 5 simulates counterfactual exercises to understand the heterogeneity in firms' financing decisions. Next, Section 6 tests the theoretical model predictions using a novel dataset which is described in Section 6.1. Lastly, Section 7 concludes.

## 2 Literature Review

Our paper contributes to two strands of literature. The first is the literature on market interventions by the government, specifically the literature on the Primary and Secondary Market Corporate Credit Facilities. Flanagan and Purnanandam (2020) documents the PMCCF and SMCFF and studies the Federal Reserve's discretion in buying corporate bonds. They find that bonds were more likely to be bought if they had a higher rating. Becker and Ivashina (2015) compares corporate bond issuance during the 2020 Covid-19 pandemic and the previous global financial crisis and find that the corporate bond market is very resilient and a key source of funding for firms. Darmouni and Siani (2023) looks at the investment decisions of firms who issued corporate bonds after the announcement of these programs. Rather than find an increase in investment, they found that majority of these firms hoarded cash. Other papers, such as Acharya and Steffen (2020), also study the corporate bond market in March 2020 to show that credit risk had a statistically significant impact on corporate cash holdings. Our paper aligns with the results of these papers in finding that firms did not engage in investment opportunities via acquisitions after issuing a bond during the time period of the CCFs.

The second strand of literature is on the financing on M&A activity. Malmendier et al. (2016) documents the rising proportion of M&A deals executed via cash and Rempel (2020) attributes this change to the speed of completing a M&A deal in cash relative to stock and shows how this speed advantage is driving the increase in cash holdings by firms. Harford (2004) finds that merger waves depend on whether or not there is sufficient capital liquidity to fund such deals. Liquidity is proxied for in this paper using spreads on commercial & industrial loans supplied by banks. Harford and Uysal (2014) then finds that firms with corporate bond market access are more likely to acquire than those without. Our paper studies a shock to firms' effective access to the credit market and its impact on acquisition activity. Furthermore, our paper contributes to the mostly under explored literature of bond issuance and M&A activity. Both Acharya et al. (2024) and Gulen et al. (2022) focus on the effects of cheaper corporate bond prices for firms on their acquisition activity. Acharya et al. (2024) shows that riskier firms benefited from quantitative easing (QE) as they could more easily issue bonds. Further, lower-rated firms on the verge of being downgraded took advantage of this QE subsidy to acquire firms and delay the downgrade. While this paper studies the effect of QE on firms' acquisition behavior, our paper directly studies how a subsidy to firm-level debt prices influences acquisition behavior. Gulen et al. (2022) demonstrates that when credit conditions are more favorable, firms issue debt to complete all-cash acquisitions. While their paper focuses on macro-level conditions, our paper isolates credit conditions for individual firms and their specific acquisition activity. Both of these papers are consistent with firms taking advantage of cheap credit and we add to this literature by using a very specific policy that had the direct intention of lowering corporate bond yields.[1]

[1]While the main purpose of the market intervention was to stabilize the corporate bond market, Fed officials also believed that it would lead to corporate investment and higher employment (of Governors of the Federal Reserve (2020)).

# 3 Model

The model features costly external financing as in Hennessy and Whited (2005) and combines elements from David (2021) of random matching of targets and acquirers in the M&A market. As the Federal Reserve has set precedence for intervening in the corporate bond markets, we use the model to run counterfactual exercises similar to the Fed's intervention to understand the effect on the real economy. We view our stylized model as a way to understand the mechanisms at play if the Federal Reserve should intervene in the corporate bond markets again. A simpler version of the model without acquisition decisions is shown in Appendix 7.

**Overview** Time is discrete. There are two beginning periods followed by an infinite horizon problem. There are three firms, targets, acquirers, and the merged firm. Firms decide how much capital to invest into a one-period risky project each period. The returns on the risky projects are unknown at the time of investment. The project output is subject to both aggregate, $A$, and idiosyncratic, $z$, shocks. The firm specific shocks are i.i.d., but the shock distribution of the acquirers stochastically dominates that of the targets. In the baseline version of the model, there is no uncertainty over the aggregate shock $A$. In Section **??**, we extend the baseline model to simulate a replication of the "Covid" shock by incorporating a one-time unexpected shock to $A$. Both targets and acquirers have access to the equity markets, but only acquirers have access to the bond markets.[2] The firms are owned by shareholders who are taxed at the individual tax rate of $\tau_i$ if they keep their funds in their individual account rather than within the firm. Therefore, the effective discount rate that the firms face is $\frac{1}{1+r(1-\tau_i)}$.

**Targets** In period 1, the target can raise funds for investment by issuing equity with a flotation cost, $\lambda$. The target makes initial capital investments, $k_t$, and invests this capital into a one-period risky project. The risky project is subject to idiosyncratic productivity shocks, $z_t \in [z_t^L, z_t^H]$ and an aggregate shock $A$. In period 2, the target realizes the project's output, $Az_tk_t^\alpha$. Firms pay corporate taxes, $\tau_c$ on the proceeds of the project and can deduct depreciation. Denote the targets tax function as $g_t(z_t, k_t) = \max\{0, Az_tk_t^\alpha - \delta k_t\}$. The target uses its proceeds from the project to pay these taxes, to invest in next period capital, $k_t'$, and to issue any positive cash flow as dividends to its shareholders, which are subject to taxes $\tau_d$. After the second period, the target faces the infinite horizon problem.

**Acquirers** In period 1, the acquirer chooses its investment for its desired capital level, $k_a$. The

[2]During the merger wave of 2021, almost all firms that were acquired did not have access to capital markets.

acquirer can raise funds for investment by either issuing equity and facing the flotation cost, $\lambda$, and/or issuing one-period debt, $p$. The debt is modeled as a discount bond that pays $\frac{p}{1+r}$ today and tomorrow the firm pays back $p$. The acquirer deducts depreciation from capital and interest when paying corporate taxes, $\tau_c$. Thus, debt has a tax advantage for the acquirer. The tax function for the acquirer is $g_a(z_a, k_a, p) = \max\{0, Az_a k_a^\alpha - \delta k_a - \frac{rp}{1+r}\}$. The acquirer must pay back $p$ and can sell off its undepreciated capital stock to do so. However, the liquidated capital stock will be valued at only $\gamma(1-\delta)k_a$. As the acquirer cannot default on the debt, it can borrow at the risk-free rate $r$. Thus, the acquirers borrowing constraint is based on its cash flow in the lowest return-realization state,

$$p \leq Az_a^L (k_a)^\alpha + \gamma(1-\delta)k_a - \tau_c g_a(z_a^L, k_a, p). \tag{1}$$

Similar to the target, if the acquirer has negative cash flow, they can issue equity to pay outflows. If the acquirer has positive cash flow, the proceeds are paid as dividends to the shareholders and taxed at rate $\tau_d$.

The acquirers' investment is subject to idiosyncratic productivity shocks, $z_a \in [z_a^L, z_a^H]$ and the aggregate productivity $A$. In period 2, the acquirer realizes the output from the project, $Az_a k_a^\alpha$, and then makes a decision about how much equity or debt to issue to finance next period's investment. In period 3, the acquirer faces the infinite horizon problem.

**Merged Firm** The last type of firm is the merged firm, which forms when the acquirer and target decide to merge in Period 2. As both the target and acquirer are subject to idiosyncratic productivity shocks, $z_a$ and $z_t$, the merged firm will have a new productivity that is a combination of both. With probability $\pi^H$, the productivity of the merged firm is $z_m^H = (z_a^H + z_t^H)^\sigma$ and with probability $(1 - \pi_H)$ the productivity of the merged firm is $z_m^L = (z_a^L + z_t^L)^\sigma$. The merged firm makes equity and capital decisions.

### Timing

1. Period 1
   (a) Acquirer makes capital and debt choices
   (b) Target makes capital choices[3]
2. Period 2

[3]Note that the acquirer has first move advantage. This simplifies the equilibrium calculation so that there is a unique equilibrium given the acquirer's first-period choices.

(a) Acquirer and target realize their returns from the risky project. They also realize if they meet to merge or not.

(b) If the firms meet, they merge if both choose to do so. If merging,

   i. The acquirer pays the target a price $P$ and receives the target's undepreciated capital $(1-\delta)k_t$. The acquirer must also pay a fixed cost $c_M$, representing administrative, legal, and other fees associated with merging.

   ii. The target exits with any remaining cash flow and the price $P$, all subject to dividend taxes.

   iii. The acquirer pays back any previous debt and makes its new capital and debt choices.

(c) If the firms do not merge,

   i. The acquirer pays back its debt and makes new capital, debt, and equity/dividend decisions.

   ii. The target makes its capital and equity/dividend decisions.

3. Period 3

   (a) If they firms merged, then the merged firm continues to make capital and equity decisions.

   (b) If the firms did not merge, then the acquirer and target continue on separately in the infinite horizon problem with no future chance at merging.

## 3.1 Period 1

This section describes the target's and acquirer's value functions in Periods 1. To solve the first-period problems of the acquirer and target, we must make assumptions about their expectations of merging. We assume that the probability of merging is $\pi_M$ and that the acquirer and target have perfect insight into the choices of the other party. This is because the acquirer knows the parameters of the target's problem and therefore can infer the decisions it would make, and vice versa. In practicality, this would map to the acquirer and target studying financial information about the other prior to merging. However, these assumptions do not guarantee a unique equilibrium. For a given $\pi_M$, there may be multiple $(k_t, k_a, p)$ combinations that are consistent with value function optimization. In this case, we assume that the acquirer has a form of first mover advantage and will always choose the $(k_a, p)$ that maximizes their own utility. The target is aware of this and will choose the corresponding equilibrium policy choice.

Denote $V_a^1$ as the acquirer's first-period value function. The firm chooses its equity issuance and/or level of borrowing to finance investment. Equity issuance occurs when investment exceeds the level of borrowing and is represented by the indicator function $\phi_i$. Otherwise, the firm will pays out the remaining cash flow as dividends, represented by the indicator function, $\phi_d$.

$$\begin{gathered}
V_a^1 = \max_{k_a,p}(1+\phi_i\lambda - \phi_d\tau_d)(-k_a + \frac{p}{1+r}) \\
+\frac{1}{1+r(1-\tau_i)}\Bigg[(1-\pi_M)\mathbb{E}_{z_a'}(V_a^2(k_a,p,z_a')) \\
+\pi_M\mathbb{E}_{z_a',z_t'}(V_a^{m,2}(k_a,p,z_a',k_t,z_t'))\Bigg] \\
\text{s.t.} \\
p \leq Az_a^L k_a^\alpha - \tau_c g(z_a^L,k_a,p) + \gamma(1-\delta)k_a \\
\phi_i = \{-k_a + \frac{p}{1+r} < 0\} \\
\phi_d = \{-k_a + \frac{p}{1+r} \geq 0\}
\end{gathered} \tag{2}$$

The acquirer faces a borrowing constraint which states that the firm cannot borrow more than they can pay back in the lowest realization of the idiosyncratic shock on the project. The acquirer can fire-sale its depreciated capital at value $\gamma$ to help pay the debt balance. The acquirer discounts the future value by $\frac{1}{1+r(1-\tau_i)}$ and takes an expectation over the idiosyncratic productivity return, $z_a'$. Tomorrow they will have value $V_a^2$ if they do not match with a target and value $V_a^{m,2}$ if they match with a target.

Denote $V_t^1$ as the target's first period problem where they chose how much equity to issue to finance investment in capital. No issuance is treated as a dividend with value of \$0. The targets make their investment decisions today, and tomorrow they realize an idiosyncratic return, $z_t$, on their project.

$$\begin{gathered}
V_t^1 = \max_{k_t} -(1+\lambda)k_t + \frac{1}{1+r(1-\tau_i)}\Bigg[(1-\pi_M)\mathbb{E}_{z_t'}(V_t^2(k_t,z_t')) \\
+\pi_M\mathbb{E}_{z_t'}(V_a^{m,2}(k_a,p,z_a,k_t,z_t'))\Bigg]
\end{gathered} \tag{3}$$

Without the ability to issue debt, the target must issue equity to cover their initial investment.[4]

[4]Recall that the target's problem could also be written as: $V_t^1 = \max_{I_t^1,k_t^1} -I + \frac{1}{1+r(1-\tau_i)}\mathbb{E}_{z_t}[V_t^2(k_t^1,z_t)]$ such that $I_t^1 \leq k_t^1 + k_t^1\lambda$

## 3.2 Period 2

At the beginning of Period 2, the acquirer and target realize if they have matched with each other. If they have matched, the acquirer and target make their decisions to merge based on the value functions $V_{a2}^{m}$ and $V_{t2}^{m}$. However, if the acquirer and target do not realize their chance to merge at the beginning of this period, they continue without any future possibility of merging. The value for the acquirer is given as $V_a^2$ and for the target, $V_t^2$.

The decision around merging for the acquirer is

$$\begin{gathered} V_{a2}^{m}(k_a, p, z_a, k_t, z_t) = \max\Bigg\{V_a^2(k_a, p, z_a), \max_{k'_m, p'_m}(1 + \phi_i\lambda - \phi_d\tau_d)(Az_a k_a^{\alpha} - \tau_c g(z_a, k_a, p) - p \\ +(1-\delta)k_a + (1-\delta)k_t - k'_m + \frac{p'_m}{1+r} - P(k_a, p, z_a, k_t, z_t) - c_M) \\ +\frac{1}{1 + r(1-\tau_i)}\mathbb{E}_{z'_m}(V_m^i(k'_m, p'_m, z'_m)))\Bigg\} \\ \text{s.t.} \\ p'_m \leq Az_m^L k'^{\alpha}_m - \tau_c g(z_m^L, k'_m, p'_m) + \gamma(1-\delta)k'_m \\ \phi_i = \{Az_a k_a^{\alpha} - \tau_c g(z_a, k_a, p) - p \\ +(1-\delta)k_a + (1-\delta)k_t - k'_m + \frac{p'_m}{1+r} - P(k_a, p, z_a, k_t, z_t) - c_M < 0\} \\ \phi_d = \{Az_a k_a^{\alpha} - \tau_c g(z_a, k_a, p) - p \\ +(1-\delta)k_a + (1-\delta)k_t - k'_m + \frac{p'_m}{1+r} - P(k_a, p, s_a, k_t, z_t) - c_M \geq 0\}. \end{gathered} \tag{4}$$

The decision for the target if matched with acquirer is

$$\begin{gathered} V_t^{m,2}(k_a, p, z_a, k_t, z_t) = \max\{V_t^2(k_t, z_t), (1 + \phi_i\lambda - \phi_d\tau_d)(Az_t k_t^{\alpha} - \tau_c g(z_t, k_t) + P(k_a, p, z_a, k_t, z_t))\} \\ \text{s.t.} \\ \phi_i = \{Az_t k_t^{\alpha} - \tau_c g(z_t(s_t), k_t) + P(k_a, p_a, s_a, k_t, s_t) < 0\} \\ \phi_d = \{Az_t(s_t)k_t^{\alpha} - \tau_c g(z_t(s_t), k_t) + P(k_a, p_a, s_a, k_t, s_t)\} \geq 0\}. \end{gathered} \tag{5}$$

Denote $V_a^2(k_a^1, p, z_a)$ as the value of the acquirer in the second period if they do not merge. The firm realizes the return on the risky investment project. This yields production value $Az_a(k_a^1)^{\alpha}$. The acquirer then must pay corporate taxes $\tau_c$ on its profits from the project. If they borrowed, then they must pay back their debt. Capital depreciates at rate $\delta$.

$$
\begin{aligned}
V_a^2(k_a^1, p, z_a) = \max_{k_a^2, p'} (1+\phi_i\lambda - \phi_d\tau_d)\left[Az_a(k_a^1)^\alpha - \tau_c g(z_a, k_a^1, p) - p + (1-\delta)k_a^1 - k_a^2 + \frac{p'}{1+r}\right] \\
+\frac{1}{1+r(1-\tau_i)}\mathbb{E}_{z_a'}(V_a^i(k_a^2, p', z_a')) \\
\text{s.t.} \\
p' \leq Az_a^L(k_a^2)^\alpha + \gamma(1-\delta)k_a^2 - \tau_c g(z_a^L, k_a^2, p') \\
\phi_i = \{Az_a(k_a^1)^\alpha - \tau_c g(z_a, k_a^1, p) - p + (1-\delta)k_a^1 - k_a^2 + \frac{p'}{1+r} < 0\} \\
\phi_d = \{Az_a(k_a^1)^\alpha - \tau_c g(z_a, k_a^1, p) - p + (1-\delta)k_a^1 - k_a^2 + \frac{p'}{1+r} \geq 0\}.
\end{aligned}
\tag{6}
$$

The acquirer then makes decisions over how much debt or equity to use to finance their capital. Similarly to period 1, the acquirer will issue equity if their flow profit is negative and will issue dividends if their flow profit is positive. They take an expectation of their future value over the idiosyncratic productivity and discount the future by $\frac{1}{1+r(1-\tau_i)}$. Tomorrow they enter the infinite horizon problem, $V_a^i$.

Denote $V_t^2$ as the target's second-period problem if they do not match with an acquiring firm. They realize the idiosyncratic return, $z_t$, on the risky project from period 1 and make decisions over equity issuance and capital. If the flow profit minus investment is positive, then the firm pays the shareholders dividends and pays taxes, $\tau_d$, on the dividends. This decision is represented by the indicator function, $\phi_d$. If the flow project minus the investment is negative, the firm must issue equity and face the equity issuance cost, $\lambda$, to cover the negative flow value. This action is represented by the indicator function, $\phi_i$.

$$
\begin{aligned}
V_t^2(z_t, k_t) = \max_{k_t'} (1+\phi_i\lambda - \phi_d\tau_d)\left[Az_t(k_t^1)^\alpha - \tau_c g_t(z_t, k_t) + (1-\delta)k_t - k_t'\right] \\
+\frac{1}{1+r(1-\tau_i)}\mathbb{E}_{z_t'}[V_t^i(k_t', z_t')] \\
\text{s.t.} \\
\phi_i = \{Az_t(k_t)^\alpha - \tau_c g_t(z_t, k_t) + (1-\delta)k_t - k_t' < 0\} \\
\phi_d = \{Az_t(k_t)^\alpha - \tau_c g_t(z_t, k_t) + (1-\delta)k_t - k_t' \geq 0\}
\end{aligned}
\tag{7}
$$

The target discounts the future by $\frac{1}{1+r(1-\tau_i)}$ and takes an expectation over the return to the risky investment project, $z_t'$. In the next period, they face the infinite horizon problem, which is denoted by $V_t^i$.

### 3.3 Period 3 - Infinite Horizon

This section shows the value functions in Period 3, which is an infinite horizon problem. There are 3 total value functions that we keep track of: value of acquirer if it does not merger $V_a^i$, value of target if it does not merge, $V_t^i$, and value of the merged firm, $V_m^i$.

The price of the merger is set by Nash bargaining, in which the target's bargaining power parameter is $\eta$. Essentially, both the acquirer and target need to earn at least the value they would receive from not merging and split the additional gains. Define the price of the merger

$$\begin{aligned} P(k_a, p, z_a, k_t, z_t) = (1-\delta)k_t + &\frac{1}{1+r(1-\tau_i)}[\pi V_t^i(k_t', z_t^H) + (1-\pi)V_t^i(k_t', z_t^L)] \\ &+ \frac{\eta}{1+r(1-\tau_i)}\Big[\pi(V_m^i(k_m', p_m', z_m^H) - V_a^i(k_a', p', z_a^H) - V_t^i(k_t', z_t^H)) \\ &+ (1-\pi)(V_m^i(k_m', p_m', z_m^L) - V_a^i(k_a', p', z_a^L) - V_t^i(k_t', z_t^L)) - c_M\Big] \end{aligned} \tag{8}$$

where the choices of $k_t', k_m', k_a', p_m', p'$ all depend on the set $(k_a, p, z_a, k_t, z_t)$. The first line of Equation 8 represents the value of continuing as a standalone firm for the target. The target will only agree to the merger if they receive at least this amount in cash. The next two lines represent the target's share of the gains from the merger, which must include the fixed cost of merging $c_M$ the acquirer will pay. The acquirer pays this price in cash, i.e. it must use its cash flow, debt, and equity issuance to pay this price in period 2 if it would like to merge and may be subject to large equity issuance costs to complete the merger.

The value of the merged firm in the remaining infinite horizon problem is now

$$\begin{aligned} V_m^i(k_m, p_m, z_m) = \max_{k_m', p_m'} &(1+\phi_i\lambda - \phi_d\tau_d)(Az_m k_m^\alpha - \tau_c g(z_m, k_m, p_m) - p_m + (1-\delta)k_m - k_m' + \frac{p_m'}{1+r}) \\ &+ \frac{1}{1+r(1-\tau_i)}\mathbb{E}_{z_m'}(V_m^i(k_m', p_m', z_m')) \\ &\text{s.t.} \\ p_m' &\leq Az_m^L {k'}_m^\alpha - \tau_c g(z_m^L, k_m', p_m') + \gamma(1-\delta)k_m' \\ \phi_i &= \{Az_m k_m^\alpha - \tau_c g(z_m, k_m, p_m) - p_m + (1-\delta)k_m - k_m' + \frac{p_m'}{1+r} < 0\} \\ \phi_d &= \{Az_m k_m^\alpha - \tau_c g(z_m, k_m, p_m) - p_m + (1-\delta)k_m - k_m' + \frac{p_m'}{1+r} \geq 0\}. \end{aligned} \tag{9}$$

In the event that the target and acquirer do not meet with each other in the beginning of the second period, they continue on without any chance of merging in the future. Denote the infinite horizon problem in period 3 for the target without merger as $V_t^i$.

$$
\begin{aligned}
V_t^i(z_t, k_t) = \max_{k_t'} (1 + \phi_i \lambda - \phi_d \tau_d) & \Big[ A z_t (k_t)^\alpha - \tau_c g(z_t, k_t) + (1-\delta) k_t - k_t' \Big] \\
& + \frac{1}{1 + r(1 - \tau_i)} \mathbb{E}_{z_t'} [V_t^i(z_t', k_t')] \\
& \text{s.t.} \\
\phi_i = \{ A z_t (k_t)^\alpha & - \tau_c g(z_t, k_t) + (1-\delta) k_t - k_t' < 0 \} \\
\phi_d = \{ A z_t (k_t)^\alpha & - \tau_c g(z_t, k_t) + (1-\delta) k_t - k_t' \geq 0 \}
\end{aligned}
\tag{10}
$$

Similarly for the acquirer without any future possibility of merging, the infinite horizon problem is

$$
\begin{aligned}
V_a^i(k_a, p, z_a) = \max_{k_a', p'} (1 + \phi_i \lambda - \phi_d \tau_d) & \Big[ A z_a (k_a)^\alpha - \tau_c g(z_a, k_a, p) - p + (1-\delta) k_a^2 - k_a' + \frac{p'}{1+r} \Big] \\
& + \frac{1}{1 + r(1 - \tau_i)} \mathbb{E}_{z_a'} (V_a^i(k_a', p', z_a')) \\
& \text{s.t.} \\
p' \leq A z_a^L (k_a')^\alpha & + \gamma (1-\delta) k_a - \tau_c g(z_a^L, k_a', p') \\
\phi_i = \{ A z_a (k_a')^\alpha - \tau_c g(z_a, k_a, p) & - p + (1-\delta) k_a - k_a' + \frac{p'}{1+r} < 0 \} \\
\phi_d = \{ A z_a (k_a')^\alpha - \tau_c g(z_a, k_a, p) & - p + (1-\delta) k_a - k_a' + \frac{p'}{1+r} \geq 0 \}
\end{aligned}
\tag{11}
$$

The acquirer enters the period with capital level $k_a^2$, debt balance, $p$, and idiosyncratic productivity value, $z_a$. Similar to Period 2, they will make decisions about debt or equity issuance. They continue like this forever since they did not meet a target at the beginning of Period 2.

Example model parameters can be found in Table 1. Using these parameters, we first solve for the capital and debt policy functions and the value of the target and acquirer in a world in which the probability of merging is 0, as described in Table 5. We find that the acquirer increases its capital investment when the project generates the higher return $z_a^H$, due to the relaxed equity constraint associated with earning cash from the previous investment. Further, the acquirer chooses a lower value of capital after the project generates the lower return $z_a^L$. The target also increases its capital upon realizing the higher return, but chooses the same level of capital if it receives the lower return. The target actually has more cash on hand after receiving the lower return than the acquirer does because the acquirer chose to borrow up to its borrowing constraint and therefore must use all cash proceeds to repay its debt. Without being able to borrow, the target does not face this issue. The ability to borrow is very useful though, as seen by the substantial difference in $V_{a1}$ and $V_{t1}$.

### 3.4 Model Parameters

Table 1: Model Parameters

| Parameter | Description | Value |
|---|---|---|
| $\alpha$ | Capital Return | 0.551 |
| $\delta$ | Depreciation Rate | 0.145 |
| $\lambda$ | Equity Issuance Cost | 0.028 |
| $\tau_i$ | Investor Tax Rate | 0.296 |
| $\tau_d$ | Dividend Tax Rate | 0.12 |
| $\tau_c$ | Corporate Tax Rate | 0.35 |
| $r$ | Risk Free Rate | 0.025 |
| $A$ | Aggregate Productivity | 1.0 |
| $z_a^H$ | Acquirer High Productivity | 0.95 |
| $z_a^L$ | Acquirer Low Productivity | 0.425 |
| $z_t^H$ | Target High Productivity | 0.75 |
| $z_t^L$ | Target Low Productivity | 0.375 |
| $\pi^H$ | Probability of High Productivity | 0.95 |
| $\eta$ | Target Bargaining Power | 0.5 |
| $\sigma$ | Merger Gains | 0.55 |
| $c_M$ | Fixed Cost of Merging | 2.0 |

## 4 Results

To understand the impact of the probability of merging on the firms' policy functions, we once again use the parameters in Table 1. In Figure 1, we plot the acquirer's initial period capital and borrowing decisions as a function of the probability of merger while holding the target's capital decision constant at the value the target chooses when the probability of merger is zero. This plot highlights how the acquirer alone reacts to the greater probability of merger. Figure 2 plots the target's decisions while keeping the acquirer's decisions constant while Figure 5 plots the true equilibrium in which each firm will optimally adjust to the decisions of the other firm.

Focusing solely on the acquirer's choices in Figure 1, the acquirer increases its capital as the probability of merger increases. Further, the acquirer slightly decreases its leverage (debt over capital) when the probability of merger passes 85%. There are two features of the merger that encourage this behavior. First, an increase in the probability of the merger increases the

Figure 1: Initial Period Policy Functions - Target Choice Constant

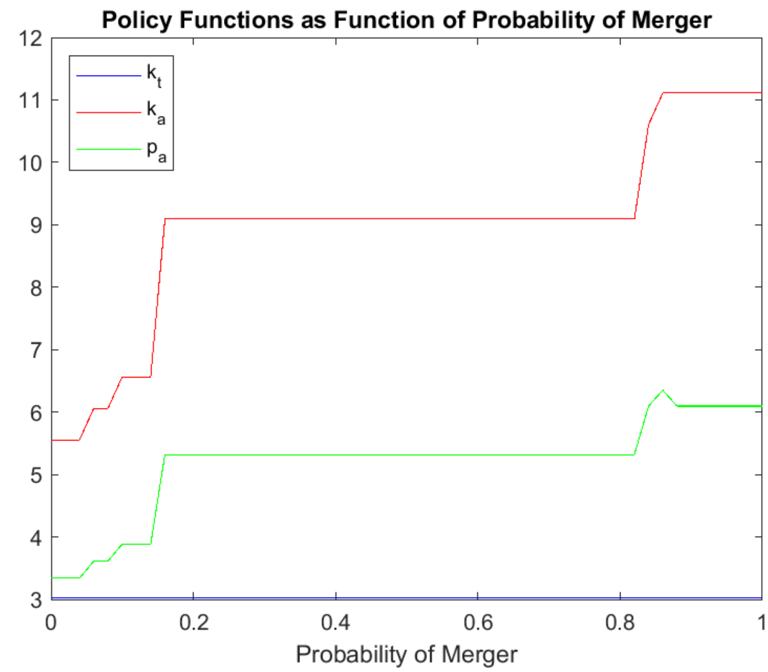



Figure 2: Initial Period Policy Functions - Acquirer Choice Constant

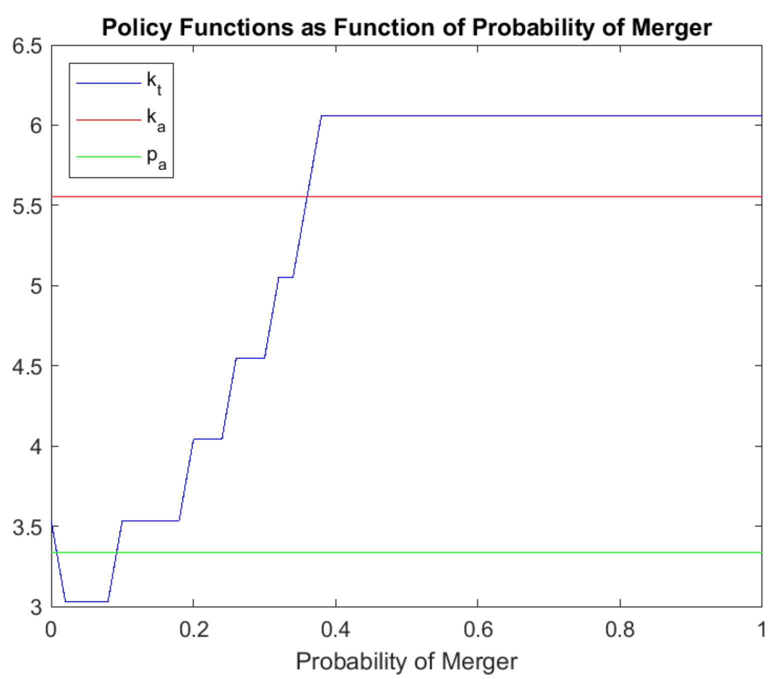
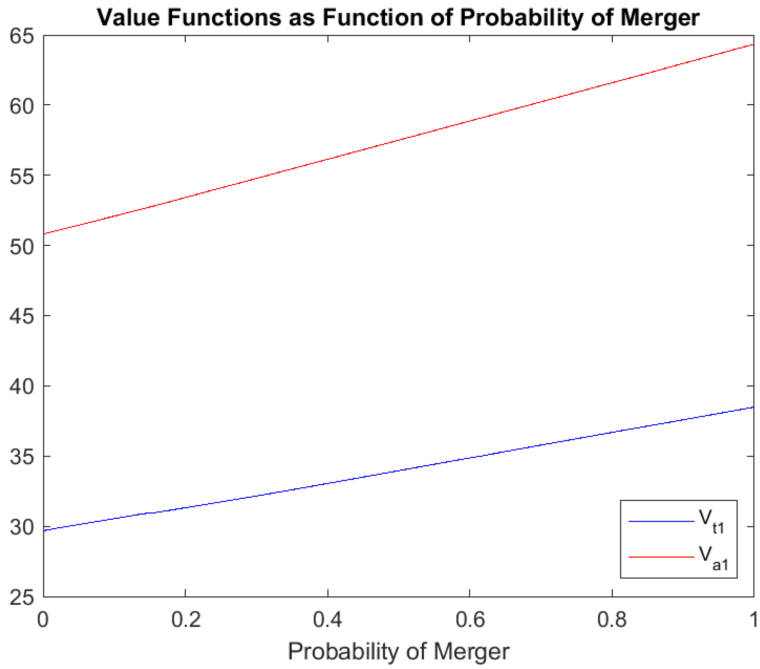


Figure 3: Initial Period Value Functions - Target Choice Constant

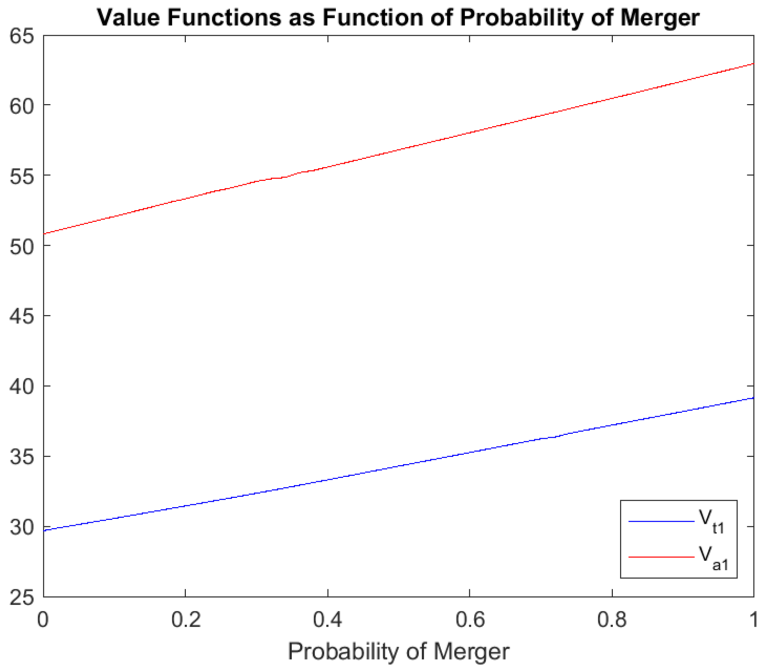



continuation value of the acquirer as the value of the merged firm is greater than the value of the acquirer alone. An increase in continuation value allows the firm to have a lower cash flow (or higher outflow of cash) in the first period, which occurs when the acquirer chooses more capital and/or less borrowing. Second, paying for the merger in cash can incur large equity issuance costs for the firm in the second period. Therefore, investing in more capital today and decreasing borrowing today both increase the firm's remaining cash after the returns of the project are realized and the debt is repaid next period. This cash can then be used to help pay for the merger.

In Figure 2, we see that the target also increases its capital when the probability of merger increases. The increased value of the second period allows the target to better stomach the high equity issuance cost in the first period. The corresponding value functions for Figures 1 and 2 can be seen in Figures 3 and 4. Value functions are strictly increasing in the probability of merging.

Figure 5 plots the equilibrium policy functions and value functions in the initial period for both firms. The equilibrium responses are approximately the same as the firms' choices when the other firm's choice is held constant. This is due to each firm absorbing a share of gains from the merger and therefore each benefiting from making the optimal decision. The value functions of the two firms can be found in the right plot. They are still increasing with the prob-

Figure 4: Initial Period Value Functions - Acquirer Choice Constant




ability of merger. Figures 6 and 7 plot the second period choices and value functions of the acquirer and target, keeping the choice of the other one fixed. These choices are a function of the probability of merger because they depend on the capital and borrowing decisions from the initial period, which depended on the probability of merger. As seen in the left plot of Figure 6, the acquirer increases its capital as the probability of merger increases. When the firm merges, however, it always chooses the same level of capital and debt, despite the capital and debt that were brought into the period. This is because the cost of the merger is quite substantial for the acquirer and they must pay large equity issuance costs to afford it. As the acquirer generally borrows up to its borrowing constraint, $-k'_m + \frac{p'_m}{1+r}$ is decreasing in $k'_m$. Therefore, the acquirer chooses to minimize this expenditure in this period in order to focus on paying the price of the merger itself. In the following period, the merged firm greatly increases its capital investment.

In the left plot of Figure 7, we see the second-period capital decisions of the target and the capital and debt decisions of the merged firm, holding the initial choices of the acquirer constant. The standalone target increases its capital investment as its initial period capital increases. The merged firm once again does not change its capital and debt investment. An increase in the capital investment of the target actually increases the value of the target and therefore the price that the acquirer must pay for the target. This binds the merged firm's borrowing contraint even more and they need to keep capital investment low in order to finance

Figure 5: Initial Period Policy and Value Functions

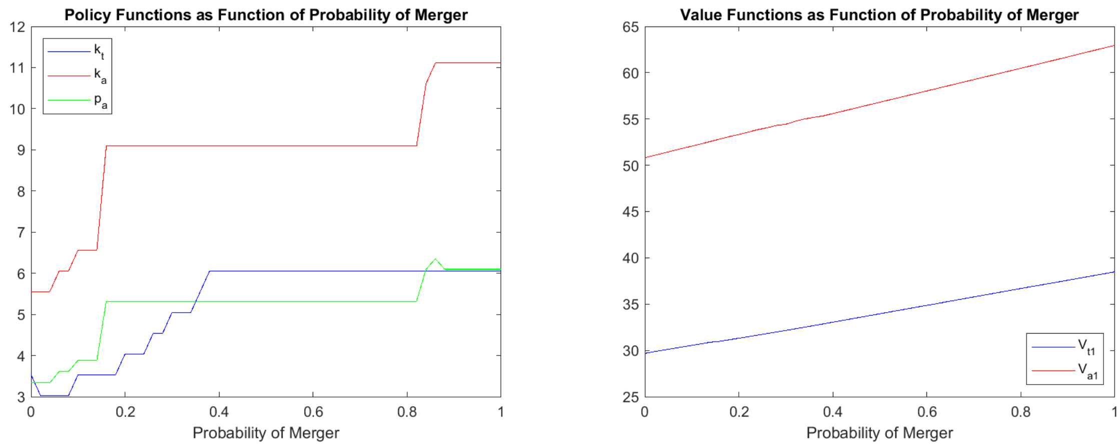



Figure 6: Second Period Functions - Target Choice Constant

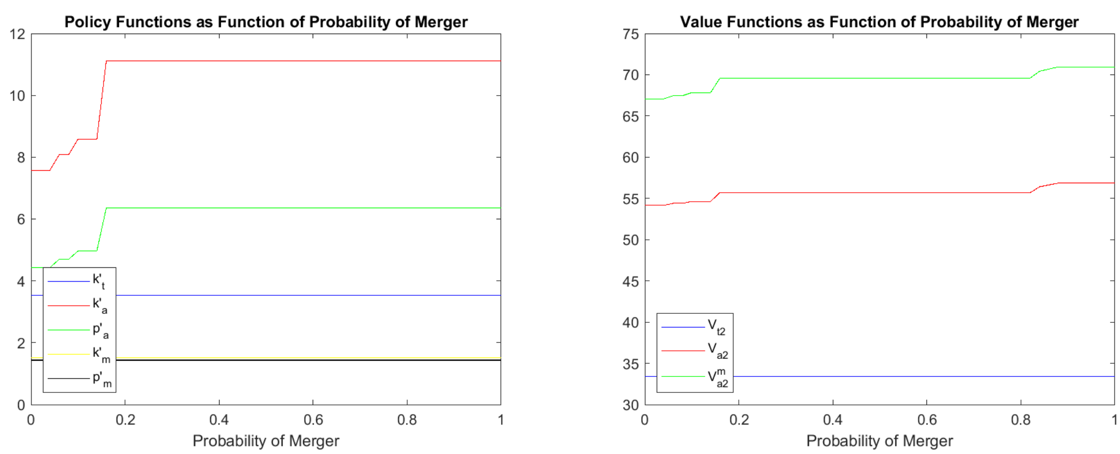
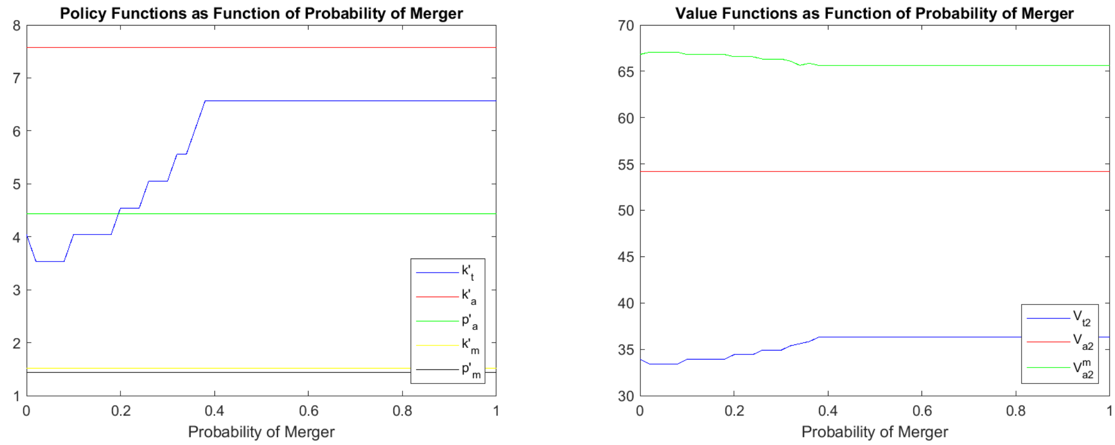


Figure 7: Second Period Functions - Acquirer Choice Constant

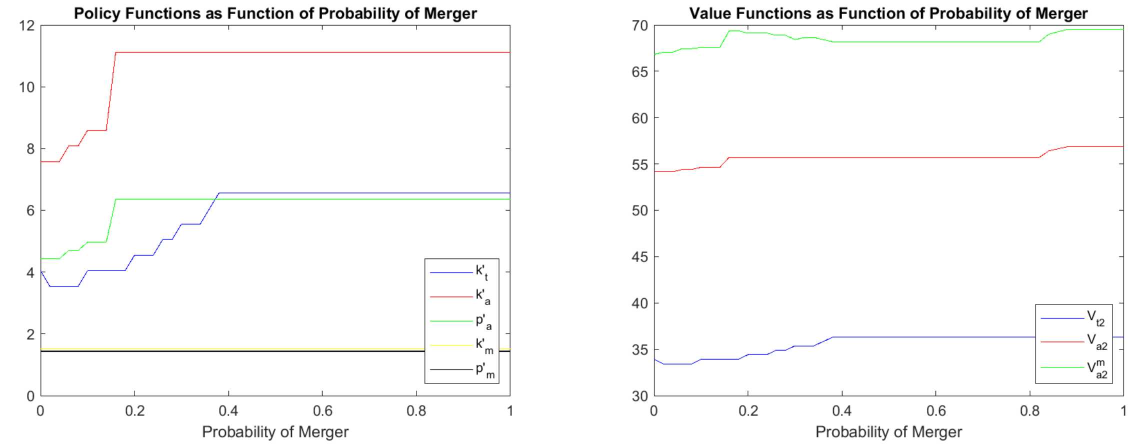



it.

Figures 6 and 7 also show the value functions associated with the second period for the target, acquirer, and merged firm, first when the target's choices are kept constant and then when the acquirer's are. The acquirer's and merged firm's values increase with the probability of merger when the target's choices (and thus value) are held constant. However, only the target's value increases when the acquirer's choices are held constant. The value of the merged firm decreases initially. This is due to the increase in the target's value needing to be incorporated into the price that is paid to the target in the merger, decreasing the value of the merging firm.

Finally, Figure 8 plots the equilibrium $k_t'$, $k_a'$, $k_m'$, $p_a'$, and $p_m'$ choices of the acquirer and target after the realization of the merger shock in its lefthand plot. The capital and borrowing decisions of the three firms are about the same as in the previous decisions. The value functions depicted in the right plot are more interesting. The value of the merged firm initially increases, due to a large bump in the acquirer's initial capital investment that produces cash to help the payment of the merger. However, there is a slight decline in the merger as the target then increases its capital investment and must be compensated for its value in the merger price. As the probability approaches one, the value of the merged firm increases again due to the reduction in leverage in the initial period by the acquirer, again providing the firm with more cash flow in the second period to pay for the merger.

Figure 8: Second Period Policy and Value Functions




# 5 Counterfactual Exercises

In this section, we run two separate counterfactual exercises to examine the impact on firm acquisition activity. The first exercise is a one-time unexpected aggregate shock to $A$ and the second is a relaxtion of acquirers' borrowing constraint. We then jointly examine these two scenarios together to fully simulate the Corporate Credit Facilities. We first provide an overview of the Primary and Secondary Market Corporate Credit Facilities.

## 5.1 Overview of the PMCCF and SMCCF

In the early onset of the COVID crisis in 2020, foreign investors and money market funds cashed in their US Treasuries. This lead to substantial increases in the balance sheets and supplementary leverage ratios (tier 1 capital/total leverage) of US Treasury Primary Dealers. On March 9, repo rates on 10 Year US Treasuries rose considerably, causing the usual risk-free basis trades held by many large hedge funds to become unprofitable. Between March 9 and March 15, hedge funds unwound their basis trades all at once, leading to illiquidity in the US Treasury market. The US corporate bond market soon followed suit.

On March 15, the Federal Reserve bought \$700 billion worth of Treasury notes, which alleviated the selling pressure felt by hedge funds. On March 23, the Federal Reserve bought more US Treasuries and announced the Primary (PMCCF) and Secondary Market Corporate Credit Facilities (SMCCF)[5]. The PMCCF was intended to allow corporations to issue bonds directly to

[5]FRBY:https://www.newyorkfed.org/markets/primary-and-secondary-market-faq/corporate-credit-facility-faq

the Federal Reserve and the SMCCF to buy existing investment grade corporate bonds. The purchase of US Treasuries and the announcement alone was enough to stabilize markets on March 23 ((Smith and Fox, 2020), Darmouni and Siani (2021)), even though corporate bond purchases did not start until June 16th. The bond market surged and lead to record issuance of corporate debt. To fund the purchases, the Treasury Department invested $25 billion into a special Federal Reserve subsidiary that could buy up to $250 billion in corporate debt from bondholders in the secondary market. The Federal Reserve extended the program until December 31, 2020 and on June 2, 2021 announced plans to wind down its corporate debt portfolio. [6]

The qualification rules for the PMCCF and SMCFF changed from the first announcement on March 23, 2020. To qualify for the program when the PMCCF and SMCCF were initially announced, the bond had to be less than 4 years in maturity, rated as investment grade as of March 22, 2020, and from a domestic firm or an international firm that had a significant amount of U.S. employees. However, on April 9th, 2020, the Fed announced it would also purchase bonds from "fallen angel" corporations — firms that were rated as investment grade before the Fed's announcement but had since been downgraded. The selection process for which bonds were going to be purchased was not transparent. For example, some have questioned why the Federal Reserve bought bonds from a large firm such as Apple[7]. Between June and July 2020, the Fed bought 414 out of 1818 potential bonds and as of September 7th, 2020 only $12.5B was used out of the $750B allocated towards the PMCCF and SMCCF. Flanagan & Purnanandam (2020) document bonds that had smaller credit spreads and longer maturity were more likely to be bought by the Federal Reserve.

## 5.2 Simulating a Recession

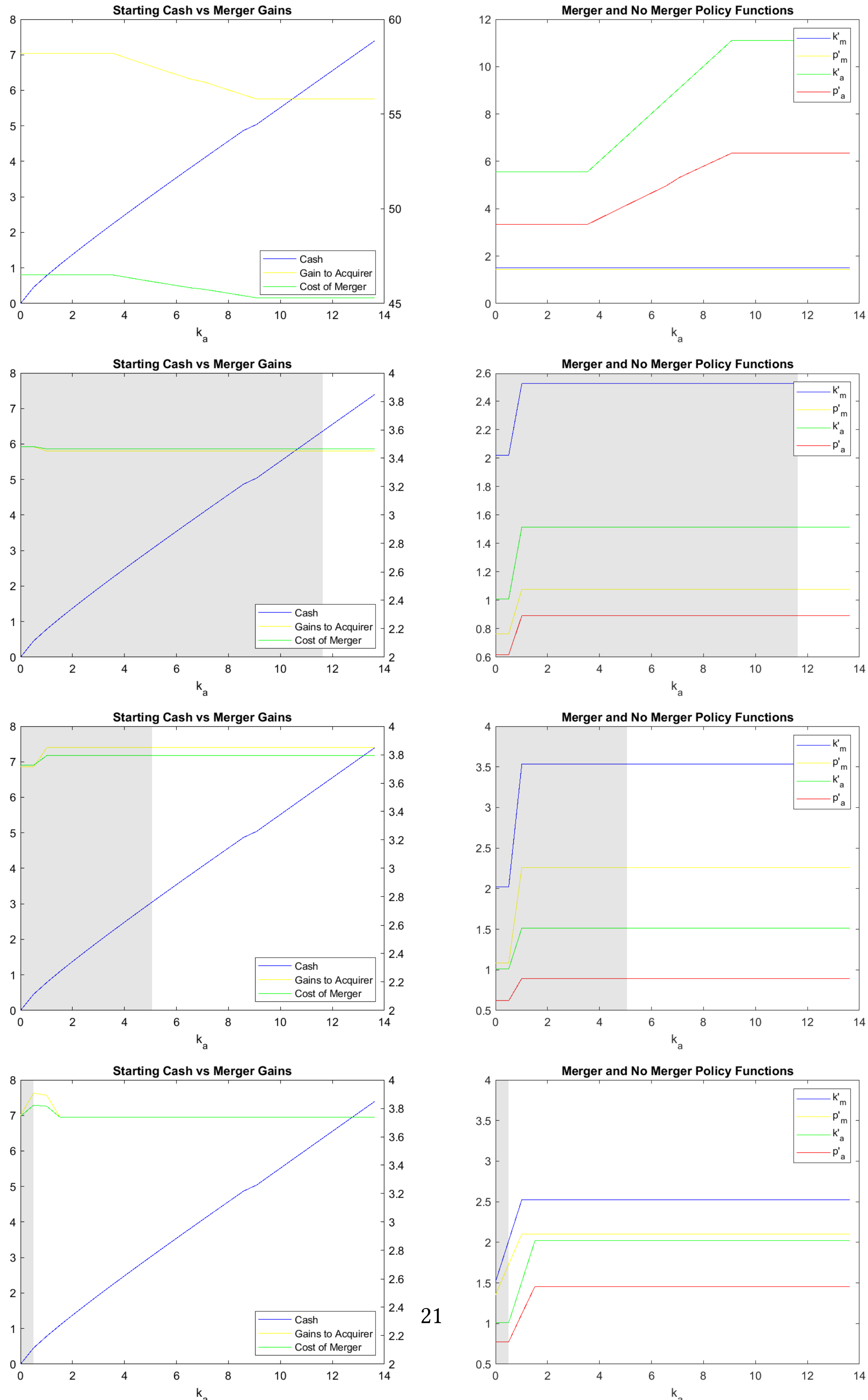
March 2020 consisted of multiple macroeconomic and financial shocks, all of which could have impacted the corporate bond and merger markets. In this section, we focus on changes that can be made to our model to highlight the most relevant shocks and their effects.

First, the onset of the COVID-19 pandemic impacted demand for the service industry, the operations of supply chains, and the availability of labor. In our simple model, these effects translate to a decrease in the aggregate productivity $A$. Not only does aggregate productivity affect the future returns of the firms, but it is also a factor in the borrowing constraint. A lower aggregate productivity translates to a lower level of debt that can be borrowed.

The second row of Figure 9 plots the impact of the aggregate productivity shock on the acquirer's capital and borrowing decisions and the effect on mergers compared to the baseline

[6]Federal Reserve Press Release
[7]CNBC Article

Figure 9: Merger, Capital, and Borrowing Choices in Various Macroeconomic Conditions



model shown in the first row. The lefthand plot displays the "starting cash" of the acquirer in the second period in the higher idiosyncratic productivity state, equal to $Az_a^L k_a^\alpha - \tau_c g(z_a^L, k_a, p_a) - p_a + (1-\delta)k_a$, with values of $k_a$ on the x-axis. In our previous analysis, we generally found that the acquirer would max out its borrowing constraint, so we assume that $p_a = Az_a^L k_a^\alpha + s(1-\delta)k_a - \tau_c g(z_a^L$. We also hold constant the value of $k_t$ and the idiosyncratic return of the target at X and $z_t^H$, respectively. Cash is increasing in the value of $k_a$ that the acquirer entered the period with. The yellow line plots the next period gains of the acquirer from the merger, or $\beta(V_m^i(k_m', p_m') - V_a^i(k_a', p_a'))$ where $k_m', p_m', k_a', p_a'$ are all optimally chosen based on $k_a, p_a, k_t$, and all parameter values. The green line represents the total cost of the merger to the acquirer, which includes the price it must pay $P = \beta(V_t^i(k_t') + \eta(V_m^i(k_m', p_m') - V_a^i(k_a', p_a') - V_t^i(k_t') - c_M))$ and the cost of merging $c_M$. In the righthand plot, the optimal choices of $k_m', p_m', k_a', p_a'$ as a function of $k_a$ are plotted for each scenario. Finally, in both plots, the grey shaded area represents state spaces in which the acquirer and/or target would choose *not* to merge.

In comparing the baseline results (first row) to the lowered aggregate productivity shock results (second row), the first thing to note is the much reduced gain and cost of merging. Due to the lowered aggregate productivity indefinitely, the value functions of each firm are greatly reduced, also resulting in a lowered price of merging. With such a low aggregate productivity, the increased idiosyncratic productivity associated with the merger is less of a benefit to the acquirer. The second major difference is that the firms choose not to merge for most of the state space. In the baseline, the firms always merge under the parametrization plotted here. However, in the lowered aggregate productivity scenario, the acquirer needs to have entered the period with substantial cash in order to be willing to merge. This is due to both the fixed cost of merger and the cost of raising equity to pay the cash price of the merger to the target in this period.

The righthand plot shows that the standalone acquirer will invest in much less capital now that the aggregate productivity is lower. The merged firm, however, will invest in slightly more. This actually demonstrates the choice the merged firm makes when financing the merger. In the baseline scenario, the price of the merger is very high. Even though the gains are also large, the acquirer must pay substantial equity issuance costs. This incentivizes the acquirer to save money in the current period on capital investment and instead spend it on the cost of the merger itself. The merged firm increases its capital investment in the periods following the merger. In the lowered aggregate productivity state however, the cost of the merger is lower. Therefore, the acquirer is willing to invest in a little more capital today.

Lowered aggregate productivity does not fully capture the ways in which the Covid shock has impacted corporate firms and their merger decisions. As a reaction to the shock, in March

2020, the Federal Reserve cut its benchmark rate twice, including a 50 bps cut on March 3 and a 100 bps cut on March 16. We represent these cuts by decreasing $r$, the risk-free rate in the model, from 2.5% to 1.0%. As rate cuts are seen as persistent and because we permanently decreased aggregate productivity $A$, we solve for the infinite horizon problem with this new risk-free rate as the new permanent risk-free rate as well as with the new lowered aggregate productivity.

The third row of Figure 9 plots the merger, capital, and borrowing decisions of the acquirer and the merged firm under this scenario. The lowered risk-free rate has a few effects: 1) it decreases the cost of borrowing 2) it increases the firm's discount factor and 3) it increases the borrowing constraint. These factors should attenuate the impact of the lowered aggregate productivity and lead to more investment and more mergers. This is what we see in the left-hand plot as the shaded area has been substantially reduced although the non-merger part of the state space is still greater than it was in the baseline scenario. In the righthand plot, the acquirer chooses similar capital investment as in the previous, but the merged firm chooses higher capital investment. The increases in the borrowing constraint helps offset the price of this investment while still paying for the cost of the merger.

## 5.3 Simulating the CCFs

On March 16, 2020, the Federal Reserve announced the Primary and Secondary Market Corporate Credit Facilities (PMCCF and SMCCF). The Fed promised to purchase corporate bonds using the PMCCF that 1) had 4 or less years of maturity and 2) were issued by issuers with an investment grade rating at the time of issuance. Additionally, the Fed promised to purchase corporate bonds on the secondary market using the SMCCF if the bonds 1) had 4 or less years of maturity remaining and 2) were issued by issuers with a current rating of investment grade. This announcement was the first time the Fed promised to purchase corporate bonds and a record-breaking issuance wave soon followed.

To model the effects of the PMCCF and SMCCF, we relax the acquirer's borrowing constraint, in order to represent an increase in demand for corporate bonds or that the government may be more willing to lend to the firms in this situation. In the model, we multiply the right-hand side of the borrowing constraint by $\epsilon$. For the merged firm, this translates to the constraint

$$p'_m \leq \epsilon[z_m^L {k'}_m^{\alpha} - \tau_c g(z_m^L, k'_m, p'_m) + s(1-\delta)k'_m]. \tag{12}$$

The acquirer's borrowing constraint will be adjusted in the same way.

We test this effect using the scenario in which in the second period, the interest rate is lowered to $r = .01$ and the aggregate productivity is reduced to $A = 0.5$. The results can be seen in the final row of Figure 9. While there is little impact on the cost or gains from merger, the no-merger state space is greatly reduced, almost to there being no such space at all. The increased borrowing limit assists the standalone acquirer in investing in more capital. However, this leads to the merged firm slightly decreasing its investment in order to have more gains from the merger to offset the cost.

The latter exercise demonstrates the exact mechanism we hope to show: an interference in the corporate bond market can lead to a greater rate of acquisition activity. However, this impact greatly depends on the starting level of cash of the firms. We find that those firms with large amounts of cash already were willing to merge in the adverse macroeconomic scenario, even without the CCFs.

# 6 Support of Model Prediction

In this section, we test our model predictions in the data. We first explain the novel dataset we formed to test the model predictions.

## 6.1 Data

We obtain firm-level characteristics from Compustat for all firms between 2000 - 2022. The data includes balance sheet information, such as cash holdings, debt holdings, PPE, and assets, and income statement variables, including operating income and sales, at the quarterly level. Bond issuance data comes from Mergent FISD at a daily frequency. In this dataset, we observe the offering amount, date of issuance, and maturity of each bond that corporations issue from 2000-2022. Also using Mergent FISD, we gather the individual rating of each security issued by the firm and any subsequent updating of that security's rating. In the merged Compustat - Mergent FISD sample, we have 1,623 firms that issued bonds during our time period. For acquisition activity, we use Securities Data Company (SDC) from Refinitiv to gather data on historical mergers and acquisition deals and characteristics of the deal, such as if the deal was paid for via cash or stock, the dates of announcement and completion, and the industry of the target. We gather daily stock price and return data from the Center for Research in Security Prices (CRSP) for our Compustat firms. Our final dataset consists of the universe of firms that exist in both Compustat and CRSP, with merged-in Mergent FISD and SDC variables from 2000-2022. In this dataset, we have 4,109 firms that engage in acquisition deals and 995 firms that both issue bonds and acquire. The rest of the data section elaborates more on each individual data set, explains any restrictions, and provides summary statistics.

#### 6.1.1 Firm Data: Compustat and CRSP

Our base set of firms consists of Compustat firms from 2010-2022. We drop firms in the financial and regulated utilities industries by dropping those with SIC codes between 6000-6999 and 4900-4999, respectively. We use the Compustat-CRSP crosswalk provided by Wharton Research Data Services in order to match CRSP data to Compustat. For firms with more than one identifier in the CRSP data (less than 2% of all CRSP firms), we keep the primary identifier designated by WRDS or remove the observations if one is not identified. This drops less than 1% of all firms. Sixty-one percent of our Compustat firms match with CRSP.

#### 6.1.2 Bond Data: Mergent FISD

We use corporate bond issuance data from Mergent FISD. The sample is restricted to bonds issued in US dollars by firms that report in US dollars. Similar to the literature studying the Corporate Credit Facilities, we exclude sovereign debt and debt issued by financial and utility firms. Furthermore, we exclude convertible bonds, capital impact bonds, community bonds, PIK securities, and bonds issued in exchange for a Rule 144A bond.

Data on bonds' credit ratings is obtained from Mergent FISD. There are three companies that report credit ratings in this dataset: Standard & Poor's, Fitch, and Moody's. A mapping between these companies' ratings and the numeric code we use to represent them can be found in the Appendix Table 6. We use ratings that are designated as an initial rating and then any subsequent updated rating of the security. If a bond issuance has either an initial or updated rating from all three companies, we take the median of the three ratings. If only two companies rated the bond, we use the minimum of the ratings as in Becker and Ivashina (2015). If there is a singular company rating the bond, we use that company's rating. Throughout the paper, HY bonds are those with credit rating less than BBB- (numeric code 13) and IG bonds are those with initial credit rating greater than or equal to BBB-.

The COVID-19 induced recession led to both unprecedented monetary and fiscal policies, including the CCFs. Spurred by the announcement introducing the CCFs on March 23, 2020, firms issued a record number of bonds compared to previous years. As an illustration of this effect, Figure **??** plots histograms of the number of firms offering bonds from March 2-June 30 in 2018, 2019, and 2020. We split the histograms into IG (left) and HY (right) issuers. The distribution of IG firms issuing bonds by week in 2020 is clearly to the right of the same distribution in 2018 and 2019. Further, no week exceeds 15 firms issuing in 2018 or 2018 when a significant mass of weeks in 2020 have over 20 IG issuers. The change in distribution is less stark for HY issuers. On the one hand, there were five weeks with 10 or more HY issuers and two weeks with more than 15 HY issuers in 2020 with a max of 12 HY issuers in a week in previous years. However, there were no HY issuances from March 9-29 in 2020. Before the second announcement about the CCFs on April 9, HY issuers per week was around the 10% of weeks in all of 2019.

After creating the bond sample, we merge the data with Compustat. We find 1,623 unique firms in the Compustat sample that issued a bond between 2000Q1-2021Q3 (the latest quarter for which we currently have Mergent FISD data). There are 6,573 firm-quarter observations in which the firm issued at least one bond that quarter.

We can now compare issuers during the pre-CCFs and post-CCFs periods based on Compustat balance sheet items and their issuing habits. This comparison can be seen in Table **??**. We also split issuers into IG and HY issuers in the last four columns[8]. For this table, we define the pre-CCFs period issuers as those issuing a bond between 2000 and 2019. We find 1,507 unique issuers in Compustat during this time. We define Covid issuers as those issuing a bond between March 23-June 30, 2020, which results in 262 unique issuers that merge with the Compustat data. 228 of these firms also issue from 2000-2019. Balance sheet characteristics in the table are based on the quarter-end prior to the bond issuance and the table reports the means of these characteristics. On average, Covid issuers are larger, more leveraged, and hold a slightly higher fraction of their assets in cash. Total bonds issued, average bond size, credit rating, and average tenor are calculated over the full dataset back to 2000. Covid issuers have issued significantly more bonds back to 2000 compared to the mean issuer in 2000-2019. They also have a higher credit rating and issue bonds with a higher tenor. We then look at the number of bonds these two groups of issuers issued in 2019 versus the Covid period. 103 of the Covid issuers also issued in 2019. Covid issuers issued on average 1.34 bonds in 2019, compared to only 0.61 for pre-CCFs issuers. They also issued 2.02 bonds in the Covid period, while pre-CCFs issuers only issued 0.35. This suggests that many of the pre-CCFs issuers did not issue at all from March 23-June 30, 2020.

Breaking the issuers down into IG and HY issuers, we have 548 unique IG and 858 unique HY issuers. However, for Covid issuers, there are 163 unique IG issuers, and only 68 unique HY issuers. This shows that IG issuers were more likely to issue during Covid than HY issuers. IG issuers are generally larger, less leveraged, and hold more cash than HY issuers. They issue

[8]The sum of the number of IG and HY firms does not equal the total number of firms. This is because we are designating firms, not issuances, as IG or HY. If a firm issues both IG and HY firms in the time period, it is difficult to make this designation. We lose some of the issuers in this process. We will continue to update the process until we can keep all issuers.

more bonds, which are generally larger and have longer tenor. From March 23-June 30, 2020, for those that did issue, IG issuers issued an average of 2.54 bonds while HY issuers only issued 1.22.

#### 6.1.3 M&A Data: SDC

Data on acquisition activity come from the Securities Data Company (SDC) of Refinitiv. We screen for acquisitions performed by firms with headquarters in the U.S. We pull all acquisitions announced from January 2010 - March 2022. We create indicators for the quarter of an announcement of an acquisition deal and merge these into our combined Compustat-Mergent FISD dataset. SDC contains data on both private and public firms while Compustat only contains data on public firms, so our final merged sample only consists of acquisition deals announced by public firms in Compustat. We find 3,507 unique firms that engaged in acquisitions and have 9,345 firm-quarter observations.

While 2020 was unprecedented because of COVID, so was the number of acquisition deals. The total amount of acquisition deals announced in 2020 surpassed the amount of deals in any year in the ten years prior. Figure **??** shows the amount of acquisition activity between 2010Q1 - 2022Q1 based on our sample of firms from SDC. Surprisingly, according to the SDC data sample, we see an uptick in acquisition deals throughout the entire year. For example, all quarters saw relatively high completion of acquisition deals relative to previous years at 737, 707, 646, and 731 for each quarterly, respectfully. Acquisitions proceeded to break records as 1,188 deals were announced in 2021Q1, the highest ever in our sample. When we merge our sample with Compustat, this dramatic effect decreases, but we find that 30% of the acquisition deals announced in 2020 for Compustat firms occurred in 2020Q4. In our merged SDC-Compustat sample, only 144 firms engaged in an acquisition in 2020Q1 and 74 firms engaged in an acquisition deal in 2020Q2. The remainder of 2020 saw an uptick in 2020Q3 and 2020Q4 with 145 and 159 acquisition deals and 153 deals in 2021Q1. These numbers are still higher than the past 3 years' average number of deals per quarter, indicating that the number of acquisitions in 2020 was higher than average. While our data sample does not capture all firms in SDC, given that 2020Q3, 2020Q4, 2021Q4 saw record numbers of acquisition deals, one main goal of this paper is to use firm characteristics to understand why the number of acquisition deals reached an all time high for 2020 and 2021.

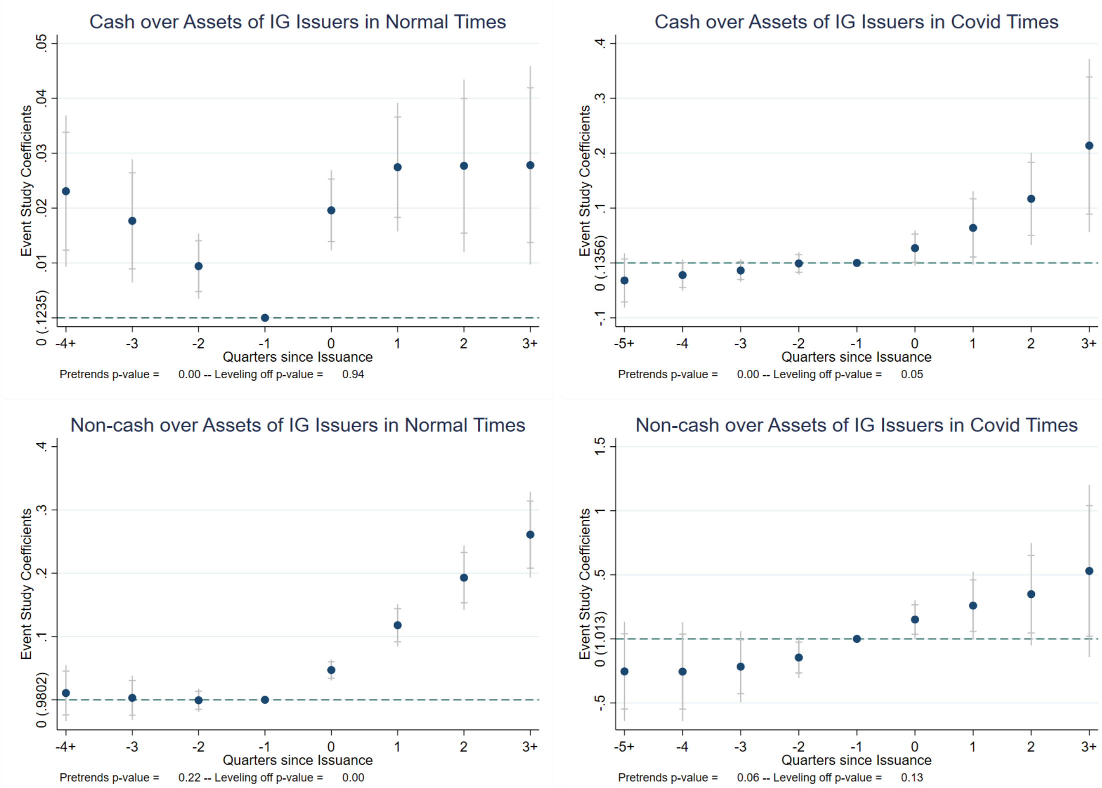
We summarize the characteristics of the firms who conduct acquisitions in Table **??** over various time frames. All variables are represented as averages except market-to-book, where we take the median of the distribution due to some extreme tail events. Balance sheet characteristics are winsorized at the 1% level. The first column of Table **??** consists of balance sheet items for all firms in our sample that acquired another firm from 2010Q1-2022Q1. The second column represents firms in our sample that acquired during the COVID period defined as 2020Q2 - 2022Q1. The third column represents firms in our sample that acquired during the pre-CCFs period defined as 2010Q1-2019Q4 and the fourth column represents the overlap in firms that acquired during the pre- and post-CCFs periods. There were 595 firms out of the 3,173 firms during the pre-CCFs period that also engaged in acquisitions after the announcement of the CCFs. Surprisingly, there were 312 firms that had never engaged in acquisition activity in the pre-CCFs period, but engaged for the first time in the post-period. These firms had slightly higher market-to-book, suggesting that these firms may have been over-valued. The maximum number of deals in the post-CCFs period by a first-timer was 6, which is almost half the maximum number of deals per firm in a year during the pre-CCFs period. Table **??** shows that acquisitions after the CCFs announcement were quite different than before in terms of numbers and firm characteristics. Our replication of the CCFs suggests that the intervention will not affect the likelihood of bond issuance-induced acquisitions if the firms already had substantial cash to fund acquisitions. We therefore return to the data to study the relationship between cash and bond issuance before and after the announcement of the CCFs.

We start with an event study analysis of cash over assets for firms surrounding a bond issuance, first during the pre-CCF period and then in the post-CCF period. The specification is

$$\frac{Y_{f,q}}{Assets_{f,q-4}} = \sum_{t=-5}^{4} \beta_t \mathbb{1}\{Issue\}_{f,q+t} + \alpha_f + \alpha_{indxyear} + \epsilon_{f,q}.$$

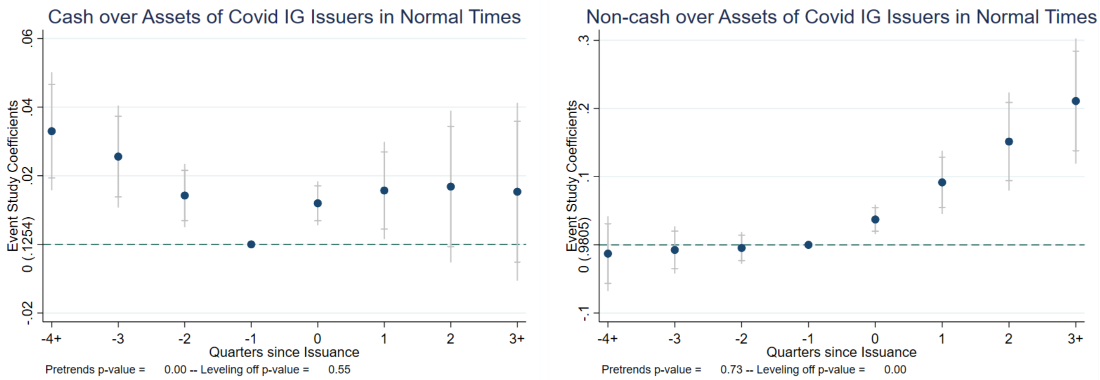
The left hand side outcome variable, $Y_{f,q}$, is a firm-quarter observable balance sheet characteristic normalized by a one year lag in Assets to control for firm size. For this exercise, we compare the effect of bond issuance on two different outcomes: cash and non-cash assets. Cash is defined as cash and short-term investments while non-cash assets are all other assets and serves as a proxy for real investment. We use indicator variables up to 5 quarters before issuance and 4 quarters after issuance. To control for heterogeneity within industry and year, we include a industry-year fixed effect, using 2 digit NAICs codes for industry. Similarly to control for heterogeneity within firms, we include a firm fixed effect. To explore how bond issuance pre-CCF ("Normal") times defined as January 2010 - December 2019 and for post-CCF ("Covid") times defined as March 23 - June 30, 2020. The Fed announced the CCFs on March 23, so any $\beta_t$ after that day would capture the effect of bond issuance on cash holdings after the announcement. Additionally, to account for across-firm heterogeneity, we run this specification for IG firms and HY firms. The cash over assets and non-cash over assets ratios are winsorized at the 1% level. Figures 10 and 12 plot the results of the event studies for IG and HY issuers, respectively.

Figure 10: Balance Sheet Items Surrounding IG Bond Issuance



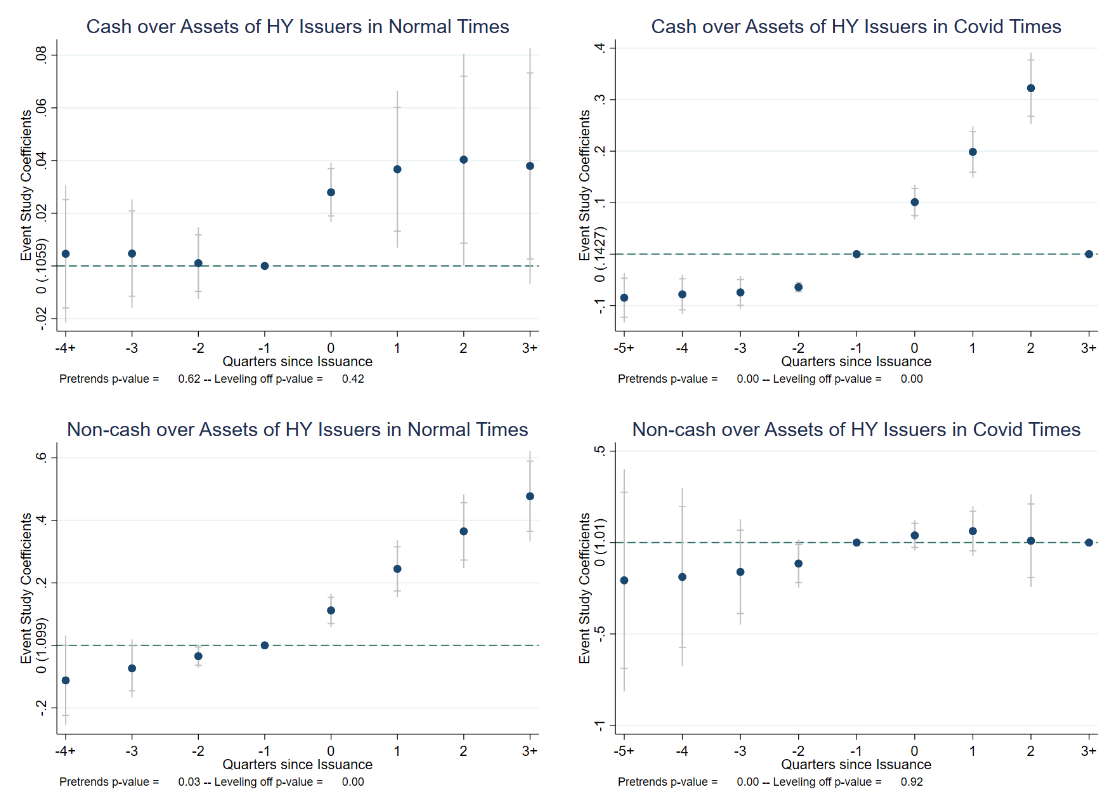

The first row of Figure 10 plots the event study of cash over assets, for IG issuers in the pre-CCF period on the left and in the post-CCF on the right. In the pre-CCF period, IG issuers issue bonds after quarters of decreasing cash. Following issuance, cash over assets reaches a new, seemingly steady value. This suggests that bond issuance is very strategic — IG firms issue bonds and deplete the cash by using it for their operating activities. Once the cash has reached a low enough level, they will issue again. This is supported by the rise in non-cash over assets for IG issuers following an issuance in the bottom left graph of Figure 10. Importantly, the decreasing trend in cash over assets prior to a bond issuance does not exist for the post-CCF IG issuers. Cash over assets did not differ or was slightly lower in the quarters leading up to an issuance than it was in the quarter before this issuance. This suggests that IG issuers did not follow their previous strategy of issuing a bond following the depletion of cash over assets as they did in normal times. Instead, they seemed to be induced to issue due to Fed intervention, the Covid crisis, or some other event, such as the decrease in the interest rates in March 2020, as suggested by the findings of our model that a decrease in $r$ leads to greater borrowing. To further dive into this, we look at the same issuers who issued in post-CCFs period and their issuances during the pre-period, for both cash and non-cash as the dependent variables. A plot

Figure 11: Balance Sheet Items Surrounding IG Bond Issuance - Post-CCFs Issuers Only




of the coefficients from the event study can be found in Figure 11. The figure in the left panel demonstrates the behavior of cash over assets of post-CCF IG issuers during the pre-period. Comparing to the top right figure in Figure 10, we see that cash over assets behaves differently for these issuers in the pre and post periods, not only after the issuance, but before the issuance as well. Cash does seem to continue to rise following an issuance in the post-period, suggesting that the firm is holding onto the cash instead of investing in real investment (non-cash increasing). However, cash over assets was not declining prior to an issue as it was in the pre-period. This suggests that these issuers had other reasons for issuing the bonds following the announcement of the CCFs. Further, this supports the finding of our model that if the firm already had more cash, the CCF would not impact its likelihood of acquisition. Figure 12 repeats the results from the same event study as Figure 10, but for HY issuers. Interestingly, HY issuers do not have the same pre-trend for cash over assets as IG issuers do. Cash over assets is not significantly different in two to four quarters before issuance than it is one quarter before issuance. Cash is then greater following an issuance and is still slightly significant as late as two quarters after issuance. In the post-period, however, cash over assets is actually significantly less two to four quarters before issuance than it is one quarter before. Cash is then significantly higher and increasing after the issuance. For non-cash, the figures support the story told in Darmouni and Siani (2022). Non-cash over assets increases following a bond issuance in the pre-period, but does not significantly change after the announcement of the CCFs. Therefore, it seems that HY issuers use bond issuance for real investment in the pre-period, but did not do so in the post-period. While we were not able to replicate the post issuance cash hoarding found by Darmouni and Siani (2022), our new result presented in Figures 12 and 10 is aligned with one strand of literature analyzing why firms are holding more cash. Acharya (2012) studies the precautionary savings of firms with different bond credit ratings and find that firms with lower

Figure 12: Balance Sheet Items Surrounding HY Bond Issuance




ratings tend to have higher precautionary savings as they face more financing risk than higher rated firms. In the left panel of Figure 10, we can see this relationship. Our results suggest that IG firms are decreasing in their cash balances before issuance, indicating that their precautionary motives are not as strong leading up to issuance. This contrasts greatly with HY firms who do not have a significant pre trend prior to issuance.

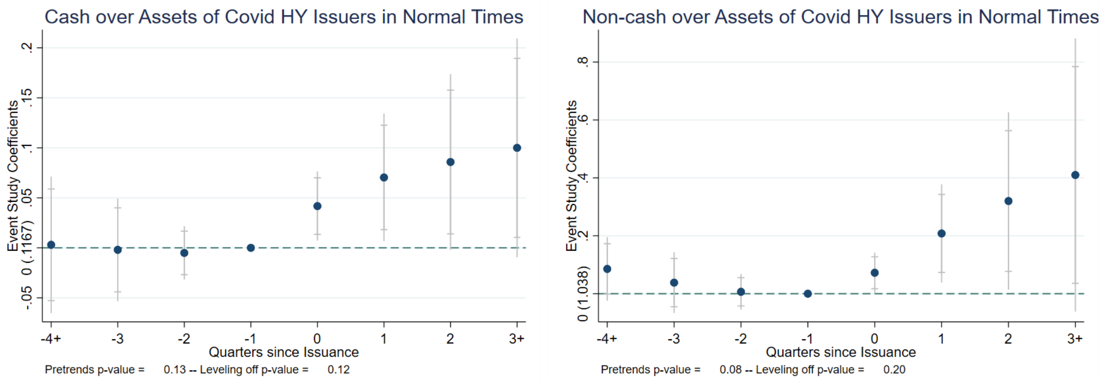
To ensure the effect seen in Figure 12 is not due to a change in the composition of issuers from the pre to post periods, we repeat the pre-CCF event studies for only HY post-CCF issuers, seen in Figure 13. HY post-CCF issuers seem to follow the same patterns as HY non-post issuers.

We further investigate this pre-trend of cash over assets before an issuance by studying a bond issuance indicator as a function of cash over assets. These regressions take the form of

$$Issue_{f,q} = \beta X_{f,q} + \alpha_f + \alpha_{indxyear} + \epsilon_{f,q}. \tag{13}$$

Table 2 shows the results for IG issuers. The first column shows that there is significantly negative relationship between last period's cash and the probability of issuing a bond in this

Figure 13: Balance Sheet Items Surrounding HY Bond Issuance - Post-CCF Issuers Only




period for all IG issuers during the period 2010-2019. Last period's cash is the most important predictor, as controlling for other lags does not significantly change the results. We can also look at change in cash instead of the level of lag cash. Column 3 shows that an increase in the change of cash from 2 periods ago to last period is associated with a significant decrease in the probability of issuing a bond this period. Therefore, IG firms issue bonds in the pre-CCFs period when cash had declined. Columns 4-6 repeat 1-3 but using only IG issuers who issued following the announcement of the CCFs. The direction is the same, but the magnitude on lag cash is higher. The coefficient for lag change in cash is less significant, however. In the final three columns, we replicate the specifications in Columns 1-3, but add in an interaction between the independent variables and an indicator for being a post-CCFs issuer. This is to test if there is a difference in the bond issuance strategies of those IG firms who did and did not issue following the announcement of the CCFs in the pre-period. The indicator for being a post-CCF Issuer is absorbed in the firm fixed effects. The only interaction term that is significant is that in Column 7 for lagged cash. This suggests that the decline in cash is an even stronger predictor for post-CFF issuers than other issuers in the pre-period.

Table 3 shows the results for HY issuers. As we saw in the event study, there does not appear to be a relationship between previous cash and the decision to issue a bond for HY issuers in the pre-period. This holds true for both those HY firms who issued after the CCFs announcements and those who did not.

Now, we can compare the relationship between previous cash and bond issuance in the pre and post periods. As seen in Table 2, one lag of cash is the best predictor for bond issuance out of the predictors we have studied for IG issuers. No function of cash seems to predicts bond issuance for HY issuers. Therefore, we run a diff-in-diff to compare lag cash, interacted with an indicator for the post-period, on bond issuance, or

## Table 2: IG Bond Issuance as a Function of Cash

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| $\frac{Cash_{t-1}}{Assets_{t-5}}$ | -0.162*** | -0.186*** | | -0.237*** | -0.247*** | | -0.109*** | -0.127*** | |
| | (0.301) | (0.0418) | | (0.0526) | (0.0791) | | (0.0395) | (0.0529) | |
| $\frac{Cash_{t-2}}{Assets_{t-6}}$ | | 0.0124 | | | 0.0342 | | | 0.0110 | |
| | | (0.400) | | | (0.0791) | | | (0.0489) | |
| $\frac{\Delta Cash_{t-1}}{Assets_{t-5}}$ | | | -0.0940*** | | | -0.144* | | | -0.0709 |
| | | | (0.0391) | | | (0.0781) | | | (0.0503) |
| Post Issuer# $\frac{Cash_{t-1}}{Assets_{t-5}}$ | | | | | | | -0.124** | -0.143 | |
| | | | | | | | (0.0597) | (0.0874) | |
| Post Issuer# $\frac{Cash_{t-2}}{Assets_{t-6}}$ | | | | | | | | 0.0257 | |
| | | | | | | | | (0.0853) | |
| Post Issuer# $\frac{\Delta Cash_{t-1}}{Assets_{t-5}}$ | | | | | | | | | -0.0728 |
| | | | | | | | | | (00.839) |
| Constant | 0.135*** | 0.136*** | 0.115*** | 0.188*** | 0.188*** | 0.184*** | 0.135*** | 0.135*** | 0.115*** |
| | (0.00461) | (0.00531) | (0.00572) | (0.00914) | (0.0101) | (0.0108) | (0.00461) | (0.00534) | (0.00239) |
| N | 16,736 | 15,966 | 16,702 | 6,007 | 5,817 | 5,674 | 16,736 | 15,966 | 16,702 |
| Issuer Group | All IG | All IG | All IG | Post IG | Post IG | Post IG | All IG | All IG | All IG |
| Time Period | 2010-2019 | 2010-2019 | 2010-2019 | 2010-2019 | 2010-2019 | 2010-2019 | 2010-2019 | 2010-2019 | 2010-2019 |

## Table 3: HY Bond Issuance as a Function of Cash

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| $\frac{Cash_{t-1}}{Assets_{t-5}}$ | -0.0166 | -0.0177 | | -0.0900 | -0.105 | | -0.0155 | -0.0114 | |
| | (0.0140) | (0.0219) | | (0.0774) | (0.114) | | (0.0144) | (0.0225) | |
| $\frac{Cash_{t-2}}{Assets_{t-6}}$ | | -0.00361 | | | 0.00833 | | | -0.0948 | |
| | | (0.400) | | | (0.114) | | | (0.0602) | |
| $\frac{\Delta Cash_{t-1}}{Assets_{t-5}}$ | | | 0.00093 | | | -0.0376 | | | -0.00235 |
| | | | (0.0216) | | | (0.116) | | | (0.0221) |
| Post Issuer# $\frac{Cash_{t-1}}{Assets_{t-5}}$ | | | | | | | -0.0948 | -0.108 | |
| | | | | | | | (0.0602) | (0.0949) | |
| Post Issuer# $\frac{Cash_{t-2}}{Assets_{t-6}}$ | | | | | | | | 0.00189 | |
| | | | | | | | | (0.0945) | |
| Post Issuer# $\frac{\Delta Cash_{t-1}}{Assets_{t-5}}$ | | | | | | | | | 0.0276 |
| | | | | | | | | | (0.0974) |
| Constant | 0.135*** | 0.136*** | 0.115*** | 0.188*** | 0.188*** | 0.184*** | 0.0785*** | 0.0807*** | 0.0751*** |
| | (0.00461) | (0.00531) | (0.00572) | (0.00914) | (0.0101) | (0.0108) | (0.00228) | (0.00250) | (0.00170) |
| N | 22,926 | 21,967 | 23,920 | 2,900 | 2,805 | 2,730 | 22,926 | 21,967 | 23,920 |
| Issuer Group | All HY | All HY | All HY | Post HY | Post HY | Post HY | All HY | All HY | All HY |
| Time Period | 2010-2019 | 2010-2019 | 2010-2019 | 2010-2019 | 2010-2019 | 2010-2019 | 2010-2019 | 2010-2019 | 2010-2019 |

Table 4: Differences-in-differences in Cash and Issuance

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| $\frac{Cash_{t-1}}{Assets_{t-5}}$ | -0.173*** | -0.239*** | -0.0155 | -0.0729 |
| | (0.0299) | (0.0515) | (0.0140) | (0.0755) |
| Post-CCFs$_{t-1}$ | 0.0732** | 0.517*** | 0.0623*** | 0.764*** |
| | (0.0300) | (0.225) | (0.0220) | (0.0648) |
| Post-CCFs$^*_{t-1}\frac{Cash_{t-1}}{Assets_{t-5}}$ | 0.424*** | 0.116 | 0.303** | 0.232 |
| | (0.130) | (0.225) | (0.146) | (0.354) |
| Constant | 0.141*** | 0.194*** | 0.0776*** | 0.128*** |
| | (0.00458) | (0.00895) | (0.00222) | (0.0101) |
| N | 17,412 | 6,292 | 23,779 | 3,048 |
| Issue Group | All IG | Covid IG | All HY | Covid HY |
| Time Period | 2010Q1-2020Q2 | 2010Q1-2020Q2 | 2010Q1-2020Q2 | 2010Q1-2020Q2 |

$$Issue_{f,q} = \beta_1 \frac{Cash_{f,q-1}}{Assets_{f,q-5}} + \beta_2 \text{Post-CCFs}_{q-1} + \beta_3 \text{Post-CCFs}^*_{q-1} \frac{Cash_{f,q-1}}{Assets_{f,q-5}} \tag{14}$$
$$+\alpha_f + \alpha_{indxyear} + \epsilon_{f,q}.$$

We define $Post - CCFs_{q-1} = 1$ if the date $q - 1$ is at least 2020Q1. The results of this regression for IG and HY issuers alike can be found in Table 4. As before, we find a significantly negative relationship between lag cash and the probability of issuing a bond for IG issuers, but an insignificant relationship for HY issuers. For all four regressions, the coefficient on Post-CCFs is significantly positive. As detailed in Section **??**, issuances were much higher following the Fed intervention into corporate bond markets than in historical times, for both IG and HY issuers. The coefficient of interest is the interaction between Post-CCFs and the lagged value of cash over assets. When using all IG issuers, we find that this coefficient is significantly positive. This suggests that the relationship between lag cash and issuing a bond differs in the Post-CCFs time period, as it is now firms with more cash that are more likely to issue in the Post-CCFs time. However, if we look at only post-CCFs IG issuers, we find an insignificant effect from this interaction. For the firms who did issue bonds during the Post-CCFs time, their lag cash had no impact on their decision to do so. When we look at all HY issuers, we see a slightly significant positive effect on this interaction term, suggesting that there is a small relationship between cash and the probability of issuing a bond during Covid times. This does not hold true when we only look at HY post-CCFs issuers though. This suggests that the HY issuers who issue following the announcment simply have more lagged cash than other HY issuers.

We repeat the above exercise using lagged non-cash and change in non-cash instead of cash. We find no significant results for any of the regressors. This suggests that non-cash levels or changes are not a predictor of the issuance of bonds, during the pre or post-period.

## 7 Conclusion

In this paper, we investigate the relationship between corporate bond issuance and firm acquisition activity. We build a stylized model of the acquisition market that features rich choices in firm financing and merging decisions. We use this model to understand how firms change their financing and M&A decisions in response to two scenarios: an aggregate downturn and a subsidy to corporate debt, similar to the Corporate Credit Facilities. We find that a bond market stimulus program changes firms effective access to external financing. Firms only take advantage of increased credit access to finance cash M&A deals if they have low levels of cash.

We further investigate this theoretical model prediction in the data by using the CCFs as a natural experiment to further understand firms financing decisions around M&A. To do this, we build a novel dataset that combines Compustat, Mergent FISD, and SDC to create a dataset of firms with information on bond issuances and M&A deals. We first conduct a differences-in-differences analysis of the likelihood of acquisitions by firms on credit ratings before and after the announcement of the CCFs. The empirical results suggest that this intervention did not change firms likelihood of acquisition as many firms had high cash balances at the time of the intervention.

Ultimately we find that the empirical results around the CCFs support our theoretical predictions from the model. Bond market stimulus do not impact the probability of acquisitions given the starting conditions of firms, but that this channel could become relevant if a similar intervention is used in the future. We view the contribution of our paper as two fold. The first is understanding mechanisms that influences firms financing decisions of M&A deals. The second is to understand how unconventional monetary policy can transmit to the real economy through the M&A market.

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# Appendix A: Model without Mergers and Acquisitions

**Overview** This is the baseline model without acquisitions to illustrate firms financing decisions. Time is discrete. There are two beginning periods followed by an infinite horizon problem. There are two firms, targets and acquirers. Firms decide how much capital to invest into a one period risky project each period. The returns on the risky projects are unknown at the time of investment. The project output is subject to both aggregate, $A$, and idiosyncratic shocks. The firm specific shocks are i.i.d., but the shock distribution of the acquirers stochastically dominates that of that the targets. In the baseline version of the model, there is no uncertainty over the aggregate shock, $A$. In Section **??**, we extend the baseline model to simulate the recession of 2020 by incorporating a one-time unexpected shock to $A$. Both targets and acquirers have access to the equity markets, but only acquirers have access to the bond markets.[9] The firms are held by shareholders who are taxed at the individual tax rate of $\tau_i$ if they keep their funds in their individual account rather than within the firm. Therefore, the effective discount rate that firms face is $\frac{1}{1+r(1-\tau_i)}$.

**Targets** In period 1, the target can raise funds for investment by issuing equity and faces flotation cost, $\lambda$. The target makes initial capital investments, $k_t$, and invest this capital into a one period risky project. The risky project is subject to idiosyncratic productivity shocks, $z_t \in [z_t^L, z_t^H]$. In period 2, the target realizes the project output, $Az_tk_t^\alpha$. If the project results in positive cash flow, the firm pays out the profits as dividends to the shareholders, which are subject to taxes $\tau_d$. Firms pay corporate taxes, $\tau_c$ on the proceeds of the project and can deduct depreciation. Denote the targets tax function as $g_t(z_t, k_t) = \max\{0, Az_tk_t^\alpha - \delta k_t\}$. After the second period, the target faces the infinite horizon problem.

**Acquirers** In period 1, the acquirer makes investment and capital choice choice decision, $k_a$. The acquirer can raise funds for investment either by issuing equity and facing flotation cost, $\lambda$ and/or issuing one period debt, $p$. The debt is a discount bond that pays $\frac{p}{1+r}$ today and tomorrow the firm pays back amount $p$. The acquirer is able to deduct depreciation from capital and also interest when paying corporate taxes, $\tau_c$, on profits from the project. Thus, debt has a tax advantage for the acquirer. The tax function for the acquirer is $g_a(z_a, k_a, p) = \max\{0, Az_ak_a^\alpha - \delta k_a - \frac{rp}{1+r}\}$. Unlike the target, the acquirer can sell off its capital stock to help pay down it's debt balance. In this scenario, the firm sells capital at value of $\gamma$. The acquirer can borrow at rate $r$ but must be able to pay back all of its debt in the event of the lowest shock

[9]During the merger wave of 2021, almost all firms that were acquired did not have access to capital markets.

realization, $z_a^L$. Thus, the acquirers borrowing constraint is

$$p \leq Az_a^L(k_a)^\alpha + \gamma(1-\delta)k_a - \tau_c g_a(z_a^L, k_a, p) \tag{15}$$

Similar to the target, if the acquirer has negative cash flow, they can issue equity to pay outflows. If the acquirer has positive cash flow, the proceeds are given as dividends to the shareholders and taxed at rate $\tau_d$.

The acquirers investment is subject to idiosyncratic productivity shocks, $z_a \in [z_a^L, z_a^H]$. In period 2, the acquirer realizes output from project, $Az_a k_a^\alpha$ and then makes a decision about how much equity or debt to issue to finance investment. In period 3, the acquirer faces the infinite horizon problem.

**Timing**

1. Period 1: Acquirer makes capital and debt choices, target makes capital choices
2. Period 2: The acquirer wakes up with the capital from Period 1, but it has depreciated at rate $\delta$. The idiosyncratic productivity on the risk project is realized and acquirers pay taxes on dividends and capital. In the event the acquirer cannot pay back its debt, they can fire-sale capital at price $\gamma$. If the acquirer realizes positive profit from the project, then the pay out dividends to the shareholders, which is taxed at rate $\tau_d$ The target wakes up with capital choice from Period 1, but it has also depreciated at rate $\delta$. If the realized profit of the project is positive, then the target pays out dividends that are subject to taxes, $\tau_d$.
3. Period 3 (infinite horizon): In the absence of M&A, period 3 looks exactly the same for both the target and the acquirer.

### .0.1 Target

This section shows the target value function in Periods 1, Period 2, and Period 3, where in Period 3 the target faces an infinite-horizon problem.

**Period 1** Denote $V_t^1$ as the target's first period problem where they chose how much equity to issue to finance investment, $I$. No issuance is treated as a dividend with value of \$0. The targets make their investment decisions today and tomorrow they realize idiosyncratic return on their project, $z_t$.

$$V_t^1 = \max_{k_t^1}(1+\lambda)(-k_t^1) + \frac{1}{1+r(1-\tau_i)}\mathbb{E}_{z_t'}[V_t^2(k_t^1, z_t')]. \tag{16}$$

Without the ability for the target to issue debt, they will be issuing equity to cover their initial investment.[10]

**Period 2** Denote $V_t^2$ as the target's second period problem. They realize the return, $z_t$ on the risky project from period 1 and make decision over equity issuance and capital choices for investment. If the flow profit minus investment is positive, then the firm pays the shareholders dividends and pays taxes, $\tau_d$ on the dividends. This decision is represented by the indicator function, $\phi_d$. If the flow project minus the investment is negative, the firm must issue equity and face the equity issuance cost, $\lambda$, to cover the negative flow value. This action is represented by the indicator function, $\phi_i$.

$$\begin{aligned} V_t^2(z_t, k_t^1) = \max_{k_t'} (1 + \phi_i \lambda - \phi_d \tau_d) \Big[ & A z_t (k_t^1)^\alpha - \tau_c g_t(z_t, k_t^1) + (1-\delta) k_t^1 - k_t^2 \Big] \\ & + \frac{1}{1 + r(1-\tau_i)} \mathbb{E}_{z_t'} [V_t^i(k_t^2, z_t')] \\ & \text{s.t.} \\ \phi_i &= \{A z_t (k_t^1)^\alpha - \tau_c g_t(z_t, k_t^1) + (1-\delta) k_t^1 - k_t^2 < 0\} \\ \phi_d &= \{A z_t (k_t^1)^\alpha - \tau_c g_t(z_t, k_t^1) + (1-\delta) k_t^1 - k_t^2 \geq 0\} \end{aligned} \tag{17}$$

The target discounts the future by $\frac{1}{1+r(1-\tau_i)}$ and takes expectation over the return to the risky investment project, $z_t'$. In the next period, they face the infinite horizon problem, which is denoted by $V_t^i$.

**Period 3 - Infinite Horizon Problem** In the model without acquisitions, the final infinite horizon problem follow the decisions of the period 2. Denote the infinite horizon problem in period 3 for the target as $V_t^i$.

$$\begin{aligned} V_t^i(z_t, k_t^2) = \max_{k_t'} (1 + \phi_i \lambda - \phi_d \tau_d) \Big[ & A z_t (k_t^2)^\alpha - \tau_c g(z_t, k_t^2) + (1-\delta) k_t^2 - k_t' \Big] \\ & + \frac{1}{1 + r(1-\tau_i)} \mathbb{E}_{z_t'} [V_t^i(z_t', k_t')] \\ & \text{s.t.} \\ \phi_i &= \{A z_t (k_t^2)^\alpha - \tau_c g(z_t, k_t^2) + (1-\delta) k_t^2 - k_t' < 0\} \\ \phi_d &= \{A z_t (k_t^2)^\alpha - \tau_c g(z_t, k_t^2) + (1-\delta) k_t^2 - k_t' \geq 0\} \end{aligned} \tag{18}$$

[10]Recall that the target's problem could also be written as: $V_t^1 = \max_{I_t^1, k_t^1} -I + \frac{1}{1+r(1-\tau_i)} \mathbb{E}_{z_t} [V_t^2(k_t^1, z_t)]$ such that $I_t^1 \leq k_t^1 + k_t^1 \lambda$

### .0.2 Acquirer

This section shows the acquirer problem in Period 1, Period 2, and Period 3, which is an infinite horizon problem.

**Period 1** Denote $V_a^1$ as the acquirer first period value function. The firm makes decision over how much cash and debt to issue to finance investment. The firm will issue equity if investment plus debt issuance is negative, this is represented by the indicator function $\phi_i$. The firm will pay out dividends if the investment plus bond issuance is weakly positive, represented by the indicator function, $\phi_d$.

$$
\begin{gathered}
V_a^1 = \max_{k_a^1, p}(1 + \phi_i\lambda - \phi_d\tau_d)(-k_a^1 + \frac{p}{1+r}) + \frac{1}{1+r(1-\tau_i)}\mathbb{E}_{z_a'}(V_a^2(k_a^1, p, z_a')) \\
\text{s.t.} \\
p \leq Az_a^L(k_a^1)^\alpha + \gamma(1-\delta)k_a^1 - \tau_c g_a(z_a^L, k_a^1, p) \\
\phi_i = \{-k_a^1 + \frac{p}{1+r} < 0\} \\
\phi_d = \{-k_a^1 + \frac{p}{1+r} \geq 0\}.
\end{gathered} \tag{19}
$$

The acquirer faces a borrowing constraint which states that the firm cannot borrow more than they can pay back in the lowest realization of the idiosyncratic shock on the project. The acquirer can firesale its depreciated capital at value $\gamma$ to help pay down debt balance. The acquirer discounts the future value by $\frac{1}{1+r(1-\tau_i)}$ and takes the expectation over the idiosyncratic productivity project value, $z_a'$. Tomorrow they have value $V_a^2$.

**Period 2** Denote $V_a^2(k_a^1, p, z_a)$ as the value of the acquirer in the second period. The firm realizes the return on the risky investment project. This yields production value $Az_a(k_a^1)^\alpha$. The acquirer then must pay corporate taxes $\tau_c$ on profits from the project. If they borrowed, then they must pay back their debt. Capital depreciates at rate $\delta$.

$$
\begin{aligned}
V_a^2(k_a^1, p, z_a) = \max_{k_a^2, p'} (1 + \phi_i \lambda - \phi_d \tau_d) \left[ A z_a (k_a^1)^\alpha - \tau_c g(z_a, k_a^1, p) - p + (1-\delta) k_a^1 - k_a^2 + \frac{p'}{1+r} \right] \\
+ \frac{1}{1 + r(1-\tau_i)} \mathbb{E}_{z_a'} (V_a^i(k_a^2, p', z_a')) \\
\text{s.t.} \\
p' \leq A z_a^L (k_a^2)^\alpha + \gamma (1-\delta) k_a^2 - \tau_c g(z_a^L, k_a^2, p') \\
\phi_i = \{ A z_a (k_a^1)^\alpha - \tau_c g(z_a, k_a^1, p) - p + (1-\delta) k_a^1 - k_a^2 + \frac{p'}{1+r} < 0 \} \\
\phi_d = \{ A z_a (k_a^1)^\alpha - \tau_c g(z_a, k_a^1, p) - p + (1-\delta) k_a^1 - k_a^2 + \frac{p'}{1+r} \geq 0 \}.
\end{aligned}
\tag{20}
$$

Then the acquirer makes decisions over how much debt or equity to finance capital for investment. Similarly to period 1, the acquirer will issue equity if their flow profit is negative or issue dividends if their flow profit is positive. They take expectation over their expected value of the idiosyncratic productivity project value and discount the future by $\frac{1}{1+r(1-\tau_i)}$. Tomorrow they enter the infinite horizon problem, $V_a^i$.

**Period 3 - Infinite Horizon** In the version without acquisitions, the infinite horizon problem is very similar to the acquirer's problem in Period 2.

$$
\begin{aligned}
V_a^i(k_a^2, p, z_a) = \max_{k_a', p'} (1 + \phi_i \lambda - \phi_d \tau_d) \left[ A z_a (k_a^2)^\alpha - \tau_c g(z_a, k_a^2, p) - p + (1-\delta) k_a^2 - k_a' + \frac{p'}{1+r} \right] \\
+ \frac{1}{1 + r(1-\tau_i)} \mathbb{E}_{z_a'} (V_a^i(k_a', p', z_a')) \\
\text{s.t.} \\
p' \leq A z_a^L (k_a')^\alpha + \gamma (1-\delta) k_a^2 - \tau_c g(z_a^L, k_a', p') \\
\phi_i = \{ A z_a (k_a')^\alpha - \tau_c g(z_a, k_a^2, p) - p + (1-\delta) k_a^2 - k_a' + \frac{p'}{1+r} < 0 \} \\
\phi_d = \{ A z_a (k_a')^\alpha - \tau_c g(z_a, k_a^2, p) - p + (1-\delta) k_a^2 - k_a' + \frac{p'}{1+r} \geq 0 \}
\end{aligned}
\tag{21}
$$

The acquirer enters the period with capital level $k_a^2$, debt balance, $p$, and idiosyncratic productivity value, $z_a$. Similar to Period 2, they will make decisions about debt or equity issuance.

Example model parameters can be found in Table 1. Using these parameters, we solve for the capital, debt, and value of the target and acquirer, as described in Table 5. We find that the acquirer increases its capital investment when the project generates the higher return $z(\bar{s})$, due to the relaxed equity constraint associated with earning cash from the previous investment.

Table 5: Example Results in No Merger Model

| Variable | Value |
|---|---|
| $V_{a1}$ | 50.7922 |
| $k_a$ | 4.898 |
| $p_a$ | 2.980 |
| $k'_a(\bar{s})$ | 7.3469 |
| $p'_a(\bar{s})$ | 4.3059 |
| $k'_a(\underline{s})$ | 6.1224 |
| $p'_a(\underline{s})$ | 3.4666 |
| $V_{t1}$ | 29.5038 |
| $k_t$ | 3.6735 |
| $k'_t(\bar{s})$ | 4.898 |
| $k'_t(\underline{s})$ | 3.6735 |

Further, the acquirer chooses a lower value of capital after the project generates the lower return $z(\underline{s})$. The target also increases its capital upon realizing the higher return, but chooses the same level of capital if it receives the lower return. The target actually has more cash on hand after receiving the lower return than the acquirer does because the acquirer chose to borrow up to its borrowing constraint and therefore must use all cash proceeds to repay its debt. Without being able to borrow, the target does not face this issue. The ability to borrow is very useful though, as seen by the substantial difference in $V_{a1}$ and $V_{t1}$.

# Appendix B: Credit Rating Mapping

Table 6: Credit Rating Mapping

| S&P | Moody | Fitch | Numerical |
|---|---|---|---|
| AAA | Aaa | AAA | 22 |
| AA+ | Aa1 | AA+ | 21 |
| AA | Aa2 | AA | 20 |
| AA- | Aa3 | AA- | 19 |
| A+ | A1 | A+ | 18 |
| A | A2 | A | 17 |
| A- | A3 | A- | 16 |
| BBB+ | Baa1 | BBB+ | 15 |
| BBB | Baa2 | BBB | 14 |
| BBB- | Baa3 | BBB- | 13 |
| BB+ | Ba1 | BB+ | 12 |
| BB | Ba2 | BB | 11 |
| BB- | Ba3 | BB- | 10 |
| B+ | B1 | B+ | 9 |
| B | B2 | B | 8 |
| B- | B3 | B- | 7 |
| CCC+ | Caa1 | CCC+ | 6 |
| CCC | Caa2 | CCC | 5 |
| CCC- | Caa3 | CCC- | 4 |
| CC | Ca | CC | 3 |
| C | C | C | 2 |
| D | D | D | 1 |