Payout Restrictions and Bank Risk-Shifting

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Abstract

This paper studies the effects of bank payout restrictions, imposed during the COVID-crisis in 2020, on risk-shifting incentives within US banks. Using a high-frequency differences-in-differences empirical strategy, I show that when share buybacks are banned and dividends restricted for Fed-supervised banks, their equity prices fall while their CDS spreads and bond yields decline differentially. In sum, these results indicate that payout restrictions shift risk from debt towards equity holders. Consistent with this channel, I further find that after lifting the restrictions, both effects revert. Moreover, removing the restrictions is followed by higher payouts and by differentially stronger growth in riskier (non-investment grade) lending, showing that payout and risk-taking choices are complements during this episode. While lending portfolios become riskier, spreads charged on loans decline, suggesting risk-shifting by bank equity holders.

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1 Introduction

Over the last decades, there has been an increase in equity payouts, particularly through share buybacks, and in managerial equity compensation in the United States and other advanced economies. This empirical pattern has given rise to concerns about risk-shifting and excessive risk-taking. By paying out safe cash flows, managers and shareholders might shift the risk of the remaining assets from shareholders onto debtholders. Hence, the question looms on how to align incentives across the different claim holders of the firm and restrictions on corporate payouts have been proposed to limit risk-shifting motives. In this paper, I focus on payout restrictions in the financial sector.

In June 2020, for the first time, the Federal Reserve issued stringent payout restrictions on the largest banks in the United States. Going forward, their dividends and share buybacks were substantially restricted, without a pre-determined end date. Similar measures were imposed in many other jurisdictions during the Covid crisis, including in the Eurozone, UK, Canada and Switzerland.

Payout restrictions were aimed at preventing a repetition of the playbook of the Financial Crisis. While financial sector stress rose over the course of 2007 and 2008, culminating in the failure of Lehman Brothers, many banks maintained or increased their level of payouts to shareholders via dividends and share buybacks (Acharya et al., 2017). Soon later, multiple banks found themselves with insufficient capital buffers and either failed or had to be bailed out by the government over the course of the Global Financial Crisis, resulting in large costs to taxpayers.

Why did banks not maintain larger capital buffers in the face of the crisis and instead weakened their capital base by paying out funds to shareholders? One major reason was risk-shifting. The rewards from economic activity are shared between debt holders and shareholders. Yet, only shareholders run the bank and make decisions about payouts and risk-taking. Moreover, banks are highly levered. For each dollar of equity, large banks commonly have an order of magnitude more dollars of liabilities. Jointly, these two forces give rise to risk-shifting incentives as first analyzed by Jensen and Meckling (1976): For bank shareholders it can be optimal to pay out safe cash flows to themselves, shrinking the bank's equity cushion and exposing the bank to greater default risk. This effectively transfers more risk onto debtholders who hold a claim on the remaining assets after the capital distribution. Government guarantees on deposits and expectations of government bailouts in times of crisis, both of which are pervasive in the financial sector, further increase the incentives to risk-shift. Payout restrictions as a policy intervention can mitigate the risk-shifting forces, shore up equity buffers in the financial sector and reduce the expected transfer from the public to the banking sector in times of crisis.

In this paper, I analyze how payout restrictions affect bank equity and debt prices during the 2020 recession and how payout restrictions affect risk-taking decisions for banks. First, I lay out a theoretical framework to analyze payout restrictions. Second, I test the frameworks' predictions in the data.

The first part of the paper lays out a partial equilibrium model of a single bank that lives for two periods, and needs to make a payout decision with assets and liabilities in place. This mimics a setting where a payout restriction is unexpectedly imposed after asset and liability choices have already been made. In this setup, a payout restriction imposed by a bank regulator prevents shareholders from paying out if the restriction binds. This stops risk-shifting from shareholders onto debtholders. Rather than paying out safe cash flows, shareholders retain more assets in the bank and those are subject to risk. At the same time, the bank accumulates a bigger equity cushion that shields debtholders from default. In sum, a binding payout restriction is predicted to lower equity values and appreciate debt values.

Risk-shifting cannot only occur via payouts but also by taking on riskier, potentially negative net present value, projects. To analyze the joint choice of payout and risk-taking policies, I therefore extend the model and allow banks to make a risk-taking decision beyond the payout decision. Specifically, shareholders can select from two distributions of assets: a safer one with lower variance and a riskier one with higher variance. Here, the possibility of a complementarity between payouts and risk-taking emerges: When leverage is sufficiently high but below a lower bound, an unrestricted bank would select high payouts and the riskier assets but when restricted in its ability to pay out, it also reduces risk-taking. In the empirical part, I will provide support for this complementarity.

To test these predictions empirically, I exploit the imposition of explicit payout restrictions for the subsample of 33 bank holding companies subject to the Federal Reserve's Comprehensive Capital Analysis and Review (CCAR), henceforth CCAR banks, on June 25, 2020 as well as the subsequent relaxation of these restrictions on December 18, 2020 as natural experiments. My paper is the first detailed account for how these policies affected US banks over the course of 2020.

Using high-frequency tick-by-tick equity markets data and an event-study methodology, I document that the CCAR banks lose more than 2 % in equity value relative to a control group of other financial and non-financial firms within minutes of the restrictions being imposed. Conversely, equity prices jump by 4 % relative to the same control group within minutes of the 12/18/2020 announcement that the restrictions would be relaxed. The high-frequency approach mitigates concerns about other industry-wide shocks driving the results. Moreover, these announcement effects highlight that the changes in payout restrictions are partly unanticipated and were not fully priced in ex-ante.

However, since the announcements about payout restrictions are released after regular stock market trading hours when liquidity of smaller stocks is low, the control group includes non-financial firms. To mitigate this concern and, additionally, provide evidence for persistence of the equity response, I also implement the Campbell et al. (2012) cumulative abnormal returns methodology. The differential response of equity prices by the CCAR banks persists over the 10 trading days after the announcements and slightly strengthens over time, relative to a control group that now consists only of the smaller publicly listed banks. This tighter identification confirms that results in the high-frequency event-studies are not driven by the different market microstructure in after-hours trading.

Theoretically, this equity response is consistent with two sets of explanations. First, the Fed imposing payout restrictions could communicate bad news about banks' assets to the market. This argument reflects a potential negative news effect. Alternatively, risk-shifting could be at work where payout restrictions prevent banks from paying out funds and transferring the risk of the remaining assets onto debt holders. In that case, shareholders have to assume more risk following the payout restrictions, leading to lower equity values. To distinguish between the negative news and risk-shifting stories, I use data on unsecured debt prices, both CDS spreads and corporate bond yields, to estimate event studies comparing the CCAR banks to a control group of financial firms. Focusing on unsecured debt ensures that I remove valuation effects coming from the value of the collateral backing the debt or, in the case of convertible bonds, the value of equity.

If payout restrictions mostly communicate bad news about assets, not only do equity values fall but debt is predicted to become riskier as well. Hence, the imposition of payout restrictions should lower bond prices while raising bond yields and CDS spreads. In contrast, risk-shifting implies a divergence of equity and debt prices when payout restrictions change. Curbing payouts benefits debtholders in the presence of risk-shifting as there is a larger equity cushion to support risk and previous risk-shifting is reversed. Thus, debt prices help solve the identification challenge between the news and risk-shifting channel. In event-study regressions, I find that daily CDS spreads fall differentially for the CCAR banks relative to other financial firms when payout restrictions are imposed on 06/25/2020 and, conversely, rise differentially after they are relaxed on 12/18/2020. Using corporate bond yields as the dependent variable and running Campbell and Taksler (2003)-style regressions corroborates the risk-shifting explanation: Similar to CDS spreads, corporate bond yields decline differentially when the restrictions are announced and rise when the restrictions are relaxed.

Next, I analyze whether payout restrictions interact with risk-taking decisions at banks. Using data on newly issued syndicated loans, which capture the extensive margin of new lending, I show empirically that the CCAR banks increase their non-investment grade lending by 32 % relative to investment-grade lending when the payout restrictions are removed. This is evidence for banks taking on riskier loans. At the same time, the average interest rate spread charged by CCAR banks declines differentially for riskier loans. Jointly, these two results suggest greater risk-taking that is not being compensated via higher credit spreads. Payout and risk-taking decisions therefore act as complements. When payout restrictions are relaxed, risk-taking simultaneously increases.

These results indicate that payout restrictions can restrict banks' risk-taking and build up their equity buffers in times of crisis, which in turn lowers default risk and reduces the cost of expected government intervention.

Finally, I analyze whether imposing the payout restrictions lowers the expected bailout payments from the public to the banking sector. Payout restrictions shore up banks' capital buffers. While banks normally face a choice whether to pay out or retain earnings, the payout restrictions lead to a forced reduction in payouts and increase in retained earnings. Higher capital buffers in turn make banks more resilient against adverse shocks.

Historically, the government has stepped in to support the banking sector and limit spillovers onto the real economy when banks have faced deteriorating funding conditions in times of crisis or when banks have failed. This bears the question by how much expected bailout payments to the banking sector were reduced through imposing payout restrictions in 2020. Using a break-even analysis, I ask how much government guarantees need to change so that jointly with changes in debt values, they offset the opposite-signed change in equity values. I find savings of $ 26 billion from imposing payout restrictions whereas government guarantees rise again by $ 36 billion once the restrictions are being lifted. In this inference exercise, I further obtain estimates for the degree of insurance on short-term and long-term debt. While short-term debt displays a high degree of insurance at the break-even point, long-term debt exhibits a negative degree of insurance, suggesting that the response in long-term debt is larger than if there was no insurance at all. This result is consistent with risk-shifting where long-term debtholders benefit disproportionately from having payout restrictions in place and lose significantly from having the restrictions relaxed.

The contribution of the paper to the literature is threefold. First, it adds an explicit evaluation of payout restrictions as a prudential tool to the large literature on banking regulation at the micro and macro level. Banking regulation can broadly be broken down into four buckets: capital requirements and leverage ratios (Admati and Hellwig (2014), Begenau (2020), Begenau and Landvoigt (2021), Brunnermeier and Sannikov (2016), Corbae and D'Erasmo (2019), Dewatripont and Tirole (2012), Gropp et al. (2019)), liquidity requirements (Bosshardt and Kakhbod (2020), Calomiris et al. (2015), Diamond and Kashyap (2016)), other measures (for example stress tests: Acharya et al. (2014), Philippon et al. (2017) or shadow banks: Gorton et al. (2010), Adrian and Ashcraft (2012), Ordonez (2018)) and payouts. Payout restrictions are the least explored area among those four, both theoretically and, in particular, empirically. For theoretical contributions in this area, see Acharya et al. (2011), Acharya and Viswanathan (2011), Acharya et al. (2016), Acharya et al. (2017) and Vadasz (2021). Acharya et al. (2017), Floyd et al. (2015) and Hirtle (2014) document payout patterns for the 2008 financial crisis. I contribute to this literature by estimating the quantitative effects of payout restrictions onto banks and their lending behavior in 2020.

The analysis of the interaction between payout restrictions and risk-taking contributes to the strand of the literature focusing on bank regulation and risk-taking decisions. In a class of models (Acharya et al. (2016), Allen et al. (2011), Mehran and Thakor (2011)), higher bank continuation value endogenously curbs risk-taking incentives as banks risk forfeiting the continuation value with excessive risk-taking. My model exhibits a similar feature while considering the specific policy of payout restrictions. This closely relates to the literature on monetary policy and risk-taking (De Nicolò et al. (2010), Jiménez et al. (2014), Delis et al. (2017)), though I consider a prudential regulatory tool: payout restrictions.

Second, my paper contributes to the corporate finance literature on payout policies and risk-shifting (Jensen and Meckling, 1976) and multi-tasking (Acemoglu et al., 2008). Hadjinicolaou and Kalay (1984) provide an early analysis of wealth redistribution within the firm after dividend surprises. Further empirical evidence in favor of, or against, risk-shifting can be found in Eisdorfer (2008), Rauh (2009), Landier et al. (2015) and Gilje (2016); Gropp et al. (2011) focus particularly on the role of public guarantees in the financial sector. Recently, the literature on payout policy is seeing a revival with a focus on explaining aggregate trends (Farre-Mensa et al. (2020), Kahle and Stulz (2020), Kroen (2021), Ma (2019), Mota (2020)). The paper at hand, in contrast, analyzes the effects of restricting and liberalizing payout policies with a pure focus on the banking sector, risk-shifting incentives and risk-taking effects in lending decisions.

Finally, this project adds to the nascent literature on banking during the COVID-crisis and the regulatory response by providing estimates for the empirical effects of explicit payout restrictions on banks. Other papers in this space have considered the "dash-for-cash" (Acharya et al., 2021), the Fed's interventions in the corporate bond market (Haddad et al., 2020) and policy measures in general including "liquidity support, borrower assistance and monetary easing" (Demirgüç-Kunt et al., 2020). The closest paper to mine is by Hardy (2021) who considers payout restrictions internationally. My paper adds high-frequency identification for the United States ruling out concerns about other industry-wide shocks, evidence for risk-shifting, an analysis of the risk-taking margin of banks and a framework to quantify the expected savings to the government in terms of averted bailouts from imposing payout restrictions.

The rest of the paper is structured as follows: Section 2 outlines a conceptual framework with a single bank, that makes payout and risk-taking decisions, and outlines how payout restrictions affect debt and equity pricing as well as risk-taking. Section 3 discusses the empirical strategy including the institutional setting, data and econometric approach. Section 4 shows results for debt and equity values around the Fed announcements about payout restrictions, Section 5 contains the analysis on risk-taking decisions and Section 6 concludes.

2 Conceptual Framework

The model builds on the framework by Acharya et al. (2017) featuring a single bank in partial equilibrium that has assets and liabilities in place and lives for two periods. The only decision for shareholders to make is their payout policy, which involves a tradeoff. Higher payouts secure safe cash flows for shareholders in the initial period but raise the default probability in the second period.

I add two additional features into the model. First, a reduced-form government guarantee on bank debt, which captures the fact that many of the banking sector's liabilities are partly ensured by the public sector. Second, I partially endogenize the bank's risk-taking decision and derive the optimal joint choice of payouts and risk-taking for an individual bank. In particular, I show under what conditions these two choices act as complements, that is imposing payout restrictions not only reduces payouts but also leads to lower risk-taking. In contrast, removing the payout restriction increases both payouts and risk-taking on the bank side in that region.

2.1 Environment

The model operates in partial equilibrium with a single bank that lives for two periods, $t = 0, 1$ and is run by risk-neutral shareholders. Without loss of generality, I assume the discount rate $r = 0$. The bank has non-stochastic cash assets c and stochastic non-cash assets $a \sim U(\underline{a}, \bar{a})$ where $\bar{a} > \underline{a} > 0$. It has liabilities in place, ℓ, which cannot be renegotiated at $t = 0$. I assume that there is non-trivial ex-ante default risk: $\ell \in [c + \underline{a}, c + \bar{a}]$. Finally, the bank equity holders derive franchise value $V > 0$ if the bank does not default in period $t = 1$. Figure 1 summarizes the bank's assets and liabilities at $t = 0$. ℓ and c are constant parameters. a is a random variable:

Bank	
Cash c	Liabilities ℓ
Assets a	

Figure 1: Bank Assets and Liabilities

The fundamental question for the bank is whether it generates enough assets in period $t = 1$ to cover its liabilities and remain solvent. Otherwise, it defaults. The only choice variable for the bank is its dividend[1]. For tractability, I assume $d \in [0, c]$.

From here, the solvency threshold for the bank $\hat{a}(d) = \ell + d - c$ can be derived. It captures the minimum amount of assets the bank needs to generate in order to remain solvent and for equity holders to realize the franchise value V.

Finally, I assume that there is a government guarantee on debt, which captures in reduced-form explicit and implicit public sector guarantees on banks' liabilities.[2] If the bank fails to meet its solvency threshold, that is $a < \hat{a}(d)$, debt holders' loss is given by $\ell + d - c - a$. Fraction $\phi < 1$ of the loss is reimbursed to debt holders through the public sector guarantee. It is important that results are robust to this assumption since public sector guarantees are ubiquitous in the banking sector.

[1]One can interpret the dividend broadly as any type of payout here, including share repurchases.

[2]One example for explicit guarantees is deposit insurance. In the US, deposit holders are insured up to $ 250,000 per bank and account type. An example for implicit guarantees are implicit bailout expectations.

2.2 Equity and Debt Values

Risk-neutral shareholders maximize shareholder value of the bank by choosing a payout policy d:

$$\max_{d} d + \mathbf{E}[a - \hat{a} \mid a > \hat{a}]Pr(a \geq \hat{a}) + Pr(a \geq \hat{a})V \tag{1}$$

Conditional on the payout policy selected by shareholders, debt value at $t = 0$, DV, is derived as:

$$DV = Pr(a \geq \hat{a})\ell + Pr(a < \hat{a})(\phi\mathbf{E}[\hat{a} - a \mid a < \hat{a}] + \mathbf{E}[a + c - d \mid a < \hat{a}]) \tag{2}$$

The total value, TV, of the bank is given by:

$$TV = d + \mathbf{E}[a + c - d] + Pr(a \geq \hat{a}(d))V + Pr(a < \hat{a}(d))\phi\mathbf{E}[\hat{a} - a \mid a < \hat{a}] \tag{3}$$

2.3 Properties

Proposition 2.1. *(From Acharya et al. (2017)) There exists a threshold $V^* = \ell - \frac{c}{2} - \underline{a}$ so that:*

$$\begin{cases} d = 0 \quad if\ V \geq V^*(c, \ell, \underline{a}) \\ d = c \quad if\ V < V^*(c, \ell, \underline{a}) \end{cases}$$

The intuition for the proof comes from the convexity of shareholders' payoffs. As a result, the first-order condition will not return the maximum and instead we end up with a corner solution. The corner depends on whether we are above or below a threshold. V^* is increasing in ℓ, which one can interpret as leverage. Since the CCAR banks are among the most levered banks in the United States, one can interpret proposition 2.1 as that the CCAR banks would choose high payouts in the absence of regulatory intervention, a pattern I will document in the empirical section. This also implies that restricting payouts lowers shareholder value when the constraint on payouts binds.

The next proposition examines debtholder value. Debtholders do not make firm decisions so they take the payout policy d as given. Yet, their payoff still depends on d:

Proposition 2.2. *Debtholder value is decreasing in d and debt value is maximized at $d = 0$.*

In the proof, I show that debtholders would prefer equity issuance if possible. Under the restriction $d \in [0, c]$, $d = 0$ maximizes debt value. Intuitively, at the margin, any increase in payouts increases the probability that the bank will not generate enough assets to cover its liabilites, implying (partial) default on debtholders. Since any marginal payout lowers debt value, debt value is maximized when there is no payout. I also show that the proof of this proposition does not require the assumption of uniformly distributed assets but that it holds generally for any distribution under the assumption of $\phi < 1$.

These two propositions imply that there exists a region where shareholders and debtholders have different preferences over payouts and restrictions to payouts imposed by an exogenous regulator therefore re-distribute risk between shareholders and debtholders.

Lemma 2.3. *Debtholders and shareholders strictly disagree on payout policies for parameter values such that* $V < V^* = \ell - \frac{c}{2} - \underline{a}$*. Equity value is increasing in payouts and debt value is declining in payouts in that region.*

Lemma 2.3 directly follows from the two previous propositions. The lemma is critical since it enables us to think about payout restrictions imposed by an exogenous regulator.

Unrestricted shareholders will select $d = c$ for $V < V^*$. If, however, an exogenous regulator imposes a payout restriction of $d = 0$, equity values decline. In contrast, debt values are predicted to appreciate since debt value is declining in payouts. Both of these predictions reverse if a previously imposed payout restriction is lifted. In that case, equity value appreciates and debt value declines.

One limitation of the result in Lemma 2.3 is that it abstracts from dynamic considerations. The model assumes that all debt is in place. In a dynamic setting, banks might issue debt after the payout restrictions have been imposed and the prediction that debt values appreciate through the payout restrictions implies lower costs of debt rollover, which would benefit shareholders. The presence of long-term debt and of government guarantees, ϕ, on bank liabilities, which attenuates the response of debt to the payout restrictions, mitigate the empirical importance of this reduction in rollover costs channel.

Proposition 2.4. *The response of debt value to reducing payouts is declining in* ϕ*.*

The intuition for this proposition is as follows: As government guarantees are more extensive, there is less benefit from avoiding default. Hence, debt prices respond less to changes in payouts. If $\phi = 1$, the response to changes in payouts is exactly zero since debtholders' payoff is independent of the debt value. At $\phi > 1$, the relationship would reverse. Higher payouts, that is higher default risk, would be favored by debtholders. As they are overinsured, the event that triggers insurance would actually be beneficial to them.

Proposition 2.5. *The expected payment from the government to debtholders rises in* d*.*

Proposition 2.5 illustrates how payout restrictions would affect the expected transfer from the government to banks' debtholders. For $\phi > 0$, those are increasing in bank payouts. Hence, imposing a binding restriction on payouts reduces the expected transfer from the government to banks' creditors. This illustrates the public payout covenant feature of payout restrictions. Since bank default imposes costs on debtholders that, in turn, are partially borne by the government, the government has incentives to limit payouts in order to reduce its expected losses - very similar to the mechanism underlying a private payout covenant.

An alternative channel through which payout restrictions could operate is via conveying news about assets of banks. When the regulator issues a payout restriction, this could communicate the regulator's private information that bank assets are worse than previously believed. To analyze the effects of this, I consider comparative statics in the asset payoff. How do equity and debt values move with the upper bound of payouts $\bar{a}$?

Proposition 2.6. *A decline of the upper bound of the asset distribution, $\bar{a}$, lowers both equity and debt values. Formally:* $\frac{dEV}{d\bar{a}} \geq 0$, $\frac{dDV}{d\bar{a}} \geq 0$

Proposition 2.6 derives empirical predictions for comparative statics in the asset payoff. In particular, it characterizes how debt and equity values change with respect to $\bar{a}$. A rise in $\bar{a}$ can be interpreted as good news about bank assets whereas a decline would by synonymous of bad news. Bad news about assets makes default more likely and also implies lower expected payoffs to shareholders upon survival. Jointly, these two forces imply that equity values fall upon bad news about assets. Debt values also decline because default risk increases and debtholders are assumed imperfectly insured against default, $\phi < 1$. Proposition 2.6 is important because when regulators impose payout restrictions, those could be a signal of bad news about bank assets, that is a decline in $\bar{a}$. However, the debt response is the opposite compared to the case where payout restrictions lead to a reversal of risk-shifting as analyzed in Lemma 2.3.

All proofs are in Appendix B.

2.4 Risk-taking Choice

So far, the model considered debt and equity values holding constant bank assets. In this section, I partly endogenize risk-taking on the asset side.

At no cost, the bank can select between having assets drawn from the previous distribution, $a \sim U(\underline{a}, \overline{a})$ or from a mean-preserving spread that widens the distribution: $a \sim U(\underline{a} - \epsilon, \overline{a} + \epsilon)$ where $\epsilon > 0$. This second distribution has the same mean as the previous one but has larger variance so it is riskier.

Bank shareholders now have to make two simultaneous choices. They have to decide on a payout policy $d \in [0, c]$ and they have to select which distribution to draw assets from. I will refer to this second choice as a risk-taking decision. Shareholder value is now given by the maximum over the optimal choices under either distribution:

$$\max_d \{\max_d EV(d, \textit{safe}), \max_d EV(d, \textit{risky})\} \tag{4}$$

where $EV(d, \textit{safe})$ denotes equity value as per Equation 1 where expectations are taken with respect to $a \sim U(\underline{a}, \overline{a})$ and $EV(d, \textit{risky})$ refers to shareholder value under $a \sim U(\underline{a} - \epsilon, \overline{a} + \epsilon)$. For this two-dimensional choice, a region of complementarity between risk-taking and payouts emerges:

Proposition 2.7. *There exist bounds* $\underline{\ell}, \bar{\ell}$ *and* $\underline{V}, \bar{V}$ *such that for liability values,* ℓ*, that satisfy* $\underline{\ell} = \max\{\frac{\bar{a}+\underline{a}}{2}, \underline{a}+c\} < \ell < \bar{\ell} < \frac{\bar{a}+\underline{a}}{2} + c$ *with* $c > \frac{\bar{a}-\underline{a}}{4}$ *and for franchise values* V *that satisfy* $\underline{V} < V < \bar{V}$*, there is complementarity as follows:*
The bank selects $U(\underline{a}-\epsilon, \overline{a}+\epsilon)$ *and* $d = c$ *if unrestricted. If* $d = 0$ *is imposed, it selects* $U(\underline{a}, \overline{a})$*. The bounds* $\underline{V}$ *and* $\bar{V}$ *are defined in the appendix.*

Proposition 2.7 highlights that for banks that are sufficiently, but not excessively levered, there is a complementarity between payout and risk-taking choices. When payouts are left unrestricted, these banks would pick high payouts and higher risk. But if forced to refrain from payouts, that is if $d = 0$ was imposed on them, they would also cut back on the risk-taking margin. This result highlights how payout restrictions can affect the bank's policies along other dimensions than payout policy only. By shifting risk from debtholders back onto shareholders a binding payout restriction incentivizes shareholders to take on less risk.

The result critically depends on the bank's debt ℓ, continuation value V and cash holdings c.

First, bank's debt ℓ is critical. Since assets are pre-determined and have the same expected value for any bank, conditional on the payout policy, we can interpret ℓ as leverage. Ceteris paribus, a bank with greater ℓ has to support more debt with the same assets implying higher leverage. For $\ell \geq \bar{\ell}$, the bank always wants to risk-shift. Even when it is restricted from paying out, shareholders will not prefer switching from the risky to the safe project. For $\ell \leq \underline{\ell}$, the opposite emerges. Shareholders have a comparatively high stake in the firm. Hence, they refrain from risk-taking and the payout restriction has no bite. Intuitively, for intermediate values of leverage, the bank's debt is such that unrestricted shareholders want to risk-shift. But if subject to a payout restriction, enough risk is shifted back onto them so that they cut back on risk-taking as well.

Second, the complementarity result depends on V. For high enough franchise values, no level of ℓ can sustain risk-shifting via payouts and hence payout restrictions do not bind. Likewise, if V - conditional on ℓ - is too low, shareholders always risk shift and thus still take on riskier projects even when payout restrictions bind.

Third, there is a condition on the amount of cash c at the bank. If full payouts $d = c$ are too low, the change in payoffs induced by the payout restriction is not strong enough to induce a shift on the risk-taking margin.

2.5 Model and Data

In the data, we observe that all large US banks pick positive levels of payouts over the entire decade preceding the Covid crisis. Through the lens of the model, this implies that their franchise values are low or moderate, consistent with the argument by Chousakos and Gorton (2017) and Sarin and Summers (2016) that the franchise values of major US banks have fallen in the aftermath of the financial crisis.

In practice, payout restrictions can operate via two channels. First, they can partly reverse risk-shifting incentives and second, they might be imposed when regulators have private information that bank assets' are worse than anticipated. If risk-shifting is the dominant channel, I derived in Lemma 2.3 that equity values should decline after payout restrictions are imposed whereas debt values should increase. In contrast, both equity and debt values are predicted to fall when bad news about assets are released, see proposition 2.6. Hence, the change in debt value is informative for discriminating between these two competing explanations. In addition, the equity response is important for two reasons. First, if equity values change after announcements about payout restrictions, this suggests that the restrictions were not fully anticipated. Second, if equity values decline when payout restrictions are announced, this would support that the potential benefit of the payout restrictions for equityholders through lower costs of debt rollover is not the dominant force.

Finally, how can Proposition 2.7 be interpreted when bringing the model to the data?

The CCAR banks were levered at the onset of the Covid crisis but to a significantly lesser extent than at the onset of the financial crisis. Moreover, we observe empirically that banks do not operate strictly at their regulatory constraints, such as capital ratios, but keep buffers relative to the constraint. Consequently, I interpret the CCAR banks as being moderately but not extremely levered through the lens of the model, which is consistent with the parameter restrictions necessary for Proposition 2.7. The empirical results are consistent with this interpretation.

The complementarity between payouts and risk-taking has implications for policy makers. Beyond shoring up banks' equity buffers and thus reducing the likelihood that a bank defaults, payout restrictions have a secondary effect: they can reduce risk-taking by banks. With equityholders bearing more risk when there is a payout restriction, they might reduce risk-taking activities. Thus, payout restrictions can directly influence decisions on the asset side of banks' balance sheets.

This implies two potential benefits from payout restrictions on banks during recessions for financial stability. First, capital buffers rise when the restrictions bind and thus force banks to retain earnings that otherwise would have been paid out. Second, banks endogenously cut back on their risk-taking which lowers their risk-weighted assets. Higher capital and lower risk-weighted assets both lead to higher risk-based capital. While the second effect does depend on parameters, the empirical analysis will support that this region of the parameter space is the empirically relevant one.

3 Empirical Strategy

The aim of the remainder of the paper consists of empirically testing the theoretical channels of payout restrictions outlined in the previous section. The focus is on payout restrictions imposed in June 2020 onto major US banks and subsequently lifted in December 2020.

3.1 Data

For US stock-market data, I use daily CRSP as well as TAQ. TAQ has daily tick-by-tick data for the major American stock exchanges (NYSE, NASDAQ, AMEX), reported with millisecond timestamps. When proceeding with the estimation, I aggregate that data by the minute, using the average stock price for each firm within a given minute. This time aggregation will allow for the inclusion of time fixed effects for each minute to absorb time-varying factors in the empirical analysis, except for ultra-high frequency variation. I use TAQ data over 2-hour time windows (4pm to 6pm Eastern) on 06/25/2020, 12/18/2020 and 03/25/2021. For ease of comparison, I normalize the pricen to one for all stocks at 4.00 pm Eastern.

For stock market data covering the Eurozone and the UK, I use Compustat Global Security Daily. It contains daily stock prices for public firms worldwide.

Next, data on debt pricing from TRACE for secondary market corporate bond transactions and Markit for credit default swap (CDS) pricing are critical. TRACE contains daily summaries of bond trades for corporate bonds at the CUSIP level, which I supplement with data on the size of the issuance from Mergent FISD. Data construction is described in Appendix A.4.

Since not all corporate bonds by a company are traded on a given day and prices in the OTC corporate bond market partly depend on liquidity and buyer/seller identities, I also use credit-default swap (CDS) data from IHS Markit to analyze changes in debt values. CDS capture the price of insuring the risk of default of a borrower and thus measure default probabilities. CDS data is largely standardized. Markit produces daily spreads for the term structure of CDS spreads ranging from 6 months to 30 years. It aggregates daily quotes into the price for firms that have at least three distinct contributors on a given day. The reported spreads are comparable over time, after controlling for legal terms and recovery rates. Critically, I only keep CDS spreads for senior unsecured debt. This ensures that the CDS response I measure is not driven by valuation effects pertaining to the value of the underlying collateral, in the case of secured bonds, or, in the case of convertible bonds, by the value of equity.

Data on balance sheet variables comes from the Federal Reserve's Y9C data and Compustat. The Y9C data provides great detail on bank balance sheets at the bank holding company (BHC) level, which is used to construct time series of payouts, profitability, net income, loan loss provisions, assets and liabilities.

Finally, loan level data for the syndicated loan market is accessed from Thomson One. It covers the near-universe of syndicated loans worldwide. I keep loans within the US originated since 2019. For each loan, the data reports a flag whether it is a leveraged transactions (defined as a below investment-grade loan by Thomson Reuters) and for about half the loans, the spread over a reference rate, usually LIBOR, is reported. The advantage of that data set is that it covers new issuances at the loan level and provides an indicator for riskiness. One drawback is that the data only covers syndicated lending, which is biased towards larger borrowers.

Further details on the data construction are outlined in Appendix A.

3.2 Institutional Setting

Following the financial crisis after the Lehman Brothers collapse in 2008, US regulators added a wide range of new financial regulations, the most important ones were imposed through the Dodd-Frank Act from 2010. Section 165 of the law lays out several new regulations pertaining to large bank holding companies[3] including stress tests and the Comprehensive Capital Analysis and Review (CCAR), which requires banks to submit their capital distribution plans at the bank holding company (BHC) level to the Fed for approval.

3.2.1 Comprehensive Capital Analysis and Review (CCAR)

All BHCs with consolidated assets exceeding $100 billion are subject to the CCAR exercise. As part of the CCAR, the Fed reviews banks' proposed distributions of dividends and share buybacks and needs to authorize these plans. Approval is subject to capital distribution plans being consistent with maintaining sufficient capitalization in times of economic or financial stress. In normal times, the CCAR is conducted once per year. During the Covid pandemic, two rounds of testing were imposed in 2020. In the analysis to follow, I remove foreign banking organizations (FBOs) since regulation and payout restrictions in their home countries, where the parent organizations are based, are critical for them as opposed to the restrictions imposed by the Fed. Throughout, I will refer to this sample of 22 domestic BHCs subject to the CCAR as "CCAR banks".

3.2.2 06/25/2020

On June 25, 2020 at 4.30 pm EDT, the Fed released a statement announcing that share buybacks would not be permitted for the third quarter and dividends would be capped by the minimum of second quarter dividends and average earnings over the past four quarters. "As a result, a bank cannot increase its dividend and can [only] pay dividends if it has earned sufficient income."[4]

The restrictions uniformly affected all CCAR banks and were the first time that the Fed issued wide-ranging payout restrictions across all Fed-supervised banks. In the announcement text, the Fed stated that the payout restrictions would be re-evaluated on a quarterly basis but no set end date for the restrictions was given. Hence, there was short and medium-run uncertainty about how long the restrictions would remain in place. This announcement will represent the first natural experiment to be exploited in the empirical analysis.

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[3] The standards also apply to non-bank financial companies supervised by the Board of Governors but those are not the focus of this paper.

[4] https://www.federalreserve.gov/newsevents/pressreleases/bcreg20200625c.htm

3.2.3 12/18/2020

On 12/18/2020 at 4.30 pm EDT, the Fed announced that it would remove the ban on repurchases for large US banks, which had been imposed in June 2020. Analyst comments suggest that the lifting of repurchase restrictions partly came as a surprise.[5] Much less stringent restrictions remained in place. Specifically, the sum of quarterly dividend and share buyback payouts could not exceed average quarterly earnings from the past four quarters.

While some restrictions remained after the 12/18/2020 announcement, it is worth noting that the highest payout ratios, compared to net income, prior to Covid hovered around paying out 1.2 times net income and that the bulk of bank payouts occurs via share buybacks, not dividends. Hence, the relaxation of payout restrictions was substantial and the remaining constraints were not very binding any more.

I will show in the next section that several banks restart share buyback programs in 2021 Q1 following the relaxation of th previous restrictions. This evidence suggests that the payout restrictions were binding constraints for some banks and effectively led banks to pay out less than if they would have been unconstrained.

The 12/18/2020 announcement serves as the second natural experiment in this paper.

3.3 Summary Statistics

Table 1 reports summary statistics for 2019 for the sample of domestic CCAR banks and the largest domestic bank holding companies outside the CCAR. Throughout, CCAR banks will refer to those domestic banks participating in the CCAR in 2020.

Net payout ratios are defined as dividends plus share buybacks net of issuance divided by net income. The average CCAR bank was paying out 92 % of its net income in 2019, compared to 65 % for publicly listed non-CCAR banks. These figures are virtually identical if I remove the investment banks from the sample.

Further summary statistics are reported in Appendix C: Tables C.5 and C.6 contain summary statistics for CDS spreads around the announcements on 06/25/2020 and 12/18/2020 respectively. Table C.7 contains summary statistics for corporate bonds and the syndicated loan data is summarized in Table C.8.

3.4 Estimation

I now outline the empirical specifications. The first goal consists of testing for the effects of the payout restrictions onto equity and debt prices. The second set of tests examine whether the lending margin is affected by the imposition or subsequent relaxation of payout restrictions.

[5] "The ability to buy back stock, within limits, was hoped for but not expected," Susan Katzke, an analyst at Credit Suisse Group AG, said in a note to clients that called the news a "clear positive." as quoted in https://www.bloomberg.com/news/articles/2020-12-18/fed-lets-banks-restart-stock-buybacks-following-stress-tests

	CCAR Banks 2019		Large non-CCAR Banks 2019	
	mean	sd	mean	sd
Total Assets	675.86	796.98	74.46	62.39
Total Liabilities	604.48	717.28	67.07	58.34
Capital Ratio	11.26	1.65	12.90	4.43
RoE	0.03	0.02	0.04	0.03
Dividends	0.61	0.81	0.07	0.07
Share Repurchases	1.77	2.59	0.19	0.33
Issuance	0.20	0.49	0.04	0.12
Net Payout Ratio	0.92	0.60	0.65	0.89
Observations	88		61	

Data is quarterly. Balance sheet information is from FR Y9C, payout information is from Compustat. Balance sheet variables in billion US dollars. RoE is quarterly return on assets defined as net income divided by total assets. Net payout ratio is defined as dividends plus share buybacks minus issuances, divided by net income. The capital ratio is Tier 1 equity capital over risk-weighted assets (Item BHCAP793). CCAR banks are domestic BHCs subject to CCAR in 2020.

Table 1: 2019 Summary statistics for banks

In trying to identify the effects of payout restrictions onto debt and equity values, I face at least two identification challenges. First, the restrictions themselves could convey private information by the Fed about the banks it supervises. By restricting bank payouts, the Fed could be signaling its (negative) private information about future bank prospects to the market. Separating such a news effect from risk-shifting explanations is a substantial challenge. While both channels imply falling equity prices, bad news also negatively affect bond holders as the overall bank would be riskier. Reversal of risk-shifting, on the other hand, implies an increase in bond prices as the higher equity cushion due to payout restrictions would provide more safety to bondholders, who only bear losses when equity is wiped out. Hence, debt pricing helps resolve the identification challenge.

Second, a low-frequency empirical approach would be potentially contaminated by other shocks that asymmetrically affect the large banks subject to the CCAR regime. To address this challenge, I will implement a high-frequency approach.

3.4.1 Equity Response

To estimate the equity response to the imposition and stepwise removal of payout restrictions onto US banks, I rely on the TAQ high-frequency equity market data. All Fed announcements are released at 4.30 pm Eastern. Using the aggregated minute-by-minute stock level data, I estimate high-frequency differences-in-differences event studies according to Equation 5:

$$P_{it} = \alpha_i + \alpha_t + \sum_{\substack{\tau=16:00 \\ \tau\neq 16:30}}^{18:00} \beta_\tau \mathbf{1}_{t=\tau} \mathit{CCAR\ Bank}_i + \epsilon_{it} \tag{5}$$

P_{it} is the stock price of firm i in minute t. I normalize P_{it} to 1 at 4.00 ET to facilitate comparison of prices across stocks. α_i and α_t are corresponding firm and time fixed-effects that remove macro-level time variation and any time-invariant factors at the firm level. *CCAR Bank*$_i$ is a binary indicator which equals one for the banks part of the 2020 CCAR and thus subject to the payout restrictions, and zero otherwise. The coefficients of interest are the sequence of β_τ. Standard errors are double-clustered at the firm and time level. The control group consists of all stocks with trades in at least 90 out of the 120 minutes of the time window. This ensures stock price reactions can be precisely estimated. The identifying assumptions are the absence of pre-trends and that there are no other announcements over the 2-hour time window which differentially affect the two groups of stocks.

Including non-financial stocks in the control group is due to the lower liquidity of after-hours stock market trading, which implies that many of the smaller non-CCAR banks are very infrequently traded over the time window. To mitigate concerns about the choice of control group, Sections 4.4.1 and 4.4.2 will provide evidence on daily equity market data with a tighter control group.

Equation 5 is a direct test of the equity implications of Lemma 2.3, which states that imposing binding payout restrictions should lower equity values whereas relaxing those restrictions should raise equity values. Moreover, Equation 5 also allows to test whether the restrictions were partly unanticipated. In an efficient stock market, the impact of the restrictions would be fully priced in if they were ex-ante anticipated.

3.4.2 Debt Response

To estimate the debt response, the baseline results build on Markit CDS spreads. The daily frequency of the data warrants an event-study approach using a 10-day window around the announcements featuring 5 trading days before and 5 after the respective Fed announcement.

$$Spread_{it} = \alpha_i + \alpha_{t,r} + \sum_{\substack{\tau=-5 \\ \tau\neq 0}}^{5} \gamma_\tau \mathbf{1}_{t=\tau} CCARBank_i + \delta_2 X_{it} + \epsilon_{it} \tag{6}$$

CDS spreads for firm i on day t are regressed on a time-rating fixed effect, firm fixed effects and contract-level controls. The main coefficients of interest are the series of coefficients γ_τ on the interaction of a time dummy for each day with the treatment CCAR-bank dummy *CCAR Bank*$_i$. non-CCAR firms are other financial firms for this specification, tightening the identification. Standard errors are again double-clustered by time and firm. In the results section, I will estimate Equation 6 for all available frequencies of CDS spreads.

An alternative approach to test for the effect on debt values consists of using data on corporate bond yields. Results for this will be shown as well. Both CDS spreads and bond yields allow to separate between the risk-shifting hypothesis derived in Proposition 2.2 and the bad news hypothesis derived in Lemma 2.3. If the imposition of payout restrictions conveys bad news about banks' assets, their default risk should increase and hence debt values should fall implying a rise in CDS spreads and corporate bond yields. Conversely, the risk-shifting hypothesis predicts a decline in CDS spreads and corporate bond yields as risk is shifted from existing bondholders onto equityholders, making default on debt less likely.

3.4.3 Lending Effects

Building on the insights how risk-shifting incentives shift debt and equity pricing, I further test whether payout restrictions affect banks' risk-taking decisions. This tests if the theoretical possibility of a complementarity between payout and risk-taking decisions derived in Proposition 2.7 has practical relevance. The theoretical rationale is that once payout restrictions are lifted, bank equityholders face incentives to pay out funds and take on riskier projects at the same time. The downside of such risky investments is then transferred onto debtholders and the government since shareholders have reduced the size of the equity stake through payouts. Shareholders nevertheless capture the upside from risky investments due to the call-option feature of equity compensation.

To test this channel empirically, I exploit the Thomson Reuters One syndicated loan data at the loan-level. The dummy $nonIG_{ijb}$ equals one if loan i by bank b to firm j is a below-investment grade loan, and zero otherwise. Using the sample of newly issued syndicated loans by US-based CCAR banks from July 2020 to March 2021, I then estimate whether there is a differential impact from lifting the payout restrictions in December 2020 onto riskier lending. The $Post_t$ dummy equals one for the post-December 2020 months. This motivates a differences-in-differences empirical strategy as outlined in Equation 7:

$$log(Loans_{ijbt}) = \alpha_{b,t} + \alpha_j + \beta_1 Post_t nonIG_{ijb} + \beta_2 nonIG_{ijb} + \beta_3 Post_t + \gamma X_{ijbt} + \epsilon_{ijbt} \quad (7)$$

$\alpha_{b,t}$ is a bank-time fixed effect and α_j is a firm fixed effect. The main coefficient of interest in this differences-in-differences specification is β_1, the coefficient on the interaction term of the non-investment-grade dummy with the post-policy change dummy. The bank-time fixed effect absorbs any other bank-level covariates. In specifications that are not saturated with a bank-time fixed effect, I include size, profitability, liquid assets to total assets and total loans to total assets as bank-level controls.

These regressions are closely related to the literature on monetary policy and bank risk-taking (e.g., Dell'Ariccia et al. (2017), Jiménez et al. (2014)). While that literature addresses the question how changes in policy rates affect the composition of the credit supply, this paper focuses on the impact of a regulatory intervention - rather than standard monetary policy interventions - on banks' risk-taking.

4 Empirical Results for Payouts, Equity and Debt Prices

This section first provides an overview of CCAR banks' financials and payout decisions before showing estimates for the high-frequency event studies for the equity response and for debt prices.

4.1 Overview of CCAR banks

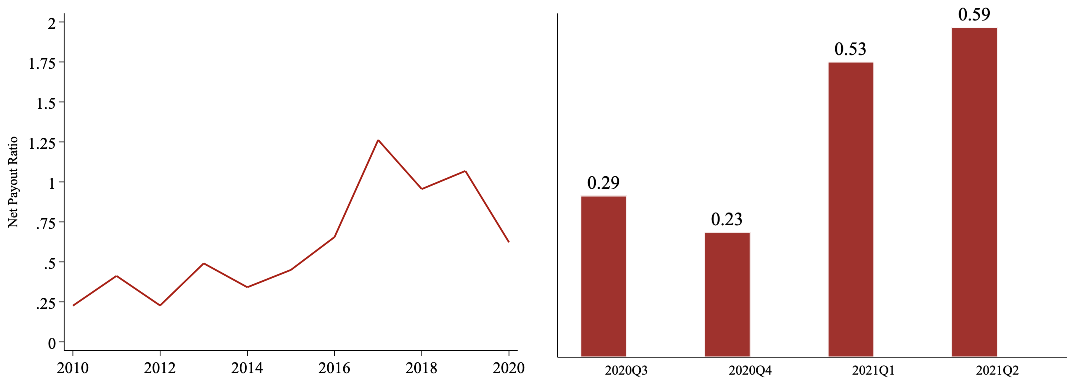
Here, I provide an overview over payout decisions by CCAR banks as well as leverage. In particular, I show that changes to payout restrictions directly affect payouts before proceeding to the analysis of the effect on debt and equity values.

4.1.1 Direct Effects on Payouts

The behavior of payouts around the announcements is informative because we can think of it as the direct impact of the payout restrictions or the "first stage". For the analysis, I define the net payout ratio for bank i at time t:

$$Net\ Payout\ Ratio_{it} = \frac{Div_{it} + BB_{it} - Iss_{it}}{Net\ Income_{it}} \tag{8}$$

It captures all funds paid out to shareholders via either dividends Div_{it} or share buybacks BB_{it} net of proceeds from stock issuance Iss_{it} and then normalized by net income $Net\ Income_{it}$. The normalization ensures that figures across banks are readily comparable. In addition, it provides for a simple interpretation of the net payout ratio. A net payout ratio of one implies that a bank is paying out all of its net income to shareholders. If the net payout ratio is below one, some retained earnings are accumulated, a net payout ratio exceeding one indicates de-cumulation of retained earnings.



(a) 2010 - 2020 **(b)** 2020Q3 - 2021Q2

Panel a) reports time series of yearly net payout ratio for CCAR banks since 2010. Net payout ratio is defined as dividends plus share buybacks minus issuances divided by net income. Panel b) reports quarterly net payout ratio from 2020 Q3 to 2021 Q2. Data is from Compustat and FR Y9C.

Figure 2: CCAR Bank Net Payout Ratio

Figure 2 reports the time series of net payout ratios for CCAR banks since 2010 in the left-hand panel. Prior to the Covid crisis, net payout ratios hovered around 1, indicating the CCAR banks were on average paying out all of their net income. In 2020, there is a sharp reduction in net payouts. the right-hand panel zooms into the evolution of the net payout ratio from 2020Q3 - 2021 Q2. It confirms that net payout ratios are low, at .29 and .23 for the two quarters when payout restrictions are in place in the United States. Likewise, when the restriction are being relaxed again at the end of 2020, we observe a strong increase in net payout ratios in the first two quarters of 2021. This is consistent with the payout restriction being binding and their relaxation therefore causing a rise in payouts.

Figure D.5 confirms that this observation is robust to correcting net income for the impact of loan loss provisioning. Since many banks released previous loan loss provisions in 2021, net payout ratios are even higher in 2021 when net income, net of loan loss provisioning, is taken as the denominator of the net payout ratio.

I also show in Figure D.6 that the net payout ratio rises for CCAR banks after the relaxation of payout restrictions in December 2020 but not for the largest 14 banks outside the CCAR. This further suggests that the increase in payouts by CCAR banks in early 2021 is driven by the changes to payout restrictions and not by other macroeconomic or industry-specific factors.

4.1.2 Changes in Leverage

If payout restrictions effectively limit banks in their ability to pay out earnings, retained earnings must be increasing and thus equity increases implying a decline in leverage. Figure 3 shows the time series of leverage, defined as Tier 1 capital over total assets used for leverage calculations, for CCAR banks in the left-hand panel and for banks outside the CCAR in the right-hand panel.

(a) CCAR bank leverage **(b)** Non-CCAR bank leverage

Figure reports the leverage ratio defined as Tier1-capital over total assets for the leverage ratio for CCAR banks and the largest non-CCAR banks from 2017 Q1 to 2021 Q2. Data is from FR Y9C.

Figure 3: Bank Leverage Time Series

Prior to the Covid-crisis, leverage of large US banks hovers around 10.5 dollars of assets for each dollar of Tier-1 capital. Leverage increases sharply at the onset of the Covid-crisis, especially over the first half of 2020. One reason is the large influx of deposits in the early days of the Covid crisis. When payout restrictions are imposed in June 2020, leverage falls for the CCAR banks in panel a) but not for the large banks outside the CCAR in panel b). This provides some first evidence that the restrictions have bite.

In the aftermath of the relaxation of payout restrictions in December 2020, one can see that leverage rises again for the CCAR banks. This highlights how the increase in payouts observed in Figure 2 leads to lower a capital base among large banks. Yet, for the banks outside the CCAR in the left-hand panel, leverage remained flat since June 2020 and slightly fell in 2021. Figure D.7 reproduces the same plot for some individual banks.

4.2 06/25/2020 - Imposing Payout Restrictions

The first empirical test exploits the June 25, 2020 announcement of payout restrictions. At 4.30pm ET, the Fed announces that payouts by large US banks, those taking part in the CCAR, will be restricted going forward for an unspecified length of time. How this announcement affected debt and equity prices of banks is an empirical question. On the one hand, the announcement could reflect bad news about banks. Alternatively, the payout restrictions could shift risk from debt onto equityholders since it is becoming more costly to pursue risk-shifting strategies for equityholders. In either case, equity values should be falling. But in the first case, debt values should fall as well if banks are in worth health than previously known whereas risk-shifting implies an appreciation of debt values.

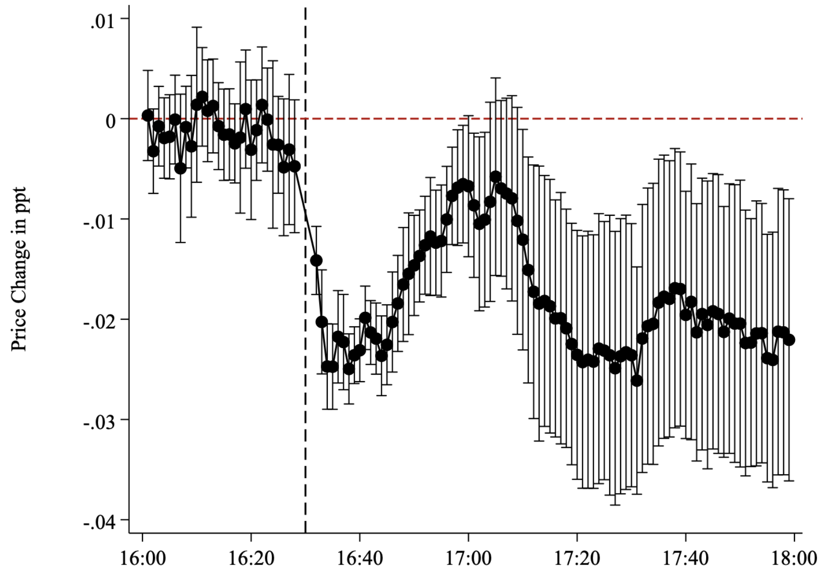
4.2.1 Equity Values

Figure 4 displays results for high-frequency event studies on equity prices. The vertical dashed line indicates the announcement time at 4.30pm ET:

Prior to the announcement, at this very high minutely frequency, CCAR bank and other stocks are trending in parallel, which provides strong support for the identifying assumption of these event-studies. However, immediately after the announcement, stock prices fall by about 2 %. This effect only takes minutes to materialize, indicating that information is processed rapidly in equity markets and that the restrictions were not fully priced ex-ante. Furthermore, the decline in equity values shows that any benefits from the payout restrictions for shareholders in terms of lowering the cost of debt rollover are dominated by risk-shifting or negative news. The debt response will now help to discriminate between those two explanations.

4.2.2 Debt Values

Panel a) of Figure 5 reports the raw data for CDS spreads, separated into CCAR banks and other financial firms. To facilitate comparison of the two time series, I normalize both time series to 1 on the announcement date, 06/25/2020, which corresponds to day 0 in the plot. Following the announcement, a persistent gap emerges between the two time series. CDS



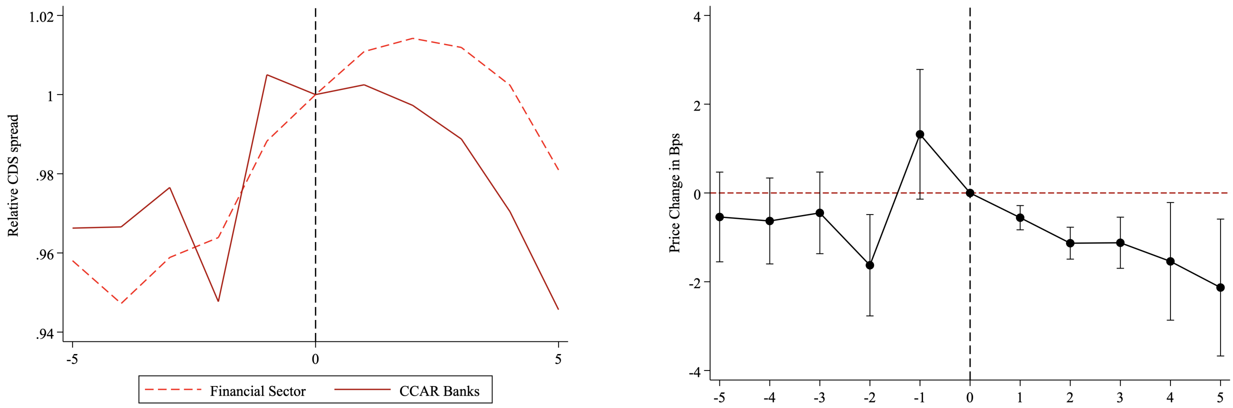
Graph reports coefficients and 95 % confidence bands for event study regressions on 06/25/2020 of normalized stock price onto minutely Time x CCAR bank interaction terms (Equation 5). Prices are normalized to 1 at 4.00 ET. Standard errors are double-clustered at the firm and time level. Source: TAQ data

Figure 4: High-frequency Event Studies 06/25/2020 4.00 - 6.00 pm ET

spreads for CCAR banks fall relative to other financial firms in the market. To remove time-invariant heterogeneity across CDS issuers and account for time-varying factors via time fixed effects, I formally estimate Equation 6 and report the event-study coefficients with their 95 % confidence bands in Panel b).

There is little evidence for a pre-trend in CDS spreads. Following the announcement, however, the event study confirms the observation from panel a). CDS spreads fall significantly and differentially for CCAR banks relative to the control group of financial firms. Quantitatively, the effect is about 2 basis points after 5 trading days.

These results reject the bad news hypothesis. If payout restrictions mostly communicated negative unexpected information about bank assets to the market, a differential rise in their CDS spreads would be expected since negative news about assets implies default likelihoods going up. However, we observe a differential decline. This suggests that risk-shifting is at play. Risk is shifted from debt onto equityholders when a binding payout restriction is imposed. Consequently, debt claims on banks become safer as there will be a larger equity cushion that can absorb losses. It is still possible that my results are only a lower bound on the size of the risk-shifting effect in absolute value terms. If both a news effect and a risk-shifting effect occurred simultaneously, my results show that the risk-shifting effect dominates but it would have been even larger in the absence of the confounding news effect.



(a) Raw Data

(b) Event-study

Panel a) reports raw data for CDS spreads around announcement day on 06/25/2020. Solid red line plots mean CDS spread for CCAR banks normalized to 1 on 06/25/2020. Dashed red line reports mean CDS spread for other financial firms, normalized to 1 on 06/25/2020. Panel b) reports estimated coefficients and 95 % standard errors from estimating Equation 6. CDS are measured in basis points. Standard errors are clustered at the firm-level.

Figure 5: Results for 5-year CDS Spreads

4.3 12/18/2020 - Lifting Payout Restrictions

The second test to substantiate the risk-shifting hypothesis relies exploits payout restrictions being lifted to a large extent on 12/18/2020 by the Fed. As discussed earlier, the restrictions that remained in place are not strongly binding.

4.3.1 Equity Values

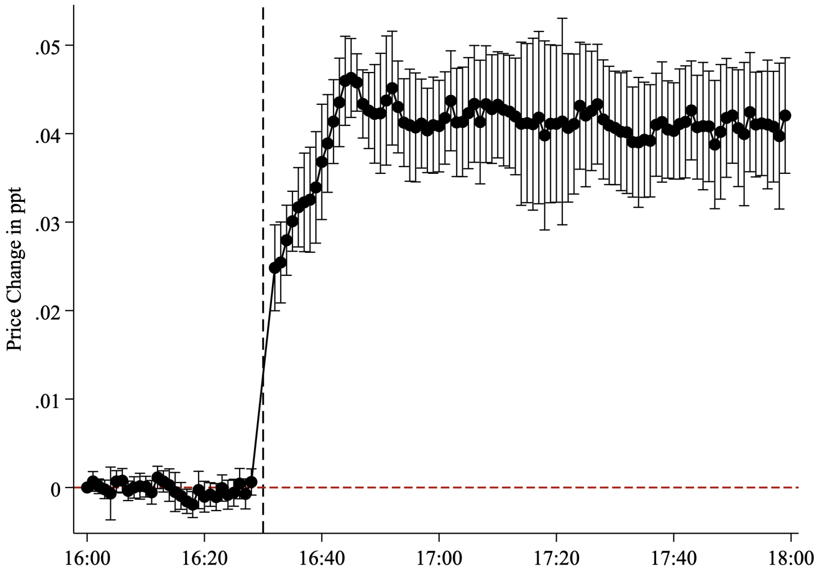
Figure 6 reports the equity response for CCAR banks relative to the remainder of public firms on 12/18/2020 between 4.00 and 6.00 pm ET:

Within minutes of the announcement that payout restrictions are being loosened, equity values rise differentially by about 4 percent for the average CCAR bank. The effect is both statistically and economically highly significant, showing that the lifting of the payout restrictions was partly unexpected and therefore not ex-ante priced. Moreover, from Figure 6, we can corroborate the identifying assumption for the event studies that there is no pre-trend.

4.3.2 Debt Values

Again, the debt response should a priori be informative whether the relaxation of payout restrictions is a signal about banks being in better than expected financial health or whether risk-shifting is occurring. Panel a) of Figure 7 plots CDS spreads by CCAR banks versus the remainder of the financial sector around the December 18 announcement. For the figure, I normalize all CDS spreads to 1 on December 18 to facilitate comparison.

While spreads trend relatively parallel until December 18, 2020, spreads sharply diverge after the announcement. The spreads of CCAR banks rise differentially more when the payout



Graph reports coefficients and 95 % confidence bands for event study regressions on 12/18/2020 of normalized stock price onto minutely Time x CCAR bank interaction terms (Equation 5). Prices are normalized to 1 at 4.00 ET. Standard errors are double-clustered at the firm and time level. Source: TAQ data

Figure 6: High-frequency Event Studies 12/18/2020 4.00 - 6.00 pm ET

restrictions are being lifted. This is suggestive of risk shifting back from equity onto debtholders, leading to a rise in default risk. The event study results reported in panel b) confirm this. CDS spreads rise differentially for the CCAR banks after banks have been allowed to pay out more funds. Consistent with risk-shifting, CDS spreads increase by more than 1 basis point. Since the average CDS spread for CCAR banks hovers around 106 basis points prior to the announcement, this corresponds to at least a .94% increase.

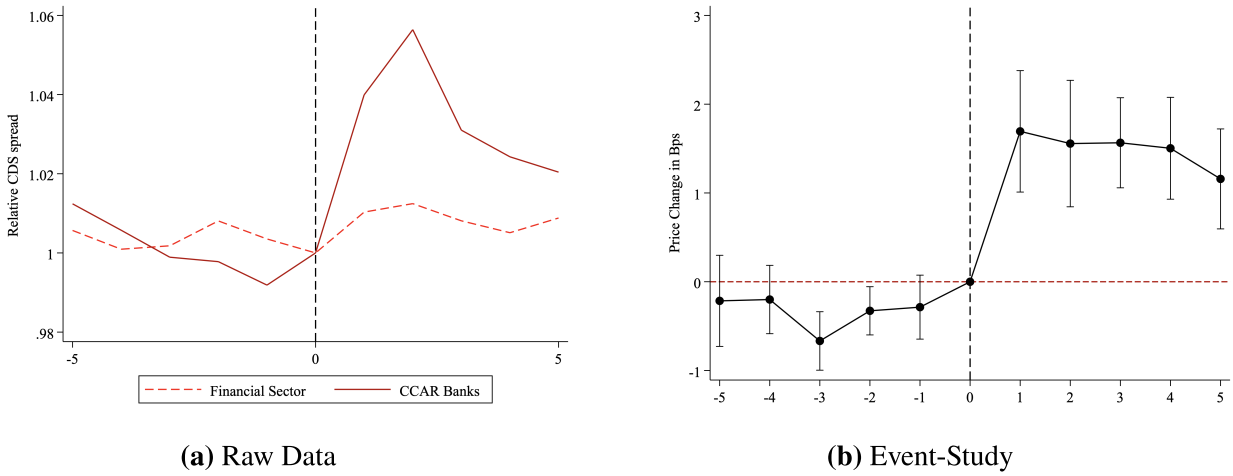
Figure D.9 again reports the entire term structure of CDS spreads. The rise in CDS spreads affects all listed maturities.

4.4 Further Results on Equity and Debt Values

This subsection presents further evidence that is consistent with the risk-shifting mechanism.

4.4.1 Abnormal Returns after 06/25/2020

One potential concern about the high-frequency event studies for stock prices is that liquidity in the after-hours market around the announcements at 4.30 pm ET is lower and this reduced liquidity could undermine the informativeness of the event studies, particularly since the control group also includes non-financial firms. To address these concerns, I estimate daily event studies for abnormal returns as outlined by Campbell et al. (2012) and commonly used in the asset pricing literature (Jayachandran (2006), Coval and Stafford (2007), Edmans et al.



Panel a) reports raw data for CDS spreads around announcement day on 12/18/2020. Solid red line plots mean CDS spread for CCAR banks normalized to 1 on 12/18/2020. Dashed red line reports mean CDS spread for other financial firms, normalized to 1 on 12/18/2020. Panel b) reports estimated coefficients and 95 % standard errors from estimating Equation 6. CDS are measured in basis points. Days are trading days. Standard errors are clustered at the firm-level.

Figure 7: Results for 5-year CDS Spreads

(2012), Acemoglu et al. (2016)).

To estimate abnormal returns, I begin by estimating a model for returns R_{it} of firm i over days indexed by t:

$$R_{it} = \alpha_i + \beta_i + R_{m,t} + \epsilon_{it} \tag{9}$$

$R_{m,t}$ denotes the market return on day t. Following the literature, I estimate this model stock by stock over a 250 trading day time window that ends 30 days before the respective event-window used to analyze the impact of the Fed's payout restrictions. Next, I infer abnormal returns for the event window as the difference between actual returns and those predicted by Equation 9:

$$AR_{it} = R_{it} - (\hat{\alpha}_i + \hat{\beta}_i R_{m,t}) \tag{10}$$

And the final step consists of constructing cumulative abnormal returns as the cumulative sum of abnormal returns over the event window where $\tilde{t}$ now indexes the days during the event window.

$$CAR_{it} = \sum_{\tilde{t}=1}^{10} AR_{i,\tilde{t}} \tag{11}$$

The advantages of estimating daily event studies are at least fourfold. First, the methodology allows to account for beta heterogeneity. Comparing purely returns over time can be misleading as banks with different leverage should see different equity price reactions to the same news. Abnormal returns account for that by netting out the sensitivity to the market return. Second, the methodology covers a longer time horizon than the high-frequency event studies and thus allows to test for persistence of the announcement effects. Third, the longer time horizon, which includes within-hours trading, addresses concerns about the high-frequency event studies potentially being driven by low liquidity of certain stocks and the different market microstructure in after-hours trading (Barclay and Hendershott, 2003). Finally, the higher liquidity in regular trading hours allows to significantly tighten the control group. Whereas the high-frequency event-studies included non-financial firms, results in this section compare CCAR banks to other financial institutions. I include in the control group all banks in the same SIC codes as the CCAR banks with at least $ 1 billion in market capitalization.

One drawback is that abnormal returns over a multi-day window could also be driven by other announcements than just the payout restrictions. The high-frequency event studies and slightly lower frequency cumulative abnormal returns regressions can therefore be viewed as complementary. As shown next, cumulative abnormal returns deliver predictions consistent with the earlier evidence that CCAR banks' stock returns drop differentially when payout restrictions are announced.

Table 2 reports results from a size-weighted regression of cumulative abnormal returns at the bank-level onto an indicator for the CCAR banks for each of the ten trading days after the announcement of payout restrictions on 06/25/2020. We can see that the differentially lower abnormal returns for CCAR banks persist relative to a control group that only consists of smaller banks. Thus, the decline in equity values persists relative to a control group that is now much tighter than in the high-frequency event studies.

Date	Coefficient	SE
06/26/2020	-.0135***	(.0050)
06/29/2020	-.0305***	(.0037)
06/30/2020	-.0336***	(.0047)
07/01/2020	-.0351***	(.0047)
07/02/2020	-.0380***	(.0053)
07/06/2020	-.0350***	(.0066)
07/07/2020	-.0423***	(.0073)
07/08/2020	-.0423***	(.0090)
07/09/2020	-.0422***	(.0099)
07/10/2020	-.0211**	(.0087)

Source: CRSP and own calculations. Table reports coefficients from daily regressions for the 10 days after the announcement date following 06/25/2020. Each daily regression regresses cumulative abnormal returns up to that day onto an indicator for the CCAR banks. Sample includes only banks with market capitalization exceeding USD 1 billion (SIC 6020, 6021, 6022, 6029, 6081, 6141, 6163, 6211, 6711, 6712) and regressions are weighted by market value.

Table 2: CAR after 06/25/2020 Weighted Regression (Banks only)

Table D.9 repeats the same exercise but without weighting regressions by size. The results are very similar. Tables D.10 and D.11 provide further robustness checks by estimating a weighted and unweighted regression with a broader control group of all financial firms (SIC codes 6000-6999, excluding 6726). Results are still quantitatively similar and highly statistically significant. Overall, all of these results suggest that the announcement effects of payout restrictions documented in the high-frequency event-studies persist over time. This supports that the payout restrictions are economically important.

4.4.2 Abnormal Returns after 12/18/2020

I repeat the same methodology for cumulative abnormal returns following the announcement about relaxing the payout restrictions on 12/18/2020. Table 3 contains the results for the same size-weighted regressions comparing CCAR banks to the control group of smaller banks.

Date	Coefficient	SE
12/21/2020	.03196***	(.0049)
12/22/2020	.01844***	(.0047)
12/23/2020	.02493***	(.0055)
12/24/2020	.02299***	(.0051)
12/28/2020	.02279***	(.0053)
12/29/2020	.02646***	(.0055)
12/30/2020	.02332***	(.0054)
12/31/2020	.02873***	(.0053)
01/04/2021	.02893***	(.0067)
01/05/2021	.02701***	(.0072)

Source: CRSP and own calculations. Table reports coefficients from daily regressions for the 10 days after the announcement date following 12/18/2020. Each daily regression regresses cumulative abnormal returns up to that day onto an indicator for the CCAR banks. Sample includes only banks with market capitalization exceeding USD 1 billion (SIC 6020, 6021, 6022, 6029, 6081, 6141, 6163, 6211, 6711, 6712) and regressions are weighted by market value.

Table 3: CAR after 12/18/2020 Weighted Regression (Banks Only)

Results confirm that the announcement effect persists into January when the payout restrictions are being relaxed in December 2020. This effectively highlights that the high-frequency response identified from the tick-by-tick data has economic relevance over a longer time window and affects economic incentives. Tables D.12, D.13 and D.14 show that results are robust to running equal-weighted regressions with banks only in the control group and to running both weighted and unweighted regressions that compare the CCAR banks to all other financial firms. Market-capitalization weighted regressions, however, have the advantage of being representative of the overall market and thus confirm that the responses observed in the unweighted regressions are not driven only by the smaller banks.

4.4.3 Fama-French 3-Factor Model

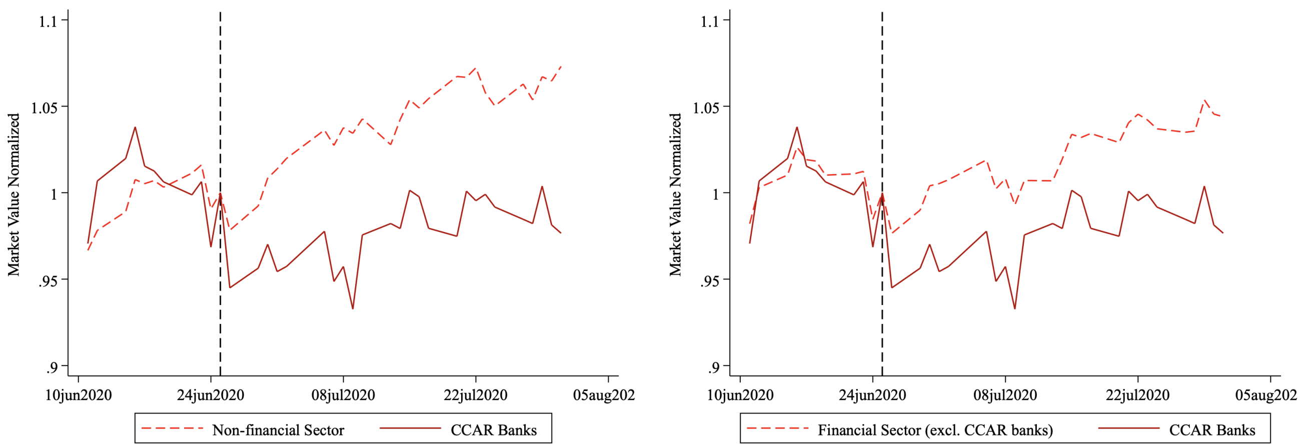
One potential criticism of the Campbell et al. (2012) methodology is that it only features one risk-factor, market risk. As a further robustness check, I re-estimate cumulative abnormal returns as outlined in equations 9 and 10 but replacing the model for returns with a Fama and French (1992) 3-factor model.

Results for weighted and unweighted regressions for the sample of banks only are reported in Tables D.15, D.16, D.17, D.18 report results for the announcement about payout restrictions on June 25, 2020 and December 18, 2020 respectively. Results are qualitatively and quantitatively comparable to the ones obtained earlier and therefore confirm that the announcement effects persist in cumulative abnormal returns.

4.4.4 Longer-run Evidence

This subsection provides evidence that the effects identified before persist also over longer time horizons. In particular, I show that the CCAR banks underperform other financial stocks for months after the payout restrictions are announced and tend to outperform other financial stocks for the months after the payout restrictions are lifted.

Figure 8 reports the total market value of CCAR banks (normalized to 1 on 06/25/2020) relative to the total market value of non-financial public firms on the left-hand side and relative to financial firms, excluding the CCAR banks, on the right-hand side.



(a) CCAR Banks vs. Non-Financials **(b)** CCAR Banks vs. Other Financials

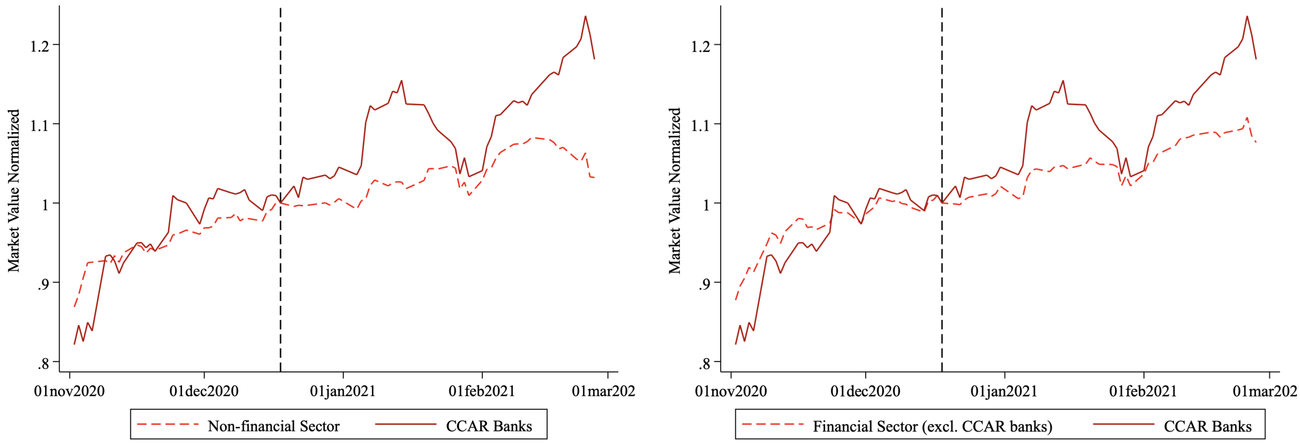
Source: CRSP and own calculations. Market values are normalized to 1 on 06/25/2020, indicated by vertical dashed line. Panel a) compares market value of CCAR banks to the non-financial corporate sector (excluding SIC 6000-6999). Panel b) compares market value of CCAR banks to the financial sector excluding the CCAR banks (SIC 6000-6999 only).

Figure 8: Market Values around 06/25/2020

Both figures reveal that the treated CCAR banks trend closely in parallel, even with financial sector firms until the announcement of payout restrictions. The drop in their equity price happens immediately after the announcement and persists into the future. Appendix **??**

reports regression results for a differences-in-differences estimation that further supports the interpretation of Figure 8.

The pattern around the 12/18/2020 announcement is similar in Figure 9. Banks perform relatively similar to other financial firms and even relative to the non-financial sector until 12/18/2020. Following the announcement of relaxation of payout restrictions, bank stocks rise differentially by 2-3 % upon impact. The magnitude culminates in a 10% difference after about 3 weeks.



(a) CCAR Banks vs. Non-Financials

(b) CCAR Banks vs. Other Financials

Source: CRSP and own calculations. Market values are normalized to 1 on 12/18/2020, indicated by vertical dashed line. Panel a) compares market value of CCAR banks to the non-financial corporate sector (excluding SIC 6000-6999). Panel b) compares market value of CCAR banks to the financial sector excluding the CCAR banks (SIC 6000-6999 only).

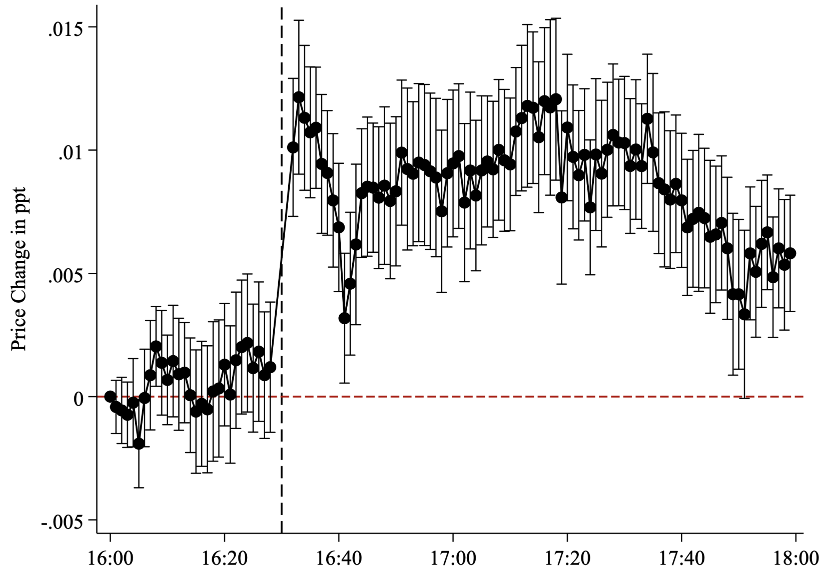
Figure 9: Market values around 12/18/2020

4.4.5 Removal of Last Restrictions on 03/25/2021

While the announcement of lifting payout restrictions on 12/18/2020 removed many restrictions, some remained in place. On 03/25/2021, the Fed announced that these remaining restrictions (the sum of buybacks and dividends being capped by average quarterly net income of the past four quarters) would be removed as well on 06/30/2021 conditional on banks passing the stress test.

Since very few banks paid out more than their net income pre-Covid, the changes in March 2021 should be expected to have a smaller effect as the constraint was already not binding in most states of the world. I repeat the estimation of Equation 5 for 03/25/2021 over the same 4pm to 6pm ET time window. Figure 10 reports the results:

The equity price response is significantly positive for CCAR banks but quantitatively sizably smaller than on 12/18/2020. The magnitude is around 1 % on impact and falls towards .5% at the end of the estimation time window. This response suggests that the remaining restrictions were less binding and thus less restrictive.



Graph reports coefficients and 95 % confidence bands for event study regressions on 12/18/2020 of normalized stock price onto minutely Time x CCAR bank interaction terms (Equation 5). Prices are normalized to 1 at 4.00 ET. Standard errors are double-clustered at the firm and time level. Source: TAQ data.

Figure 10: High-frequency stock market response 03/25/2021

4.4.6 Bond Price Response

In addition to looking indirectly at the response of debt prices through CDS spreads, one can also directly estimate the response of corporate bond yields around the announcements about payout restrictions. Figure 11 plots average corporate bond yields for the CCAR banks and the remainder of the economy around the announcement of payout restrictions. For the figures, yields are normalized to one on 06/25/2020.

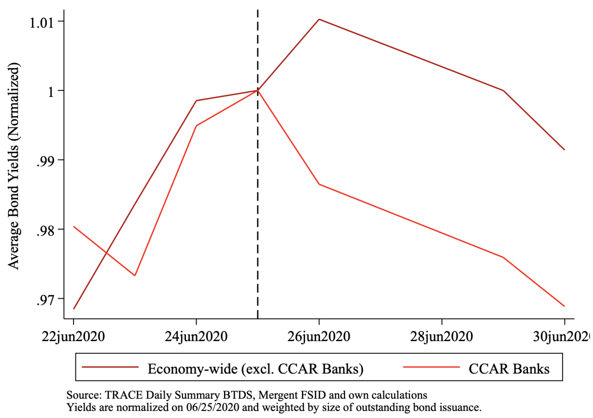


Figure 11: Corporate Bond Yields around 06/25/2020

While corporate bond yields trend relatively in parallel until the announcement, they diverge afterwards. In particular, the yields for CCAR banks fall differentially relative to the remainder of firms. Next, I test econometrically for a differential effect. The regressions are a differences-in-difference version of the Campbell and Taksler (2003) methodology. Due to the high frequency of my data with a 10 trading day time window around the announcements, I make one adjustment relative to their specification: Volatility of equity, which is almost constant about such a short time window and mostly captures idiosyncratic noise, is omitted from the regressions.

$$Yield\ Spread_{it} = \alpha_i + \alpha_t + \beta Post_t CCAR\ Bank_i + \gamma X_{it} + \delta X_{it} CCAR\ Bank_i + \epsilon_{it} \quad (12)$$

All variable definitions are identical to previous equations. $Yield\ Spread_{it}$ is the daily yield reported in the TRACE daily summary minus the yield of the closest Treasury. Controls are coupon, maturity, size, yield of the closest Treasury and a full set of rating fixed effects. The rating fixed effects remove variation that is stemming from the variation in credit ratings across different corporate bonds. Regressions are weighted by the amount outstanding of each issuance so that results are representative of the overall corporate bond market. Finally, I omit bonds that trade less than every 6 days on average to avoid that illiquid bond drive the results. The main coefficient of interest is β, which tests whether bond yields for CCAR banks evolve differentially once the payout restrictions have been imposed.

Table 4 reports the corresponding results for a regression that compares the corporate bond performance of CCAR banks to the corporate bond performance of other financial firms (SIC code between 6000 and 6999):

	(1)	(2)	(3)	(4)
Post	0.0473***		0.0402	
	(0.0098)		(0.0297)	
CCAR Bank x Post	-0.0527***	-0.0520***	-0.0409**	-0.0399**
	(0.0116)	(0.0091)	(0.0148)	(0.0168)
N	13198	13198	13197	13197
R^2	.7888	.7895	.9279	.9289
Issuer FE			x	x
Time FE		x		x
CT controls	x	x	x	x
Rating FE	x	x	x	x

$***p < .01, **p < .05, *p < .1$

Table 4: Corporate Bonds: Daily Differences-in-Differences Estimation around 06/25/2020

Following the announcement of payout restrictions, corporate bond yields for CCAR banks fall differentially by 4 basis points in the full specification. This is consistent with the results for CDS spreads that were also declining around the announcement of payout restrictions. Whereas CDS spreads provide indirect evidence for increasing debt prices, the results on corporate bond yields directly confirm that debt prices are increasing in the secondary market when payouts to shareholders are being limited.

The bond price response on December 18, 2020 is equally consistent with the previous explanations. In Figure D.10, bond yields in the secondary market rise differentially for CCAR banks after payout restrictions are relaxed. Table 5 shows results from estimating Equation 12 around the 12/18/2020 announcement.

	(1)	(2)	(3)	(4)
Post	-0.1104***		-0.1144***	
	(0.0139)		(0.0196)	
CCAR Bank x Post	0.0469***	0.0462***	0.0483***	0.0477***
	(0.0111)	(0.0113)	(0.0170)	(0.0174)
N	97395	97395	97395	97395
R^2	.6729	.6768	.8072	.8112
Issuer FE			x	x
Time FE		x		x
CT controls	x	x	x	x
Rating FE	x	x	x	x

$***p < .01, **p < .05, *p < .1$

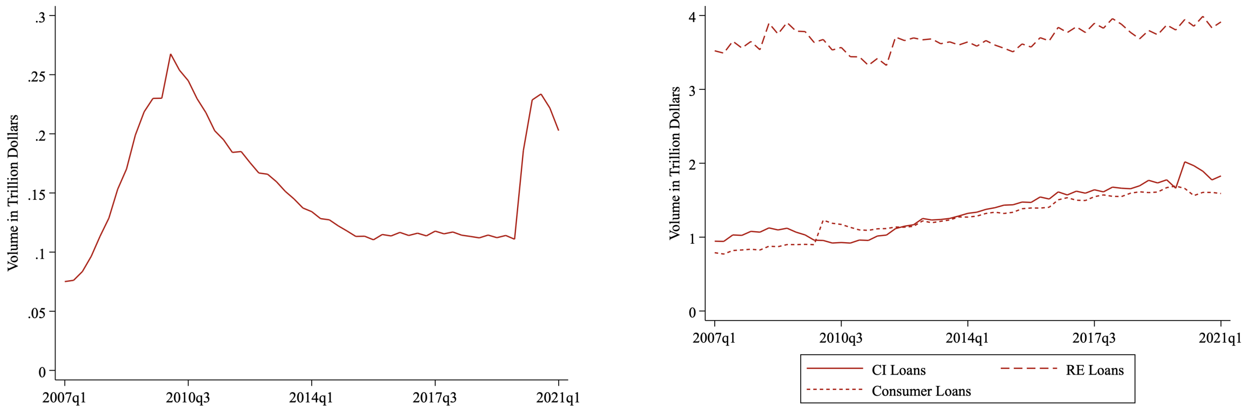
Table 5: Corporate Bonds: Daily Differences-in-Differences Estimation around 12/18/2020

Corporate bond yields rise differentially for the subset of CCAR banks. Consistent with the earlier evidence on CDS spreads, corporate bond yields rise, implying a decline in debt value. The differential increase in corporate bond yields is about 4.8 basis points in the preferred specification, suggesting that lifting payout restrictions has made bank debt riskier.

4.4.7 Loan Loss Reserves

In early 2020, large US banks rapidly accumulated loan loss reserves by expensing loan loss provisions as shown in the left panel of Figure 12. Since the set of CCAR banks is not defined for the years prior to the Dodd-Frank Act, those figures report numbers for the 30 largest US banks by assets in each quarter to have a well-defined sample over time.

Comparing the Covid-crisis to the Great Recessions, two features stand out. First, loan loss reserves almost reached financial crisis levels in 2020 and, second, this accumulation was very fast as compared to the financial crisis. This might suggest that banks might have other considerations than risk-shifting. There are, however, some caveats with this argument. First, the total volume of the loan book of the same banks was substantially larger than in 2008 (right panel of Figure 12). Hence, if risks in early 2020 were as high or higher as during the financial crisis, loan loss reserves should have exceeded their 2008 levels. Second, accounting rules have been changed by the FASB precisely to encourage earlier build-up of loan loss reserves. Incurred credit loss (ICL) accounting rules that mandated banks to build up provisions for credit losses that were about to be incurred have been replaced with expected credit loss (ECL) accounting where banks are to build up loan loss reserves given their expectations of losses over the entire life of the loan (López-Espinosa et al., 2021). These measures, intended to address procyclicality, likely explain parts of the build-up of loan loss reserves in the early times of the



(a) Loan Loss Reserves over Time **(b)** Volume of Loan Book Components

Panel a) reports loan loss reserves for the CCAR banks per quarter, measured in trillions of dollars. Panel b) reports lending disaggregated into commercial & industrial loans, real estate loans and consumer loans, measured in trillions of US dollars. Data is from FR Y9C.

Figure 12: Bank Balance Sheet Items

Covid-pandemic. Finally, Section 4013 of the CARES Act exempts bank from reporting certain delinquent loans as troubled debt restructurings, which leads to an under-reporting of explicit losses.

These three arguments could all explain the large build-up of loan loss reserves by the major banks even in the presence of a strong risk-shifting motive.

4.4.8 Profitability

Figure D.4 reports quarterly return on assets as a measure of profitability. Profitability across CCAR banks and large non-CCAR banks evolves in parallel over the course of 2019 until 2021. This suggests that agency cost theoretic explanations a la Jensen and Meckling (1976) are not a major driver of the empirical patterns documented. If agency costs were the main explanation, one would expect the payout restrictions to lower profitability of restricted banks since payout restrictions increase free cash flow at managers' disposal. Yet, profitability rises strongly for CCAR banks, and in parallel with non-CCAR banks, over the period where the payout restrictions are in place in the United States.

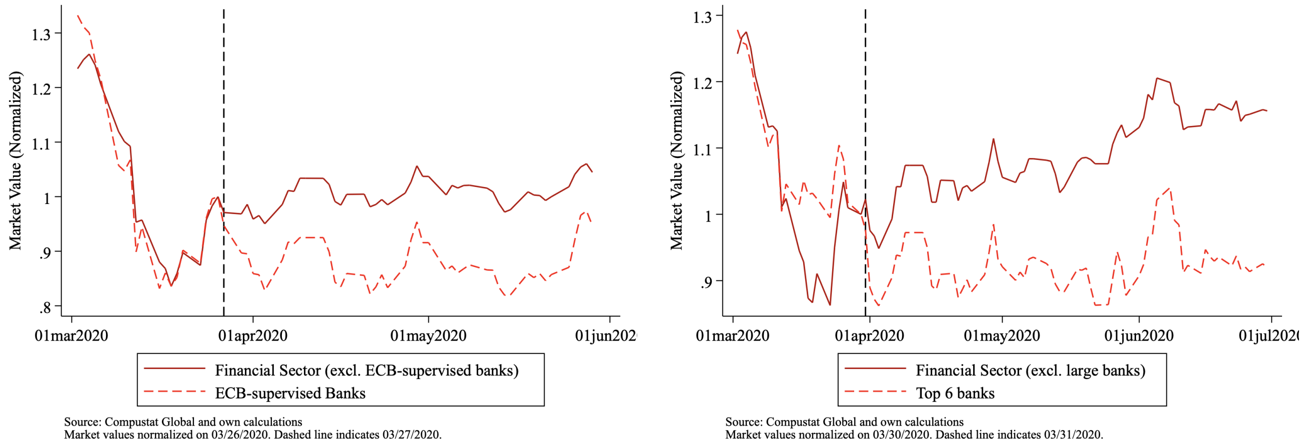
4.4.9 Evidence from other Jurisdictions

The United States is by no means the only jurisdiction that imposed payout restrictions on its banks during the Covid-crisis. In fact, these policy measures, despite country-specific institutional settings, were ubiquitous around the world, including in the Eurozone, UK, Switzerland and Canada. The main reason for focusing on the United States in this paper is that it has the largest set of banks within one country subject to payout restrictions. However, evidence from the Eurozone and from the UK corroborates the findings.

Eurozone banks are subject to common banking supervision. Here, I consider banks from six large countries - Germany, France, Spain, Italy, Belgium, and the Netherlands. Data construction follows the procedure outlined in appendix A.3. In the Eurozone, the European Central Bank asked banks not to pay out any funds, neither dividends nor share buybacks, on 03/27/2020. The legal document is only a recommendation[6], not a rule, but the implicit understanding is that banks would expose themselves to regulatory action if not adhering to the recommendation.[7]

On March 31 2020, the largest UK lenders voluntarily suspended payouts under pressure from the national regulator, the Prudential Regulation Authority (PRA). While the PRA did not explicitly ban payouts, it was widely understood that there was large-scale pressure and moral suasion to have banks commit to the payout suspension under the threat that the PRA would otherwise engage in regulatory action.[8] The six banks that announced a payout suspension in close succession to one another are: Lloyds, RBS (parent is Natwest), Barclays, HSBC, Santander and Standard Chartered.

Figure 13 reports how equity values evolve around the respective announcement data in the Eurozone (Panel a) and in the UK (Panel b).



(a) Eurozone **(b)** United Kingdom

Figure 13: Market values of large UK banks relative to economy

Financial sector stocks fell more than 30% in both jurisdictions in March 2020 as the early days of the Covid-crisis were unfolding. However, following the announcement of payout restrictions, banks supervised by the ECB and the major UK banks respectively, remain substantially depressed compared to the remainder of financial sector firms. The difference

[6] https://www.bankingsupervision.europa.eu/press/pr/date/2020/html/ssm.pr200327~d4d8f81a53.en.html
https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020HB0019

[7] See for example: https://www.wsj.com/articles/european-bank-dividend-ban-lifted-but-restrictions-remain-

[8] https://www.ft.com/content/c13d3d21-b6f3-4449-a916-2ba4271818e4

amounts to more than 10 percent and persists months into the future, again confirming that payout restrictions reduce equity prices.

5 Empirical Results for Risk-taking Decisions

In this section, I investigate whether payout restrictions also affect banks' risk-taking decisions. This follows the Jensen and Meckling (1976) risk-shifting logic, which was highlighted in Proposition 2.7. As payout restrictions are removed, bank shareholders can, on the one hand, pay out more and, on the other hand, exploit the call-option feature of risky projects. Risky projects that would optimally be turned down with the payout restrictions in place, because shareholders would bear too much risk, become optimal to take on when enough of the downside risk is transferred to debtholders and the government.

5.1 Syndicated Loans

This section tests for the strategic complementarity of risk-taking and payout decisions. This is a challenging empirical question because both decisions are endogenous choices by the bank. The explicit imposition and subsequent removal of payout restrictions by the Fed, however, provides a laboratory where the payout decision is altered through regulatory intervention. Hence, exploiting this intervention, I can test how the payout decision interacts with risk-taking choices.

To analyze risk-taking, I use monthly loan-level data from Thomson One. Figure 14 reports monthly newly issued syndicated lending for the CCAR banks, split by investment-grade and below-investment grade lending and normalized to 1 in December 2020, the month in which the payout restrictions are lifted:

While risky lending (below investment-grade) and safe lending (above investment-grade) trend in parallel over the second half of 2020, they diverge in 2021, once the payout restrictions are being relaxed. Risky lending surges for the CCAR banks. Interestingly, this does start in January 2021 but the increase is much more pronounced in February and March, consistent with the removal of restrictions being partly unexpected and new syndicated loans taking time to negotiate. Godlewski (2010) finds that, in his sample of the syndicated loan market, the average duration of the negotiation process is 55 days, which is consistent with the pattern observed in Figure 14.

To supplement Figure 14, Figure D.12 reports the empirical CDF of the ratio of risky syndicated loan originations to total syndicated loan originations for CCAR banks. The empirical CDF shifts to the right after payout restrictions are partly lifted, indicating that more banks choose a riskier mix of lending.

Furthermore, Figure D.11 shows that there is no differential change between riskier and safer lending for lenders outside the CCAR around the December 2020 event. This result further

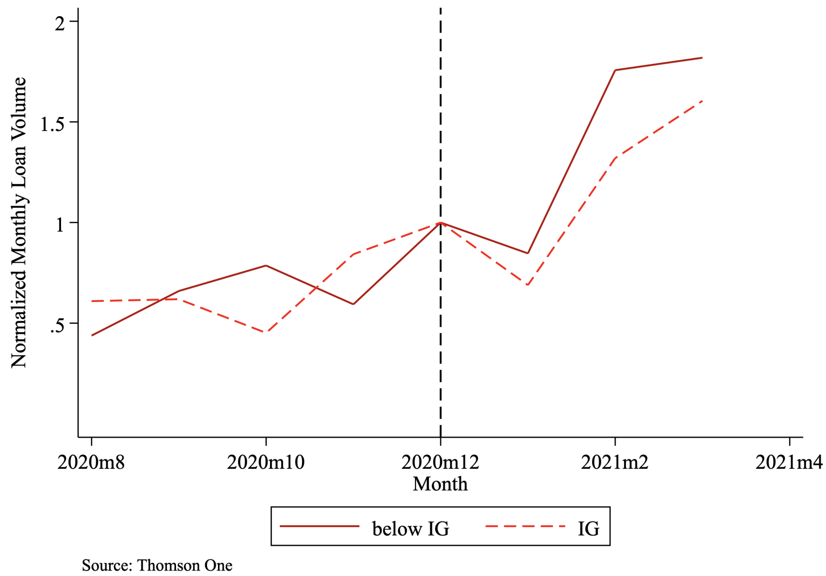


Figure 14: Lending by CCAR Banks

strengthens the interpretation that the removal of payout restrictions is driving the divergence in Figure 14 and not another aggregate shock that would affect all lenders or the demand side.

To test the channel formally, I estimate Equation 7.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Post	0.10	-0.48	-0.06				
	(0.06)	(0.29)	(0.06)				
nonIG	3.66*	0.22	3.65*	3.73*	0.34	2.68	-0.08
	(1.83)	(0.71)	(1.93)	(1.90)	(0.78)	(1.77)	(0.78)
Post x nonIG	0.34***	0.90**	0.37***	0.37***	0.81**	0.33***	0.81**
	(0.08)	(0.31)	(0.08)	(0.08)	(0.34)	(0.08)	(0.35)
N	5022	5022	5022	5022	5022	5022	5022
R^2	0.18	0.74	0.19	0.19	0.75	0.21	0.75
Bank Controls	x	x	x	x	x		
Bank FE		x	x	x	x		
Firm FE		x			x		x
Time FE				x	x		
Bank-Time FE						x	x

$***p < .01, **p < .05, *p < .1$. Table reports coefficients from a regression of (log) newly issued loans onto differences-in-differences terms for a post-December 2020 dummy interacted with a dummy for non-investment grade loans. Standard errors are clustered at the bank-level. Bank controls are lagged size, profitability, liquid assets to total assets, and total loans to total assets.

Table 6: Lending by Loan Type for CCAR banks

The main coefficient of interest is the interaction term of the post-restriction dummy and the non-investment-grade dummy. In the most saturated specification without firm fixed effects in columns (6), the coefficient indicates 33% differentially higher growth of non-investment grade loans relative to investment grade loans at domestic CCAR banks following the relaxation of the payout restrictions. Specifications with firm fixed effects - columns (2), (5), (7) - yield significantly higher point estimates of 80-90% differential loan growth. However, due to the sample's short time horizon of only 9 months, many firms only take out one loan. The concern is therefore that firm fixed effects oversaturate the regressions. Indeed, including firm fixed effects leads to a surge in R^2 by more than .5. Thus, column (6) remains the preferred specification.

These results highlight that loosening payout restrictions interacts with risk-taking choices. There is a complementarity between the two decisions. As shareholders can pay out more and hence transfer more of the risk from new loans onto bond holders, banks are taking on riskier loans at the same time as payouts are increasing. Thus, risk-shifting occurs simultaneously on the payout and on the risk-taking margin.

5.2 Interest Rate Margin

The surge in riskier lending on its own is difficult to interpret economically: Are banks taking on riskier loans, for which they are compensated by higher interest rates? Or are they becoming riskier overall? Data on interest rate spreads is informative here. For 80.3 % of loans, Thomson One reports the spread (in basis points) over a reference rate, most commonly LIBOR. Figure 15 plots the distribution of spreads for the sample of CCAR banks.

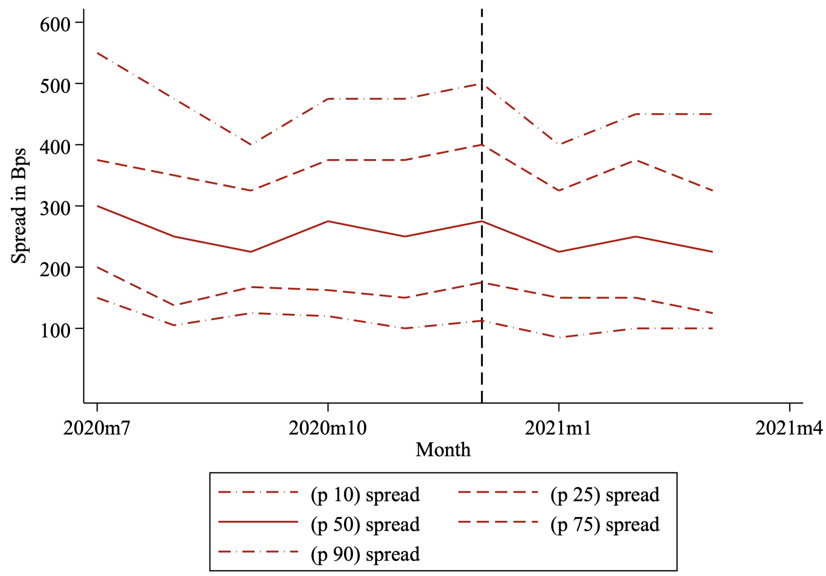


Figure reports 10th, 25th, 50th, 75th and 90th percentile of credit spreads collapsed by month on the Thomson One syndicated loan data. Spreads are reported in basispoints.

Figure 15: Distribution of Loan Spreads

Spreads are slightly declining over time. Interestingly, the decline is particularly pronounced after December 2020. At the same time as banks were taking on riskier loans, the distribution of spreads did not shift upwards, suggesting that banks' balance sheets were indeed getting riskier, without that risk being fully compensated. Risk-shifting provides an explanation for this empirical pattern. As the risk of these loans is disproportionately borne by bondholders after the payout restrictions have been lifted, shareholders do not raise interest rates but extend credit to riskier borrowers.

In the next step, I formally test whether interest rate spreads at the CCAR banks are changing after the payout restrictions have been largely lifted. I estimate a version of Equation 7 with the interest rate spread as the dependent variable.

$$Spread_{ijbt} = \alpha_{b,t} + \alpha_j + \beta_1 Post_t nonIG_{ijb} + \beta_2 nonIG_{ijb} + \beta_3 Post_t + \gamma X_{ijbt} + \epsilon_{ijbt} \quad (13)$$

The definition for the right-hand side variables are the same as for the previous regressions in Equation 7. The main coefficient of interest is β_1. Table 7 displays the estimation results.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Post	0.43	-4.76	24.91*				
	(3.58)	(3.22)	(12.63)				
nonIG	436.99***	43.42**	341.18**	335.76**	65.12*	358.31*	20.29
	(141.36)	(18.46)	(135.27)	(138.72)	(30.97)	(172.14)	(19.48)
Post x nonIG	-26.40***	-26.21***	-30.98***	-29.09**	-22.07**	-22.35**	-23.84**
	(8.73)	(7.24)	(9.35)	(9.76)	(8.80)	(9.67)	(8.88)
N	3814	3814	3814	3814	3814	3814	3814
R^2	0.37	0.91	0.39	0.40	0.91	0.42	0.91
Bank Controls	x	x	x	x	x		
Bank FE		x	x	x	x		
Firm FE		x			x		x
Time FE				x	x		
Bank-Time FE						x	x

$***p < .01, **p < .05, *p < .1$. Table reports coefficients from a regression of loan spreads, measured in basispoints, onto differences-in-differences terms for a post-December 2020 dummy interacted with a dummy for non-investment grade loans. Standard errors are clustered at the bank-level. Bank controls are lagged size, profitability, liquid assets to total assets, and total loans to total assets.

Table 7: Evolution of Loan Spreads

The results in the most saturated regressions, columns (6) and (7) indicate that following the relaxation of the payout restrictions, there is a differentially stronger reduction in the spreads charged on below investment grade lending. Quantitatively, the effect is between 22 and 23 basis points. While (7) is the most saturated regression, the very high R^2 of .91 is indicative of potential over-fitting. Hence, column (6) is the preferred specification. Quantitatively, the difference-in-differences estimate is similar across both specifications.

Together with the results on the quantity margin of lending in Table 6, the results in this section indicate that banks increase risky lending when payout restrictions are lifted, consistent with risk-shifting explanations. Moreover, the higher risk is not reflected in higher interest rate spreads. To the contrary, the spreads on risky lending fall differentially more. Hence, banks are making more risky loans at lower spreads, implying that banks - and in particular bank creditors - bear more downside risk. This confirms empirically the theoretical conjecture of Proposition 2.7.

6 Macroprudential Policy and Expected Government Savings

This section discusses how payout restrictions interact with macroprudential policy. A first channel, the interaction of payout restrictions with risk-taking decisions was established in the previous section. A second channel is that binding payout restrictions lead to an increase in capital buffers. Taken together, both channels have the potential of reducing default risk in the banking sector. This implies a decline in the government guarantees on the banking sector's debt, which will be quantified in the second subsection.

6.1 Capital Requirements versus Payout Restrictions

Whereas banks can either adjust the numerator (capital) or the denominator (risk-weighted assets) to meet tighter capital requirements, payout restrictions directly affect the amount of capital at a bank. This difference is critical since recent empirical evidence by Gropp et al. (2019) shows that banks adjust risk-weighted assets to meet higher capital requirements rather than raising more equity capital - a mechanism theoretically highlighted by Admati et al. (2018). Figure 16 shows that Tier-1 capital increased by more than $ 50 billion after the restrictions are imposed at the end of 2020 Q2. This increase in Tier-1 capital is driven by the accumulation of retained earnings.

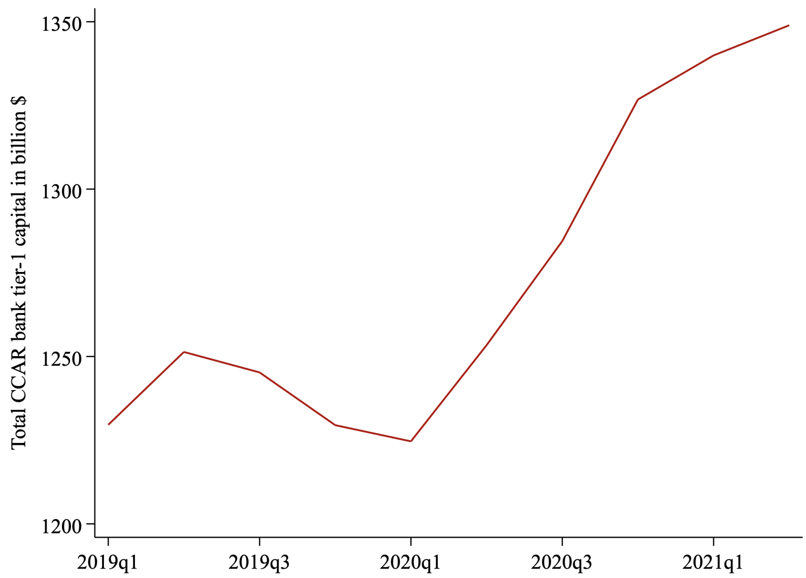


Figure reports total Tier-1 capital of domestic CCAR banks in billion US dollars. Data is from FR-Y9C.

Figure 16: Total CCAR Bank Tier-1 Capital

Hence, compared to changing capital requirements, a payout restriction is more effective at achieving the goal of raising total capital in the banking sector. This suggests a further policy tool in the discussion on how to raise the dollar amount of bank capital in times of crisis in Hanson et al. (2011). Long-term payout restrictions might instead have unintended consequences. In particular, long-lasting limits on payouts and the ensuing decline in equity prices could amplify pre-existing disincentives for banks to raise equity (debt overhang (Myers, 1977), insider control (Goetz et al., 2020), moral hazard (Demirgüç-Kunt and Detragiache, 2002)).

6.2 Quantifying Expected Government Savings

When the government imposes payout restrictions that make the banking system safer, this generates indirect gains for the government due to the extensive insurance the government provides directly, through deposit insurance, and indirectly, through implicit bailout expectations, on banking sector liabilities. However, the change in those government guarantees is not directly observed. The inference on government guarantees will assume a break-even analysis: How big a change in government guarantees, ΔGG, is needed so that, jointly with the change in debt values (ΔDV), it offsets the change in equity values (ΔEV)? Formally, I aim to solve for ΔGG such that:

$$\Delta EV = \Delta DV + \Delta GG$$

6.2.1 Framework

I make three assumptions:

1. Banks have three types of debt: fully insured deposits $DV^{fullyinsured}$, partly insured short-term debt $DV^{ST,partlyinsured}$, partly insured long-term debt DV^{LT}
2. The degree of insurance is measured by ϕ^{ST} and ϕ^{LT}
3. No seniority: In the absence of government guarantees, all three types of debt would have the same price response to the payout restrictions: $\frac{\Delta DV^{fullyinsured}}{DV^{fullyinsured}} = \frac{\Delta DV^{ST,partlyinsured}}{DV^{ST,partlyinsured}} = \frac{\Delta DV^{LT}}{DV^{LT}}$

Assumption 1 captures the fact that some liabilities, deposits below the deposit insurance threshold, are fully insured. Other short-term liabilities such as deposits exceeding deposit insurance thresholds are only partially insured. Finally, all CCAR banks have long-term liabilities outstanding. Those long-term liabilities have very different maturity than deposits, which can be called instantly.

In the absence of government guarantees, we would have $\Delta EV = \Delta DV$ at the break-even point and the percentage change of debt value would hence be given by $\frac{\Delta EV}{DV}$.

With three types of debt, all insured to a different amount we get the following under assumption 3:

$$\Delta DV = \underbrace{(1-\phi^{ST})\frac{\Delta EV}{DV} DV^{ST,partlyinsured}}_{\Delta DV^{ST,partlyinsured}} + \underbrace{(1-\phi^{LT})\frac{\Delta EV}{DV} DV^{LT}}_{\Delta DV^{LT}} \tag{14}$$

The unobserved component at the break-even point is given by the change in government guarantees, ΔGG. Formally:

$$\Delta GG = \frac{\Delta EV}{DV} DV^{fullyinsured} + \phi^{ST}\frac{\Delta EV}{DV} DV^{ST,partlyinsured} + \phi^{LT}\frac{\Delta EV}{DV} DV^{LT}$$

Empirically, the challenge now consists of solving for the unobservables ϕ^{ST}, ϕ^{LT} and ΔGG.

The empirical details are in Appendix D.10.

6.2.2 Results

Using, the estimates from the paper, I assume that the CDS response identifies the response of partly insured short-term debt and the corporate bond response identifies the response of long-term debt. The average corporate bond issued by CCAR banks has a maturity of 6.35 years.

June 25, 2020 Substituting everything, I obtain:

$$\begin{aligned} \phi^{ST} &= .9044 \\ \phi^{LT} &= -.37 \\ \Delta GG &= 25.37 \end{aligned}$$

December 18 Results Substituting everything, I obtain:

$$\begin{aligned} \phi^{ST} &= .9281 \\ \phi^{LT} &= -.12 \\ \Delta GG &= 36.15 \end{aligned}$$

The first finding is that there is a substantial degree of insurance on short-term debt around both events. On the other hand, the degree of insurance is negative on long-term debt at the break-even point. This suggests that under a break-even analysis, long-term debt holders gain more value than proportionate to the decline in equity value. Even without any public sector guarantee, the long-term debt increase is too large to break even. Finally, government guarantees are reduced by $ 25.47 billion when the Federal Reserve imposes payout restrictions on June 25, 2020.

All effects reverse on December 18, 2020. Quantitatively, the December results are comparable to the June results. The change in government guarantees is larger at $ 36.15 billion.

7 Conclusion

This paper studies risk-shifting incentives in banks using the imposition and subsequent relaxation of payout restrictions on large US banks during the Covid crisis as a natural experiment. When the Fed limits payouts for the CCAR banks in June 2020, equity values drop while debt prices appreciate, suggesting the reversal of risk-shifting. When the restrictions are lifted again in December 2020, both of these effects revert and, moreover, payouts increase substantially again.

Building on these results, I further show that the removal of payout restrictions affects lending decisions at the formerly restricted banks. Upon lifting the restrictions, riskier lending increases by 32 % relative to safer (investment-grade) lending at the CCAR banks while average loan spreads on syndicated loans decline. In sum, these results indicate that payout restrictions can serve as a tool to reverse risk-shifting whereas lifting the restrictions transfers risk from equity onto bondholders.

This paper provides the first quantitative evaluation of payout restrictions as a policy tool to mitigate risk-shifting at banks. A standard contractual solution to mitigate risk-shifting via "excessive" payouts would be payout covenants in debt contracts. In the past, the literature has pointed out that the non-existence of payout covenants in the banking sector, and in the economy more broadly, can make banks individually more fragile but also the banking sector as a whole due to spillover effects resulting from externalities (Acharya et al., 2017). Yet, both the presence of public guarantees for bank debt and the externalities onto other banks imposed by bank payouts imply under-provision of payout covenants in privately negotiated debt contracts.

Payout restrictions imposed by the respective regulator, a widespread practice across jurisdictions during the Covid-crisis, are one potential remedy. Effectively, payout restrictions amount to a publicly imposed payout covenant circumventing both of the problems that lead to private under-provision. Under the Basel III regulatory framework, breaches of the capital conservation buffer are also to be sanctioned by limits to dividends and boni.[9] This extends measures from the 1991 Prompt Corrective Action Procedure that imposes payout restrictions on US banks that breach capital ratios. While I find that the government savings from imposing widespread payout restrictions in 2020 are modest in the US, mostly because banks remain well-capitalized throughout, I show that payout restrictions can nonetheless be powerful in

[9] https://www.esrb.europa.eu/national_policy/capital/html/index.en.html

mitigating risk-shifting incentives. Exploring the optimal policy of setting payout restrictions remains an avenue for future research.

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A Data Sources and Construction

A.1 CRSP

CRSP data comes from CRSP Daily Monthly Updates. I only keep trades from AMEX, Nasdaq and NYSE, the three major American stock exchanges. Observations are identified by their CUSIP. Next, I replace prices by bid-ask spreads for some observations where pricing data is not available.

A.2 TAQ

I use the trades repository of TAQ, which captures every single trade at the security level for the major American stock exchanges with a millisecond timestamp. I drop preferred stock, warrants, convertibles and callable bonds. As noted in the prior literature (see for example Brownlees and Gallo (2006)), this ultra-high frequency data contains trades reported with errors. To correct for those, I proceed in two steps. First, I drop all trades that have been corrected later (variable TR_CORR $\neq 00$). Second, I drop observations that deviate by more than 2.5 % from either the previous or the next trade. On June 25 2020 for the 4.00 - 6.00 Eastern time window, for example, this drops 7,372 observations out of 439,977. All these data cleaning steps are performed at the millisecond time frequency. I then collapse trades by minute, taking the average across all reported quotes so there are at most 120 observations per firm over a 2-hour time window and normalizing the price to one in the first minute for ease of comparison.

A.3 Compustat Global Security Daily

I access Compustat Global Security Daily from WRDS. I drop observations with missing ISINs, ETFs, mutual funds and US listings. I also drop firms with missing shares outstanding or firms with missing SIC codes. Finally, I retain only observations that have security status "active" ($secstat == "A"$). This ensures that past ISINs that have been superseded are not included any longer. Finally, to compute market value, I first multiply shares outstanding with the daily closing price. Then I collapse the data by $gvkey$. The latter step is necessary to accurately compute the market value of firms which have both common and preferred shares outstanding and thus have multiple ISINs associated with one $gvkey$.

For Europe, I identify all banks directly subject to ECB supervision from the ECB's list of supervised entities from March 01, 2020: `https://www.bankingsupervision.europa.eu/ecb/pub/pdf/ssm.listofsupervisedentities202004.en.pdf?4c3154a498837f7e7ccf8324ad6f704` I then check which of these institutions are publicly listed. This is critical as more than half of those institutions are not publicly listed. The non-listed groups mostly consists of co-operatives and banks with public ownership. I identify 26 publicly listed, ECB-supervised banks in Germany, France, Italy, Spain, Belgium and the Netherlands. Those will consist the group of ECB-supervised banks in the analysis of publicly listed banks.

A.4 Debt Prices: TRACE and Mergent FISD

For data on corporate, I retrieve the daily summaries of corporate bond trading reported through TRACE and data on corporate bond issuances from Mergent FISD. Mergent FISD provides maturity and amount of corporate bond issuances at the CUSIP-level. I merge this information with TRACE's daily summaries of corporate bond trading using the CUSIP identifiers. I drop bond trade summaries which cannot be identified precisely because either CUSIP or company ticker is missing. I further drop observations with product type "ELN", which are equity-linked notes.

To mitigate concerns about illiquidity of corporate bonds, I only keep those which have been traded on at least 200 distinct days between January 1, 2019 and September 30, 2020. I use closing yields (variable *close_yld*) as main measure of corporate bond interest rates. I winsorize yields at the 1 and 99 percentile for the empirical analysis.

A.5 FR-Y9C

The Fed Y9C data covers detailed balance sheets and income statements for all domestic bank holding companies. For large banks, data is quarterly. The data is accessed through the Chicago Fed: https://www.chicagofed.org/banking/financial-institution-reports/bhc-data. Among, the banks in my sample - either as Fed regulated banks or as control group - there are .... mergers. I merge all merging banks from the start of the sample onward so that the entire analysis is done post-merger. The largest merger concerns BB&T and Suntrust, which later jointly from Truist Financial.

Many flow variables are reported calender-year-to-date and therefore I convert them to quarterly frequency.

Here is a detailed mapping of FR-Y9C abbreviations into variable names as used in the paper.

A.6 Thomson One Data

Loan data is accessed from Thomson One (terminal at Princeton University Library). I extract all syndicated loans since 2018. I identify all banks involved. Since Thomson One does not report the loan amounts by bank, I allocate all loans equally across all banks involved. Loan amount is inferred as principal amount in the data, which implies I construct the data set at the loan facility level (not at the package level), an approach similar to Dealscan.

B Proofs

Proof of Proposition 2.1: see Acharya et al. (2017)

B.1 Proof of Proposition 2.2

Using the uniform assumption on the distribution of a, I can express debtholder payoffs as:

$$\frac{\overline{a}-\hat{a}}{\overline{a}-\underline{a}}\ell+\frac{\hat{a}-\underline{a}}{\overline{a}-\underline{a}}[\phi\frac{\hat{a}-\underline{a}}{2}+\frac{\hat{a}+\underline{a}}{2}+c-d]$$

We can verify that this equals ℓ if $\phi=1$.[10] Re-arranging yields:

$$\begin{aligned}
&\frac{1}{\overline{a}-\underline{a}}[(\overline{a}-\hat{a})\ell+(\hat{a}-\underline{a})^2\frac{\phi}{2}+\frac{\hat{a}^2-\underline{a}^2}{2}+(c-d)(\hat{a}-\underline{a})] \\
\implies\quad &\frac{1}{\overline{a}-\underline{a}}[(\overline{a}-\ell-d+c)\ell+\frac{\phi}{2}(\ell+d-c-\underline{a})^2+\frac{(\ell+d-c)^2-\underline{a}^2}{2}+(c-d)(\ell+d-c-\underline{a})]
\end{aligned}$$

Now, collecting the quadratic terms in d, we can see that this is a concave parabola with: $d^2(\frac{\phi}{2}+\frac{1}{2}-1)$. When $\phi=1$, there is no parabola since payoffs are flat and independent of the asset realization. For $\phi<1$, the parabola is concave so the FOC identifies the global maximum.

The FOC is:

$$\begin{aligned}
&-\ell+\phi(\ell+d-c-\underline{a})+(\ell+d-c)+c-(\ell+2d-c-\underline{a})=0 \\
\implies\quad &(\phi-1)(\ell+d-c-\underline{a})=0 \\
\implies\quad &d^*_{bond}=c+\underline{a}-\ell<0
\end{aligned}$$

Since, I assumed that there is non-trivial default risk ($\ell>c+\underline{a}$), bondholders would favor issuance. In particular, they would want to issue until $\hat{a}=\underline{a}$, the point at which default risk is eliminated. Under concavity of the parabola and for $d\in[0,c]$, $d=0$ is their preferred choice as long as $\phi<1$.

The proposition in fact holds more generally for an arbitrary distribution of assets if $\phi<1$. The general expression for shareholder payoff:

$$\begin{aligned}
&Pr(a>\hat{a})\ell+Pr(a<\hat{a})(\phi E[\hat{a}-a|a<\hat{a}]+E[a+c-d|a<\hat{a}]) \\
&Pr(a>\hat{a})\ell+Pr(a<\hat{a})[\phi\ell+(1-\phi)(c-d)+(1-\phi)E[a|a<\hat{a}]]
\end{aligned}$$

Now, for $a<\hat{a}$ we have $\ell>c-d-a$ so the payoff in the default case is less than ℓ implying that debt value is maximized when default risk is lowest, which is implied by

Proof of Lemma 2.3: From Proposition 2.1, we know that equity value is maximized for $d=c$ for $V\geq V^*$. Yet, debt value is maximized at $d=0$ as seen from proposition 2.2. Hence, disagreement between shareholders and debtholders follows immediately.

[10] $\hat{a}+c-d=\ell$

B.2 Proof of Proposition 2.4

Remember that debt value was given by:

$$
\begin{aligned}
DV &= Pr(a \geq \hat{a})\ell + Pr(a < \hat{a})(\phi \mathbf{E}[\hat{a} - a \mid a < \hat{a}] + \mathbf{E}[a + c - d \mid a < \hat{a}]) \\
&= \frac{\overline{a} - \hat{a}}{\overline{a} - \underline{a}}\ell + \frac{\hat{a} - \underline{a}}{\overline{a} - \underline{a}}\Big(\frac{\phi}{2}(\hat{a} - \underline{a}) + c - d + \frac{\hat{a} + \underline{a}}{2}\Big) \\
&= \frac{1}{\overline{a} - \underline{a}}\Big((\overline{a} - \ell + c - d)\ell + \frac{\phi}{2}(\ell + d - c - \underline{a})^2 + (c - d)(\ell + d - c - \underline{a}) + \frac{(\ell + d - c)^2 - \underline{a}^2}{2}\Big)
\end{aligned}
$$

$$
\begin{aligned}
\tfrac{\partial DV}{\partial d} &= \frac{1}{\overline{a} - \underline{a}}\Big(- \ell + \phi(\ell + d - c - \underline{a}) + (\ell + d - c) + ck - (\ell + 2d - c - \underline{a})\Big) \\
\tfrac{\partial DV}{\partial d \partial \phi} &= (\ell + d - c - \underline{a}) > 0
\end{aligned}
$$

The cross-derivative is positive for any $d \in [0, c]$ since $\ell > c + \underline{a}$ by assumption. Also notice that $\frac{\partial DV}{\partial d} \Rightarrow 0$ as $\phi \Rightarrow 1$. Perfect insurance makes the pricing of debt insensitive to the firm's payout behavior.

B.3 Proof of Proposition 2.5

The ex-ante expected transfer from the government to debtholders is given by:

$$
\begin{aligned}
& P(a < \hat{a}(d))\phi \mathbf{E}[\hat{a} - a \mid a < \hat{a}(d)] \\
= \; & \frac{\hat{a} - \underline{a}}{\overline{a} - \underline{a}}\phi\Big(\frac{\hat{a} - \underline{a}}{2}\Big) \\
= \; & \frac{\phi}{2(\overline{a} - \underline{a})}(\ell + d - c - \underline{a})
\end{aligned}
$$

Taking the derivative with respect to the payout d, we see that the expected government payment is increasing in the payout by the bank:

$$
\tfrac{\partial}{\partial d} \quad \frac{\phi}{\overline{a} - \underline{a}}(\ell + d - c - \underline{a}) > 0
$$

Positivity of the derivative follows from the maintained assumptions $\ell > c + \underline{a}$ and $d \in [0, c]$.

As shown in the earlier propositions, payout policy is actually always in a corner: either $d = 0$ or $d = c$. Reducing payouts from $d = c$ to $d = 0$ generates savings for the government that are quantified as:

$$
\frac{(\ell - \underline{a})}{2(\overline{a} - \underline{a})}\phi - \frac{(\ell - c - \underline{a})}{2(\overline{a} - \underline{a})}\phi
$$

B.4 Proof of Proposition 2.6

Remember that equity and debt value are respectively given by:

$$
\begin{aligned}
EV = &\ \ argmax_d \ \ d + \frac{(\bar{a}-\ell-d+c)^2}{2(\bar{a}-\underline{a})} + \frac{(\bar{a}-\ell-d+c)}{\bar{a}-\underline{a}}V \\
DV = &\ \ \frac{(\bar{a}-\ell-d+c)}{\bar{a}-\underline{a}}\ell + \frac{\ell+d-c-\underline{a}}{\bar{a}-\underline{a}}[\phi\frac{\ell+d-c-\underline{a}}{2} + \\
&\ \ \frac{\ell+d-c+\underline{a}}{2} + c - d]
\end{aligned}
$$

I begin by analyzing equity value:. Following, proposition 2.1, the dividend policy that maximizes equity value is a corner solution depending on the franchise value. $V <= V*$ implies full payouts, $V > V^*$ implies no payouts.

For $V \leq V^*$, equity value is therefore given by:

$$
EV \quad = c + \frac{(\bar{a}-\ell)^2}{2(\bar{a}-\underline{a})} + \frac{(\bar{a}-\ell)}{\bar{a}-\underline{a}}V
$$

For $\bar{a} \geq \ell$, it can easily be verified that any increase in $\bar{a}$ clearly raises equity values. In the case of $\ell > \bar{a}$, the payout policy pushes the bank into default at $t = 1$ with certainty so the equity value is only c. Empirically, this case is not relevant for the analysis.

For $V > V^*$, equity value is instead given by:

$$
EV \quad = \frac{(\bar{a}-\ell+c)^2}{2(\bar{a}-\underline{a})} + \frac{(\bar{a}-\ell+c)}{\bar{a}-\underline{a}}V
$$

Since $\ell \leq \bar{a} + c$ by assumption, any marginal rise in $\bar{a}$ raises the equity value of the bank. Again, the proof is a simple application of the quotient rule .

For debt value in the $V \leq V^*$ region, and for a small variation around $\ell > \underline{a} + c$ we have:

$$
DV = \underbrace{\frac{(\bar{a}-\ell)}{\bar{a}-\underline{a}}}_{\frac{\partial}{\partial \bar{a}}>0}\ell + \underbrace{\frac{\ell-\underline{a}}{\bar{a}-\underline{a}}}_{\frac{\partial}{\partial \bar{a}}<0}\underbrace{[\phi\frac{\ell-\underline{a}}{2} + \frac{\ell+\underline{a}}{2}]}_{\frac{\partial}{\partial \bar{a}}=0}
$$

where the underbraces indicate the partial derivatives with respect to $\bar{a}$. It is important to notice that the comparative statics always start from $\ell \in [c+\underline{a}, c+\bar{a}]$ and are then valid for a small variation in $\bar{a}$.

A completely analogous argument show that debt value also rises in $\bar{a}$ in the $V > V^*$ region:

$$
DV = \underbrace{\frac{(\bar{a}-\ell+c)}{\bar{a}-\underline{a}}}_{\frac{\partial}{\partial \bar{a}}>0}\ell + \underbrace{\frac{\ell-c-\underline{a}}{\bar{a}-\underline{a}}}_{\frac{\partial}{\partial \bar{a}}<0}\underbrace{[\phi\frac{\ell-c-\underline{a}}{2} + \frac{\ell-c+\underline{a}}{2} + c]}_{\frac{\partial}{\partial \bar{a}}=0}
$$

B.5 Proof of Proposition 2.7

Shareholders now make a two-dimensional decision where they select a payout policy and a risk-taking policy. Regardless, shareholders objective remains convex in the payout policy so they will either select $d = 0$ or $d = c$. The risk-taking choice is between selecting the initial distribution $a \sim U(\underline{a}, \bar{a})$ and a mean-preserving spread where $a \sim U(\underline{a} - \epsilon, \bar{a} + \epsilon)$.

This choice can be visualized through the following matrix:

	$U(\underline{a}, \bar{a})$	$U(\underline{a} - \epsilon, \bar{a} + \epsilon)$
$d = 0$	$\frac{(\bar{a}-\ell+c)^2}{2(\bar{a}-\underline{a})} + \frac{(\bar{a}-\ell+c)}{(\bar{a}-\underline{a})}V$	$\frac{(\bar{a}+\epsilon-\ell+c)^2}{2(\bar{a}-\underline{a}+2\epsilon)} + \frac{(\bar{a}+\epsilon-\ell+c)}{(\bar{a}-\underline{a}+2\epsilon)}V$
$d = c$	$c + \frac{(\bar{a}-\ell)^2}{2(\bar{a}-\underline{a})} + \frac{(\bar{a}-\ell)}{(\bar{a}-\underline{a})}V$	$c + \frac{(\bar{a}+\epsilon-\ell)^2}{2(\bar{a}-\underline{a}+2\epsilon)} + \frac{(\bar{a}+\epsilon-\ell)}{(\bar{a}-\underline{a}+2\epsilon)}V$

Table B.1: Shareholder Payoffs with two-dimensional choice

Using $EV(d, safe)$ to denote equity value as a function of d conditional on the safer distribution and $EV(d, risky)$ to denote equity value as a function of d under the riskier distribution, there are two conditions that need to hold for complementarity between payout and risk-taking decisions to arise:

(1) $EV(c, \textit{risky}) \in \textit{argmax}_d EV(d, \textit{risky})$ & $\textit{argmax}_d EV(d, \textit{risky}) \geq \textit{argmax}_d EV(d, \textit{safe})$

(2) $EV(0, \textit{safe}) \geq EV(0, \textit{risky})$

I begin by verifying condition (1) for all three cases:

Case 1:

$$
\begin{aligned}
& EV(c, \textit{risky}) \geq EV(c, \textit{safe}) \\
\implies \quad & c + \frac{(\bar{a}+\epsilon-\ell)^2}{2(\bar{a}-\underline{a}+2\epsilon)} + \frac{(\bar{a}+\epsilon-\ell)}{(\bar{a}-\underline{a}+2\epsilon)}V \geq c + \frac{(\bar{a}-\ell)^2}{2(\bar{a}-\underline{a})} + \frac{(\bar{a}-\ell)}{(\bar{a}-\underline{a})}V \\
\implies \quad & (\bar{a}-\underline{a})(\bar{a}+\epsilon-\ell)^2 + 2(\bar{a}-\underline{a})(\bar{a}+\epsilon-\ell)V \geq (\bar{a}-\underline{a}+2\epsilon)(\bar{a}-\ell)^2 + 2(\bar{a}-\underline{a}+2\epsilon)(\bar{a}-\ell)V \\
\implies \quad & (\bar{a}-\underline{a})((\bar{a}-\ell)^2 + \epsilon^2 + 2\epsilon(\bar{a}-\ell)) + 2(\bar{a}-\underline{a})(\bar{a}-\ell)V + 2\epsilon(\bar{a}-\underline{a})V \geq \\
& (\bar{a}-\underline{a})(\bar{a}-\ell)^2 + 2\epsilon(\bar{a}-\ell)^2 + 2(\bar{a}-\underline{a})(\bar{a}-\ell)V + 4\epsilon(\bar{a}-\ell)V \\
\implies \quad & \frac{(\bar{a}-\underline{a})\epsilon}{2} + (\bar{a}-\underline{a})(\bar{a}-\ell) + (\bar{a}-\underline{a})V \geq (\bar{a}-\ell)^2 + 2V(\bar{a}-\ell) \\
\implies \quad & \frac{(\bar{a}-\underline{a})\epsilon}{2} + (\bar{a}-\underline{a})(\bar{a}-\ell) + (\bar{a}-\underline{a})V \geq \bar{a}^2 - 2\bar{a}\ell + \ell^2 + 2\bar{a}V - 2\ell V \\
\implies \quad & \frac{(\bar{a}-\underline{a})\epsilon}{2} - \bar{a}\underline{a} + \underline{a}\ell - \underline{a}V \geq -\bar{a}\ell + \ell^2 + \bar{a}V - 2\ell V \\
\implies \quad & (2\ell - \bar{a} - \underline{a})V \geq \ell^2 - \bar{a}\ell - \underline{a}\ell + \bar{a}\underline{a} - \frac{(\bar{a}-\underline{a})\epsilon}{2} \\
\implies \quad & V \geq \frac{\ell^2 - \bar{a}\ell - \underline{a}\ell + \bar{a}\underline{a} - \frac{(\bar{a}-\underline{a})\epsilon}{2}}{2\ell - \bar{a} - \underline{a}}
\end{aligned}
$$

A sufficient condition for the risky distribution to be preferred is high enough leverage: $\ell > \frac{\bar{a}+\underline{a}}{2}$. This guarantees that the numerator is positive so the last division was feasible and did not change the sign of the inequality. For $\ell \in [\frac{\bar{a}+\underline{a}}{2}, \bar{a}]$, the equation is trivially satisfied as the numerator is negative. For $\ell > \bar{a}$, the numerator is positive so the lower bound is real.

Case 2:

$$
\begin{aligned}
& EV(c, \textit{risky}) \geq EV(0, \textit{risky}) \\
\implies \quad & c + \frac{(\bar{a}+\epsilon-\ell)^2}{2(\bar{a}-\underline{a}+2\epsilon)} + \frac{(\bar{a}+\epsilon-\ell)}{(\bar{a}-\underline{a}+2\epsilon)}V \geq \frac{(\bar{a}+\epsilon-\ell+c)^2}{2(\bar{a}-\underline{a}+2\epsilon)} + \frac{(\bar{a}+\epsilon-\ell+c)}{(\bar{a}-\underline{a}+2\epsilon)}V \\
\implies \quad & c + \frac{(\bar{a}+\epsilon-\ell)^2}{2(\bar{a}-\underline{a}+2\epsilon)} + \frac{(\bar{a}+\epsilon-\ell)}{(\bar{a}-\underline{a}+2\epsilon)}V \geq \\
& \frac{(\bar{a}+\epsilon-\ell)^2 + c^2 + 2c(\bar{a}+\epsilon-\ell)}{2(\bar{a}-\underline{a}+2\epsilon)} + \frac{(\bar{a}+\epsilon-\ell)}{(\bar{a}-\underline{a}+2\epsilon)}V + \frac{c}{(\bar{a}-\underline{a}+2\epsilon)}V \\
\implies \quad & \bar{a}-\underline{a}+2\epsilon \geq \frac{c+2(\bar{a}+\epsilon-\ell)}{2} + V \\
\implies \quad & V \leq \ell - \underline{a} - \frac{c}{2} + \epsilon
\end{aligned}
$$

Under the assumption $\ell > \underline{a} + c$, there is always an ϵ small enough to make this inequality hold with the right-hand side remaining positive.

Case 3:

$$
\begin{aligned}
& EV(c, \textit{risky}) \geq EV(0, \textit{safe}) \\
\implies \quad & c + \frac{(\bar{a}+\epsilon-\ell)^2}{2(\bar{a}-\underline{a}+2\epsilon)} + \frac{(\bar{a}+\epsilon-\ell)}{(\bar{a}-\underline{a}+2\epsilon)}V \geq \frac{(\bar{a}-\ell+c)^2}{2(\bar{a}-\underline{a})} + \frac{(\bar{a}-\ell+c)}{(\bar{a}-\underline{a})}V \\
\implies \quad & 2(\bar{a}-\underline{a})(\bar{a}-\underline{a}+2\epsilon)c + (\bar{a}-\underline{a})(\bar{a}+\epsilon-\ell)^2 + 2(\bar{a}-\underline{a})(\bar{a}+\epsilon-\ell)V \geq \\
& (\bar{a}-\underline{a}+2\epsilon)(\bar{a}-\ell+c)^2 + 2(\bar{a}-\ell+c)(\bar{a}-\underline{a}+2\epsilon)V \\
\implies \quad & 2(\bar{a}-\underline{a})(\bar{a}-\underline{a}+2\epsilon)c + (\bar{a}-\underline{a})[(\bar{a}-\ell)^2+\epsilon^2+2\epsilon(\bar{a}-\ell)] + 2(\bar{a}-\underline{a})(\bar{a}-\ell)V + 2(\bar{a}-\underline{a})\epsilon V \geq \\
& (\bar{a}-\underline{a})[(\bar{a}-\ell)^2+c^2+2(\bar{a}-\ell)c] + 2\epsilon(\bar{a}-\ell+c)^2 + 2(\bar{a}-\underline{a})(\bar{a}-\ell)V + 2(\bar{a}-\underline{a})cV + \\
& 4\epsilon(\bar{a}-\ell+c)V \\
\implies \quad & 2(\bar{a}-\underline{a})(\bar{a}-\underline{a}+2\epsilon)c + (\bar{a}-\underline{a})[\epsilon^2+2\epsilon(\bar{a}-\ell)] + 2(\bar{a}-\underline{a})\epsilon V \geq \\
& (\bar{a}-\underline{a})[c^2+2(\bar{a}-\ell)c] + 2\epsilon(\bar{a}-\ell+c)^2 + 2(\bar{a}-\underline{a})cV + 4\epsilon(\bar{a}-\ell+c)V \\
\implies \quad & 2(\bar{a}-\underline{a}+2\epsilon)c + \epsilon^2 + 2\epsilon(\bar{a}-\ell) + 2\epsilon V \geq \\
& c^2 + 2(\bar{a}-\ell)c + 2\frac{\epsilon}{\bar{a}-\underline{a}}(\bar{a}-\ell+c)^2 + 2cV + 4\frac{\epsilon}{\bar{a}-\underline{a}}(\bar{a}-\ell+c)V \\
\implies \quad & (\bar{a}-\underline{a}+2\epsilon)c + \frac{\epsilon^2}{2} + \epsilon(\bar{a}-\ell) + \epsilon V \geq \\
& \frac{c^2}{2} + (\bar{a}-\ell)c + \frac{\epsilon}{\bar{a}-\underline{a}}(\bar{a}-\ell+c)^2 + cV + 2\frac{\epsilon}{\bar{a}-\underline{a}}(\bar{a}-\ell+c)V \\
\implies \quad & (-\underline{a}+2\epsilon)c + \frac{\epsilon^2}{2} + \epsilon(\bar{a}-\ell) + \epsilon V \geq \frac{c^2}{2} - \ell c + \frac{\epsilon}{\bar{a}-\underline{a}}(\bar{a}-\ell+c)^2 + cV + 2\frac{\epsilon}{\bar{a}-\underline{a}}(\bar{a}-\ell+c)V \\
\implies \quad & (\epsilon - c - 2\frac{\epsilon}{\bar{a}-\underline{a}}(\bar{a}-\ell+c))V \geq \frac{c^2}{2} - \ell c + \frac{\epsilon}{\bar{a}-\underline{a}}(\bar{a}-\ell+c)^2 + (\underline{a}-2\epsilon)c - \frac{\epsilon^2}{2} - \epsilon(\bar{a}-\ell)
\end{aligned}
$$

In the limit as $\epsilon \to 0$, the left-hand side bracket is negative so we get:

$$
\begin{aligned}
& V \leq \frac{\frac{c^2}{2} - \ell c + \frac{\epsilon}{\bar{a}-\underline{a}}(\bar{a}-\ell+c)^2 + (\underline{a}-2\epsilon)c - \frac{\epsilon^2}{2} - \epsilon(\bar{a}-\ell)}{(\epsilon - c - 2\frac{\epsilon}{\bar{a}-\underline{a}}(\bar{a}-\ell+c))} \\
\implies \quad & V \leq \frac{\frac{c^2}{2} - \ell c + \underline{a}c + \frac{\epsilon}{\bar{a}-\underline{a}}(\bar{a}-\ell+c)^2 - 2\epsilon c - \frac{\epsilon^2}{2} - \epsilon(\bar{a}-\ell)}{(-c + \epsilon - 2\frac{\epsilon}{\bar{a}-\underline{a}}(\bar{a}-\ell+c))} \\
\implies \quad & V \leq \frac{\frac{-c^2}{2} + \ell c - \underline{a}c - \frac{\epsilon}{\bar{a}-\underline{a}}(\bar{a}-\ell+c)^2 + 2\epsilon c + \frac{\epsilon^2}{2} + \epsilon(\bar{a}-\ell)}{(c - \epsilon + 2\frac{\epsilon}{\bar{a}-\underline{a}}(\bar{a}-\ell+c))}
\end{aligned}
$$

In the limit as $\epsilon \to 0$, both the numerator and denominator are positive. As $\epsilon = 0$, the expression reduces to the familiar $V \leq \ell - \underline{a} - \frac{c}{2}$

Condition 2:

$$
\begin{aligned}
& EV(0, \textit{safe}) \geq EV(0, \textit{risky}) \\
\implies \quad & \frac{(\bar{a}-\ell+c)^2}{2(\bar{a}-\underline{a})} + \frac{(\bar{a}-\ell+c)}{(\bar{a}-\underline{a})}V \geq \frac{(\bar{a}+\epsilon-\ell+c)^2}{2(\bar{a}-\underline{a}+2\epsilon)} + \frac{(\bar{a}+\epsilon-\ell+c)}{(\bar{a}-\underline{a}+2\epsilon)}V \\
\implies \quad & (\bar{a}-\underline{a}+2\epsilon)(\bar{a}-\ell+c)^2 + 2(\bar{a}-\underline{a}+2\epsilon)(\bar{a}-\ell+c)V \geq \\
& (\bar{a}-\underline{a})(\bar{a}+\epsilon-\ell+c)^2 + 2(\bar{a}-\underline{a})(\bar{a}+\epsilon-\ell+c)V \\
\implies \quad & (\bar{a}-\underline{a})(\bar{a}-\ell+c)^2 + 2\epsilon(\bar{a}-\ell+c)^2 + 2(\bar{a}-\underline{a})(\bar{a}-\ell+c)V + 4\epsilon(\bar{a}-\ell+c)V \geq \\
& (\bar{a}-\underline{a})(\bar{a}-\ell+c)^2 + (\bar{a}-\underline{a})\epsilon^2 + 2(\bar{a}-\underline{a})(\bar{a}-\ell+c)\epsilon + 2(\bar{a}-\underline{a})(\bar{a}-\ell+c)V + 2(\bar{a}-\underline{a})\epsilon V \\
\implies \quad & (\bar{a}-\ell+c)^2 + 2(\bar{a}-\ell+c)V \geq \frac{(\bar{a}-\underline{a})\epsilon}{2} + (\bar{a}-\underline{a})(\bar{a}-\ell+c) + (\bar{a}-\underline{a})V \\
\implies \quad & 2(\bar{a}-\ell+c)V - (\bar{a}-\underline{a})V \geq \frac{(\bar{a}-\underline{a})\epsilon}{2} + (\bar{a}-\underline{a})(\bar{a}-\ell+c) - (\bar{a}-\ell+c)^2 \\
\implies \quad & (\bar{a}+\underline{a}-2\ell+2c)V \geq \frac{(\bar{a}-\underline{a})\epsilon}{2} + (\ell-c-\underline{a})(\bar{a}-\ell+c)
\end{aligned}
$$

The right-hand side is positive by assumption. The positivity comes from the $\ell \in [\underline{a}+c, \bar{a}+c]$ assumption implying that $(\ell-c-\underline{a})(\bar{a}-\ell+c) \geq 0$.

Now, if $(\bar{a}+\underline{a}-2\ell+2c) < 0$, we get a contradiction since V would have to be less than or equal to a negative number, which violates the assumptions about positivity of V. Hence, we need $(\bar{a}+\underline{a}-2\ell+2c) > 0$. This implies $\frac{\bar{a}+\underline{a}}{2} + c > \ell$. Intuitively, the bank cannot be too levered. Else it will select the risky distribution regardless, even with a payout restriction in place.

$$
\begin{aligned}
\implies \quad & V \geq \frac{\frac{(\bar{a}-\underline{a})\epsilon}{2} + (\bar{a}-\underline{a})(\bar{a}-\ell+c) - (\bar{a}-\ell+c)^2}{(\bar{a}+\underline{a}-2\ell+2c)} \\
\implies \quad & V \geq \frac{\frac{(\bar{a}-\underline{a})\epsilon}{2} + (\ell-c-\underline{a})(\bar{a}-\ell+c)}{(\bar{a}+\underline{a}-2\ell+2c)}
\end{aligned}
$$

In sum, the following conditions need to hold for a region of complementarity between payout and risk-taking decisions to exist:

$$
\begin{aligned}
(L1) \quad & \ell < \frac{\bar{a}+\underline{a}}{2} + c \\
(L2) \quad & \ell > \frac{\bar{a}+\underline{a}}{2} \\
(V1) \quad & V \geq \frac{\ell^2 - \bar{a}\ell - \underline{a}\ell + \bar{a}\underline{a} - \frac{(\bar{a}-\underline{a})\epsilon}{2}}{2\ell - \bar{a} - \underline{a}} \\
(V2) \quad & V \geq \frac{\frac{(\bar{a}-\underline{a})\epsilon}{2} + (\ell-c-\underline{a})(\bar{a}-\ell+c)}{(\bar{a}+\underline{a}-2\ell+2c)} \\
(V3) \quad & V \leq \ell - \underline{a} - \frac{c}{2} + \epsilon
\end{aligned}
$$

$(L1)$ defines an upper bound for leverage and $(L2)$ defines the lower bound of admissible leverage ratios. Condition $(V3)$ is positive by definition so the existence of a region of complementarity hinges on $(V1)$ and $(V2)$.

So I now analyse when the following two conditions hold:

$$V3 > V1$$
$$V3 > V2$$

I begin with $(V1)$ and $(V3)$. To have a non-empty interval of continuation values V for which we have complementarity, we need:

$$\begin{aligned}
& \ell - \underline{a} - \frac{c}{2} + \epsilon > \frac{\ell^2 - \bar{a}\ell - \underline{a}\ell + \bar{a}\underline{a} - \frac{(\bar{a}-\underline{a})\epsilon}{2}}{2\ell - \bar{a} - \underline{a}} \\
\implies & (\ell - \underline{a} - \frac{c}{2} + \epsilon)(2\ell - \bar{a} - \underline{a}) > \ell^2 - \bar{a}\ell - \underline{a}\ell + \bar{a}\underline{a} - \frac{(\bar{a}-\underline{a})\epsilon}{2} \\
\implies & 2\ell^2 - 2\ell\underline{a} - \ell c - \bar{a}\ell + \bar{a}\underline{a} + \frac{\bar{a}c}{2} - \ell\underline{a} + \underline{a}^2 + \frac{\underline{a}c}{2} + \epsilon(2\ell - \bar{a} - \underline{a}) > \\
& \ell^2 - \bar{a}\ell - \underline{a}\ell + \bar{a}\underline{a} - \frac{(\bar{a}-\underline{a})\epsilon}{2} \\
\implies & \ell^2 - 2\ell\underline{a} - \ell c + \frac{\bar{a}c}{2} + \underline{a}^2 + \frac{\underline{a}c}{2} + \epsilon(2\ell - \bar{a} - \underline{a}) > -\frac{(\bar{a}-\underline{a})\epsilon}{2} \\
\implies & \ell(\ell - \underline{a} - c) - \ell\underline{a} + \underline{a}^2 + \frac{c(\bar{a}+\underline{a})}{2} + \epsilon(2\ell - \bar{a} - \underline{a}) > -\frac{(\bar{a}-\underline{a})\epsilon}{2} \qquad (15)
\end{aligned}$$

The following Lemma facilitates this comparison greatly:

Lemma B.1. *The upper bound given by (V3) always lies above the lower bound given by (V1) for the values of ℓ satisfying (L1) and (L2) as well as the initial assumption of $\ell \in [\underline{a} + c, \bar{c} + c]$*

The proof proceeds in two steps and follow the following logic. The left-hand side of Equation 15 is monotonically increasing in ℓ and the right-hand side is always negative so to prove Lemma B.1, we only need to show that the left-hand side is positive for both the lower and upper bound for admissible ℓ.

Case 1: Lower bound. The lower bound for ℓ is given by $\max\{\frac{\bar{a}+\underline{a}}{2}, \underline{a} + c\}$

Case 1a: $\ell = \underline{a} + c$. Then the left-hand side of Equation 15, ignoring theϵ-term reduces to:

$$\begin{aligned}
& -(\underline{a} + c)\underline{a} + \underline{a}^2 + \frac{c(\bar{a}+\underline{a})}{2} \\
= \; & -c\underline{a} + \frac{c(\bar{a}+\underline{a})}{2} > 0
\end{aligned}$$

Thus, a continuation value with complementarity does exist in that case.

Case 1b: $\ell = \frac{\bar{a}+\underline{a}}{2}$ at the lower bound. This requires $\frac{\bar{a}+\underline{a}}{2} > \underline{a} + c$ which implies $\frac{\bar{a}-\underline{a}}{2} > c$. Now, the left-hand side of Equation 15 reads as (again ignoring the ϵ-term) :

$$
\begin{aligned}
& \left(\frac{\bar{a}+\underline{a}}{2}\right)\left(\frac{\bar{a}+\underline{a}}{2}-\underline{a}-c\right)-\left(\frac{\bar{a}+\underline{a}}{2}\right)c+\underline{a}^2+\left(\frac{\bar{a}+\underline{a}}{2}\right)c \\
= \; & \frac{\bar{a}^2}{4}+\frac{\underline{a}^2}{4}+\frac{\bar{a}\underline{a}}{2}-\frac{\underline{a}^2}{2}-\frac{\underline{a}\bar{a}}{2}-(\underline{a}+\bar{a})c+\underline{a}^2+\frac{\underline{a}+\bar{a}}{2}c \\
= \; & \frac{\bar{a}^2}{4}+\frac{3\underline{a}^2}{4}-\frac{\underline{a}+\bar{a}}{2}c
\end{aligned}
$$

Now, we established earlier that $\frac{\bar{a}-\underline{a}}{2} > c$ in Case 1b. Hence, we can bound the previous expression from below:

$$
\begin{aligned}
& \frac{\bar{a}^2}{4}+\frac{3\underline{a}^2}{4}-\frac{\underline{a}+\bar{a}}{2}c > \frac{\bar{a}^2}{4}+\frac{3\underline{a}^2}{4}-\left(\frac{\underline{a}+\bar{a}}{2}\right)\left(\frac{\bar{a}-\underline{a}}{2}\right) \\
= \; & \frac{\bar{a}^2}{4}+\frac{3\underline{a}^2}{4}-\left(\frac{\bar{a}^2}{4}-\frac{\underline{a}^2}{4}\right) \\
= \; & \underline{a}^2 > 0
\end{aligned}
$$

Hence, Equation 15 is satisfied at the lower bound for admissible ℓ and the LHS is strictly monotonic. It remains to show that the equation also holds at the upper bound.

Case 2: Upper bound. The upper bound is given by $\min(\bar{a}+c, \frac{\bar{a}+\underline{a}}{2}+c) = \frac{\bar{a}+\underline{a}}{2}+c$ so there is only one case to consider here.

The left-hand side of Equation 15 now reads as:

$$
\begin{aligned}
& \left(\frac{\bar{a}+\underline{a}}{2}+c\right)\left(\frac{\bar{a}+\underline{a}}{2}+c-\underline{a}-c\right)-\left(\frac{\bar{a}+\underline{a}}{2}+c\right)\underline{a}+\underline{a}^2+\frac{c(\underline{a}+\bar{a})}{2} \\
= \; & \frac{\bar{a}^2}{4}+\frac{\underline{a}^2}{4}+\frac{\bar{a}\underline{a}}{2}+\frac{c(\underline{a}+\bar{a})}{2}-\underline{a}\left(\frac{\underline{a}+\bar{a}}{2}\right)-\underline{a}c-\underline{a}\left(\frac{\underline{a}+\bar{a}}{2}\right)-c\underline{a}+\underline{a}^2+\frac{c(\underline{a}+\bar{a})}{2} \\
= \; & \frac{\bar{a}^2}{4}+\frac{\underline{a}^2}{4}+\frac{\bar{a}\underline{a}}{2}+c(\underline{a}+\bar{a})-\underline{a}(\underline{a}+\bar{a})-2\underline{a}c+\underline{a}^2 \\
= \; & \frac{\bar{a}^2}{4}+\frac{\underline{a}^2}{4}+\frac{\bar{a}\underline{a}}{2}+c\bar{a}-\underline{a}\bar{a}-\underline{a}c \\
= \; & \frac{\bar{a}^2}{4}+\frac{\underline{a}^2}{4}-\frac{\bar{a}\underline{a}}{2}+c(\bar{a}-\underline{a}) \\
= \; & \left(\frac{\bar{a}-\underline{a}}{2}\right)^2+c(\bar{a}-\underline{a}) > 0
\end{aligned}
$$

So continuation values exist so that Equation 15 is also satisfied at the upper bound. Together with monotonicity and with the proof for Case 1, this proves Lemma B.1.

The last step consists of comparing conditions $(V2)$ and $(V3)$:

$$
\begin{aligned}
&\ell - \underline{a} - \frac{c}{2} + \epsilon > \frac{\frac{(\bar{a}-\underline{a})\epsilon}{2} + (\ell - c - \underline{a})(\bar{a} - \ell + c)}{(\bar{a} + \underline{a} - 2\ell + 2c)} \\
\implies\ &(\bar{a} + \underline{a} - 2\ell + 2c)(\ell - \underline{a} - \frac{c}{2} + \epsilon) > \frac{(\bar{a}-\underline{a})\epsilon}{2} + (\ell - c - \underline{a})(\bar{a} - \ell + c) \\
\implies\ &\bar{a}\ell - \bar{a}\underline{a} - \frac{\bar{a}c}{2} + \underline{a}\ell - \underline{a}^2 - \frac{\underline{a}c}{2} - 2\ell^2 + 2\ell\underline{a} + c\ell + 2c\ell - 2c\underline{a} - c^2 + \epsilon(\bar{a} + \underline{a} - 2\ell + 2c) > \\
&\bar{a}\ell - \ell^2 + c\ell - c\bar{a} + c\ell - c^2 - \bar{a}\underline{a} + \underline{a}\ell - \underline{a}c + \frac{(\bar{a}-\underline{a})\epsilon}{2} \\
\implies\ &-\frac{\bar{a}c}{2} - \underline{a}^2 - \frac{\underline{a}c}{2} - 2\ell^2 + 2\ell\underline{a} + 2c\ell - 2c\underline{a} + \epsilon(\bar{a} + \underline{a} - 2\ell + 2c) > \\
&-\ell^2 + c\ell - c\bar{a} - \underline{a}c + \frac{(\bar{a}-\underline{a})\epsilon}{2} \\
\implies\ &\frac{\bar{a}c}{2} - \underline{a}^2 - \frac{3\underline{a}c}{2} - \ell^2 + 2\ell\underline{a} + c\ell + \epsilon(\bar{a} + \underline{a} - 2\ell + 2c) > \frac{(\bar{a}-\underline{a})\epsilon}{2}
\end{aligned}
$$

In the limit as $\epsilon \to 0$, the expression only holds if:

$$
\begin{aligned}
&\frac{\bar{a}c}{2} - \underline{a}^2 - \frac{3\underline{a}c}{2} - \ell^2 + 2\ell\underline{a} + c\ell > 0 \\
\Leftrightarrow\ &\frac{(\bar{a}-\underline{a})c}{2} - \underline{a}c - \underline{a}^2 - \ell(\ell - c - 2\underline{a}) > 0 \\
\Leftrightarrow\ &\frac{(\bar{a}-\underline{a})c}{2} - \underline{a}c - \underline{a}^2 - \ell(\ell - c - \underline{a}) + \underline{a}\ell > 0 \qquad (16)
\end{aligned}
$$

The proof strategy is slightly different now. As in the previous proof for Lemma B.1, the upper bound for admissible ℓ is given by $\frac{\bar{a}+\underline{a}}{2} + c$. In the limit as $\ell \to \frac{\bar{a}+\underline{a}}{2} + c$, the denominator in the right-hand side of $(V2)$ goes to 0, hence the right-hand side of $(V2)$ goes to infinity and thus complementarity cannot hold since $(V3)$ defines a finite upper bound and a finite upper bound in combination with an infinite lower bound would imply the empty set.

Lemma B.2. *For $\underline{\ell} = \max(\frac{\bar{a}+\underline{a}}{2}, \underline{a} + c)$ and $c > \frac{\bar{a}-\underline{a}}{4}$, $\exists \bar{\ell} \leq \frac{\bar{a}+\underline{a}}{2} + c$ with $\bar{\ell} > \underline{\ell}$ such that the intersection of the upper bound from $(V3)$ and the lower bound from $(V2)$ is non-empty on $(\underline{\ell}, \bar{\ell}]$*

Before proceeding to the proof, it is useful to provide intuition for the result and the conditions necessary to derive it. First, notice that $\underline{\ell} < \frac{\bar{a}+\underline{a}}{2} + c$ so the set of ℓ is always non-empty as long as the condition on c holds.

Second, there is a condition on c. If the cash payout c is too low, that is $c < \frac{\bar{a}-\underline{a}}{4}$, complementarity fails. The payout risk-shifting motive is still present for low enough V. However, the risk-taking motive is too strong for a mean-preserving spread - unless V is so high that the payout risk-shifting motive gets weeded out.

The interpretation is the following. The payout restriction exhibits only complementarity with the risk-taking decision if it is strong enough, not only to lead to a change in payout policy (which is mechanical) but also to change the risk-taking decision of the bank. The risk-taking decision in turn is only affected on the margin if c is large enough. For c small, the change in payoffs for the bank across states is not sufficient to induce cutting back on the risk-taking margin when a payout restriction is imposed.

The idea for the proof is to proceed in 3 steps. First, I show that complementarity is exhibited if the leverage lower bound is given by $\underline{\ell} = \underline{a} + c$, then I look at the case where $\underline{\ell} = \frac{\underline{a}+\bar{a}}{2}$. Finally, I provide an implicit equation for $\bar{\ell}$. In the first two steps, I will show that there is complementarity given the assumptions as we go to $\underline{\ell}$. The upper bound on ℓ than guarantees a non-empty set.

Step 1: $\underline{\ell} = \underline{a} + c$:

Substituting into Equation 16 yields:

$$\begin{aligned} &\frac{(\bar{a} - \underline{a})c}{2} - \underline{a}c - \underline{a}^2 - (\underline{a} + c)(\underline{a} + c - c - \underline{a}) + \underline{a}(\underline{a} + c) > 0 \\ = &\frac{(\bar{a} - \underline{a})c}{2} > 0 \end{aligned}$$

Clearly, this always holds.

Step 2: $\underline{\ell} = \frac{\bar{a}+\underline{a}}{2}$ which requires $\frac{\bar{a}+\underline{a}}{2} > \underline{a} + c \implies \frac{\bar{a}-\underline{a}}{2} > c$. Now, condition 16 reduces to:

$$\begin{aligned} &\frac{(\bar{a} - \underline{a})c}{2} - \underline{a}c - \underline{a}^2 - \ell(\ell - c - \underline{a}) + \underline{a}\ell > 0 \\ \implies &\frac{(\bar{a} - \underline{a})c}{2} - \underline{a}c - \underline{a}^2 - \left(\frac{\bar{a} + \underline{a}}{2}\right)\left(\frac{\bar{a} + \underline{a}}{2} - c - \underline{a}\right) + \underline{a}\left(\frac{\bar{a} + \underline{a}}{2}\right) > 0 \\ \implies &\frac{(\bar{a} - \underline{a})c}{2} - \underline{a}c - \underline{a}^2 - \left(\frac{\bar{a} + \underline{a}}{2}\right)\left(\frac{\bar{a} - \underline{a}}{2} - c\right) + \underline{a}\left(\frac{\bar{a} + \underline{a}}{2}\right) > 0 \\ \implies &\frac{(\bar{a} - \underline{a})c}{2} - \underline{a}c - \underline{a}^2 - \left(\frac{\bar{a}^2}{4} - \frac{\underline{a}^2}{4}\right) + \frac{c(\bar{a} + \underline{a})}{2} + \underline{a}\frac{\bar{a} + \underline{a}}{2} > 0 \\ \implies &\bar{a}c - \underline{a}c - \underline{a}^2 - \frac{\bar{a}^2}{4} + \frac{\underline{a}^2}{4} + \frac{\underline{a}^2}{2} + \frac{\underline{a}\bar{a}}{2} > 0 \\ \implies &c(\bar{a} - \underline{a}) - \frac{\bar{a}^2}{4} - \frac{\underline{a}^2}{4} + \frac{\bar{a}\underline{a}}{2} > 0 \\ \implies &c(\bar{a} - \underline{a}) - \left(\frac{\bar{a} - \underline{a}}{2}\right)^2 > 0 \\ \implies &c > \frac{\bar{a} - \underline{a}}{4} \end{aligned}$$

In sum, due to continuity of the left-hand side of the inequality in Equation 16, the proposition holds for ℓ sufficiently small but above the lower bound. The upper bound for ℓ is implicitly defined in step 3:

Step 3: The upper bound for ℓ is given by the breakeven point of equation 16. In the limit as $\epsilon \to 0$, this is given by:

$$\frac{(\bar{a} - \underline{a})c}{2} - \underline{a}c - \underline{a}^2 - \ell(\ell - c - \underline{a}) + \underline{a}\ell = 0$$

Finally, taking together Lemmas B.1 and B.2 proves proposition 2.7.

C Summary Statistics

C.1 TAQ data

Variable	Obs	Mean	Std. Dev.	P10	P50	P90
Normalized Price	57295	1.001	.038	.986	1	1.011
Shares Outstanding in 1,000s	57436	409611.1	988584.5	12934	108613	948380
Size of Trade	57436	4531.284	32203.92	2	75	4630.667
Market Value in $1,000	57436	3.02e+07	1.30e+08	29984.55	1057751	5.87e+07

Table reports prices, shares outstanding, size of trade and market value for TAQ data on 06/25/2020 for the 4.00 to 6.00 ET time window. Prices are normalized to 1 at 4.00 ET.

Table C.2: TAQ Summary statistics; June 25, 2020

Variable	Obs	Mean	Std. Dev.	P10	P50	P90
Normalized Price	85372	1.003	.022	.996	1	1.012
Shares Outstanding in 1,000s	85906	366738.7	1041450	18732	99236	789392
Size of Trade	85906	24022.6	155797.2	3	125	17827
Market Value in $1,000	85906	3.18e+07	1.34e+08	85190.4	2687889	6.60e+07

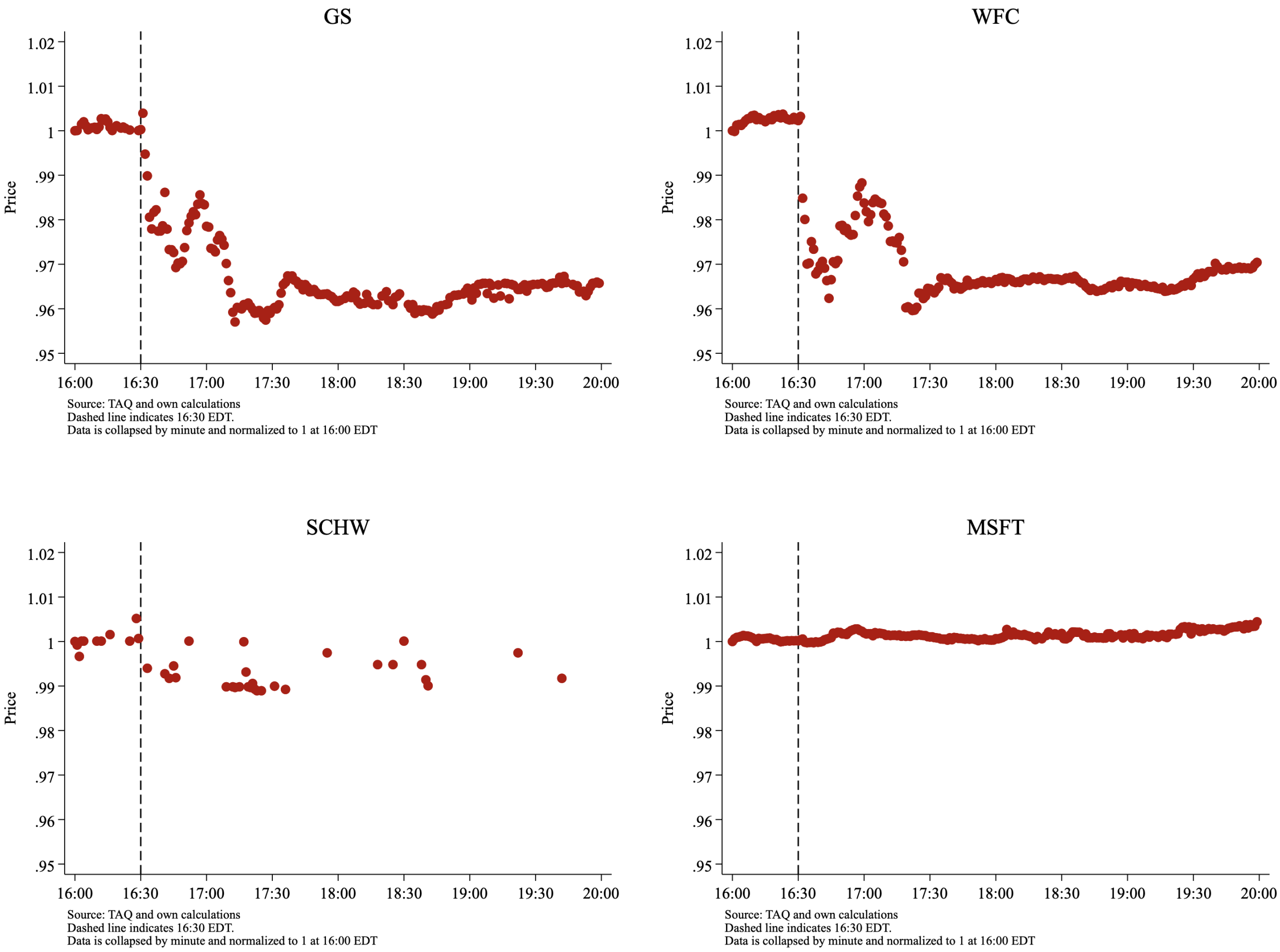
Table reports prices, shares outstanding, size of trade and market value for TAQ data on 12/18/2020 for the 4.00 to 6.00 ET time window. Prices are normalized to 1 at 4.00 ET.

Table C.3: TAQ Summary statistics; December 18, 2020

Variable	Obs	Mean	Std. Dev.	P10	P50	P90
Normalized Price	63558	1.001	.022	.99	1	1.011
Shares Outstanding in 1,000s	63579	407176.8	1174403	15483	97663	914711
Size of Trade	63579	3429.281	32795.68	1	50	2500.5
Market Value in $1,000	63579	3.65e+07	1.57e+08	39739.2	1468074	7.52e+07

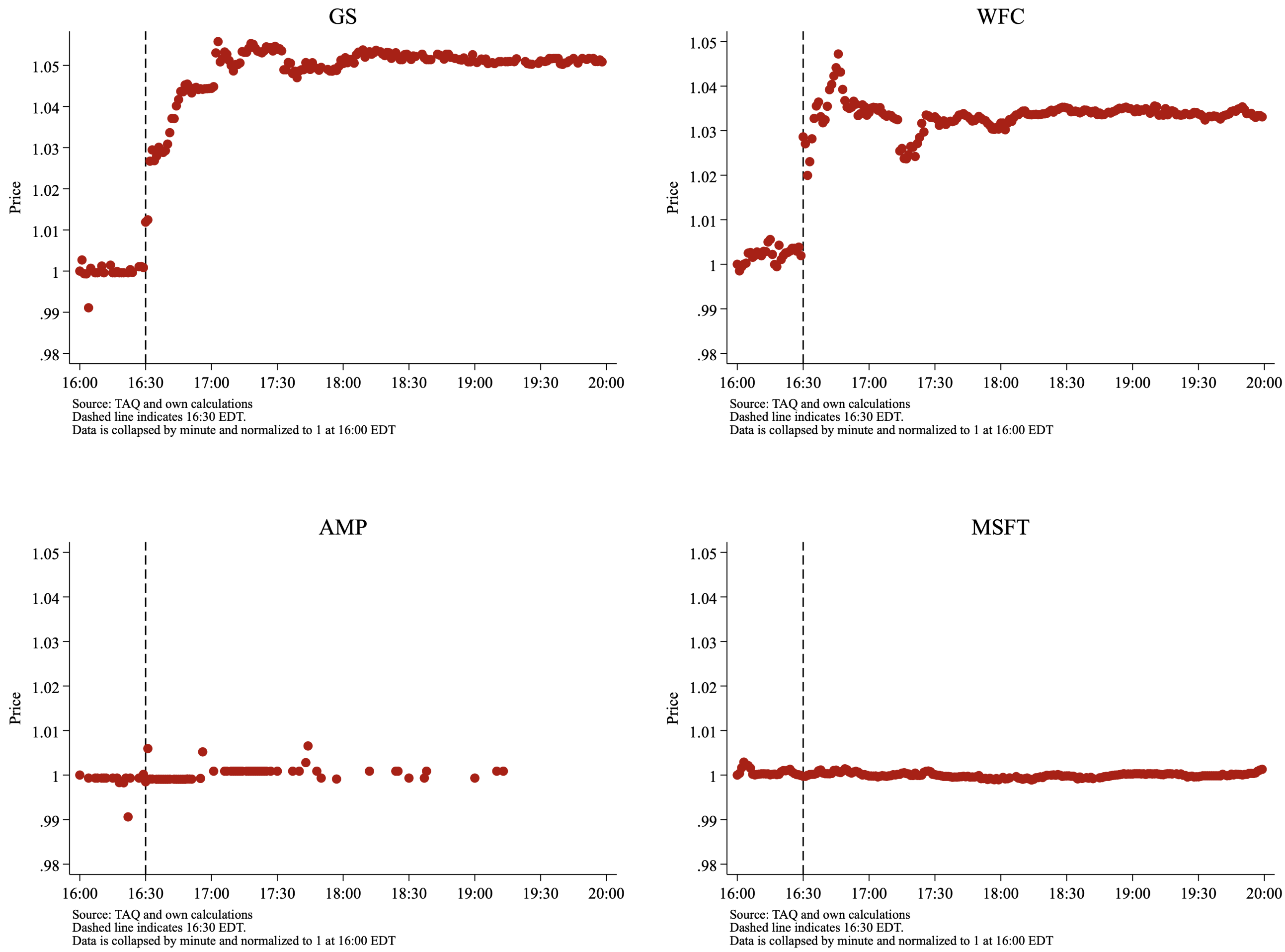
Table reports prices, shares outstanding, size of trade and market value for TAQ data on 03/25/2021 for the 4.00 to 6.00 ET time window. Prices are normalized to 1 at 4.00 ET.

Table C.4: TAQ Summary statistics; March 25, 2021



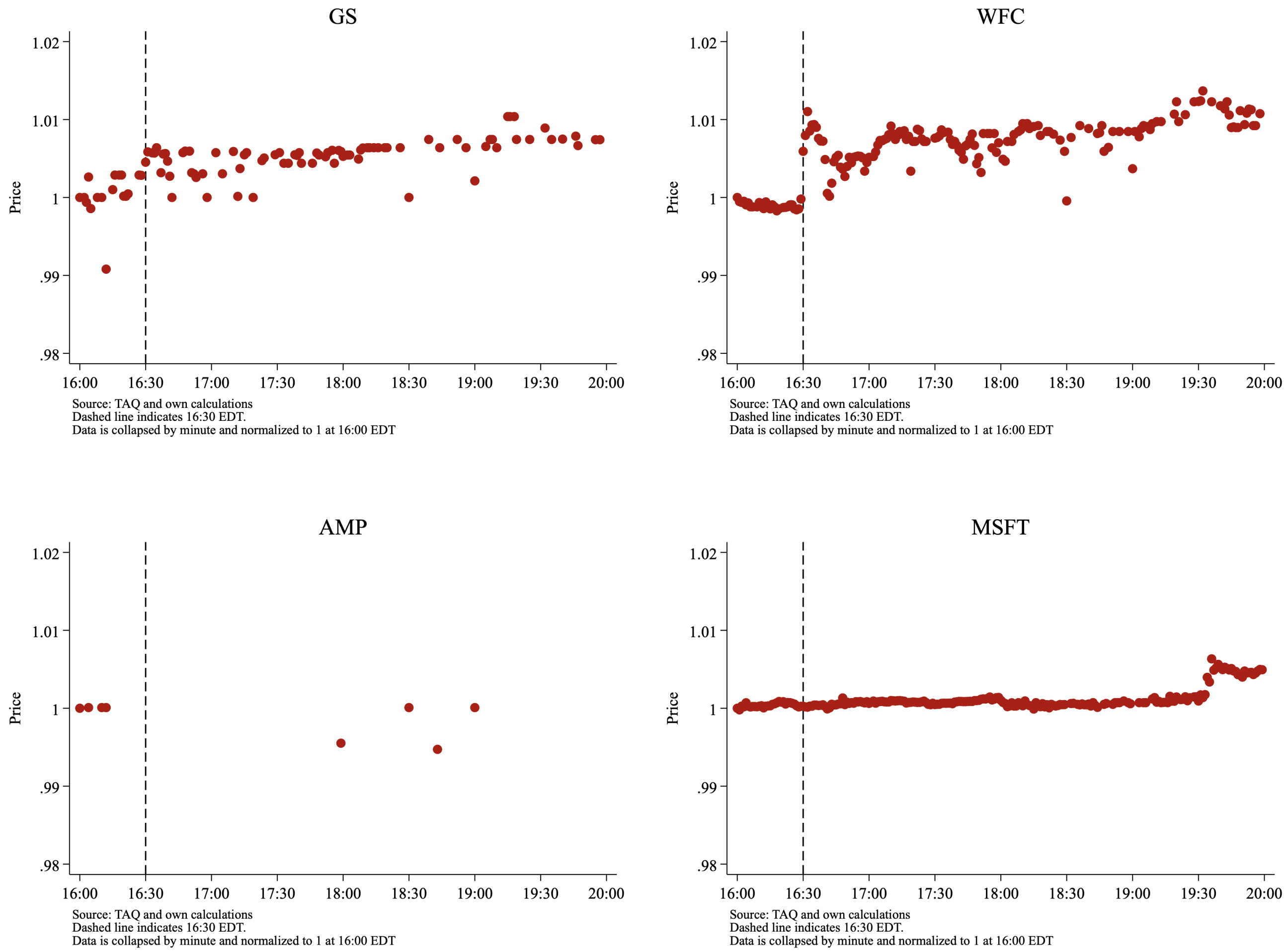
Stock price reaction for Goldman Sachs (GS), Wells Fargo (WFC), Charles Schwab (SCHW) and Microsoft (MSFT). Data is from TAQ. Dashed vertical line indicates 4.30 ET. Prices are collapsed by minute and normalized to 1 at 4.00 ET.

Figure C.1: Stock Price Reaction around 06/25/2020 Fed announcement for Goldman Sachs, Wells Fargo, Charles Schwab, Microsoft



Stock price reaction for Goldman Sachs (GS), Wells Fargo (WFC), Ameriprise (AMP) and Microsoft (MSFT). Data is from TAQ. Dashed vertical line indicates 4.30 ET. Prices are collapsed by minute and normalized to 1 at 4.00 ET.

Figure C.2: Stock Price Reaction around 12/18/2020 Fed announcement for Goldman Sachs, Wells Fargo, Ameriprise, Microsoft



Stock price reaction for Goldman Sachs (GS), Wells Fargo (WFC), Ameriprise (AMP) and Microsoft (MSFT). Data is from TAQ. Dashed vertical line indicates 4.30 ET. Prices are collapsed by minute and normalized to 1 at 4.00 ET.

Figure C.3: Stock Price Reaction around 03/25/2020 Fed announcement for Goldman Sachs, Wells Fargo, Ameriprise, Microsoft

C.2 CDS Data

	Financial Sector (excl. CCAR Banks)		CCAR Banks	
	mean	sd	mean	sd
Spread - 1Y	0.77	1.41	0.35	0.20
Spread - 2Y	0.94	1.47	0.48	0.26
Spread - 3Y	1.12	1.60	0.56	0.29
Spread - 5Y	1.44	1.74	0.77	0.38
Spread - 10Y	1.74	1.74	1.05	0.48
Spread - 20Y	1.73	1.58	1.19	0.55
Spread - 30Y	1.76	1.56	1.22	0.53
Observations	5497		350	

CDS spread data from Markit. Table reports means and standard deviations of CDS spreads for time window starting 5 trading days before 06/25/2020 and ending 5 trading days after. CDS spreads are reported in percentages. Financial sector includes SIC codes 6000-6999.

Table C.5: CDS spreads around 06/25/2020

	Financial Sector(excl. CCAR Banks)		CCAR Banks	
	mean	sd	mean	sd
Spread - 1Y	0.64	1.25	0.26	0.10
Spread - 2Y	0.78	1.31	0.36	0.17
Spread - 3Y	0.95	1.47	0.44	0.22
Spread - 5Y	1.27	1.65	0.65	0.32
Spread - 10Y	1.58	1.64	0.92	0.38
Spread - 20Y	1.61	1.54	1.04	0.43
Spread - 30Y	1.63	1.50	1.07	0.42
Observations	7700		495	

CDS spread data from Markit. Table reports means and standard deviations of CDS spreads for time window starting 5 trading days before 06/25/2020 and ending 5 trading days after. CDS spreads are reported in percentages. Financial sector includes SIC codes 6000-6999.

Table C.6: CDS spreads around 12/18/2020

C.3 Corporate Bond Data

	Economy (excl. CCAR Banks)		CCAR Banks	
	mean	sd	mean	sd
Daily Close Price	105.97	11.47	103.95	11.13
Daily Close Yield	3.30	2.19	2.76	1.47
Maturity in Years	9.49	10.08	6.35	6.56
Observations	3507585		642250	

Table reports closing prices and closing yields from TRACE daily summary at the security level for secondary market corporate bond transactions. Yields are measured in percentages. Maturity is measured in years.

Table C.7: Corporate Bond Trade Summary Statistics

C.4 Thomson One Syndicated Loan Data

	mean	sd
Loan Amount (Million Dollars)	126.63	300.51
Loan Spread (bps)	234.84	146.20
Leveraged Loan Flag	0.65	0.48
Observations	51127	

Table reports loan amounts, spreads over reference rate (in basis points) and a flag for leveraged loans for syndicated loan data at the bank-borrower level. Flag equals zero for loans with investment-grade rating and one for companies with ratings below investment-grade.

Table C.8: Syndicated Loans: Summary Statistics

D Further Results

D.1 Further Balance Sheet Variables

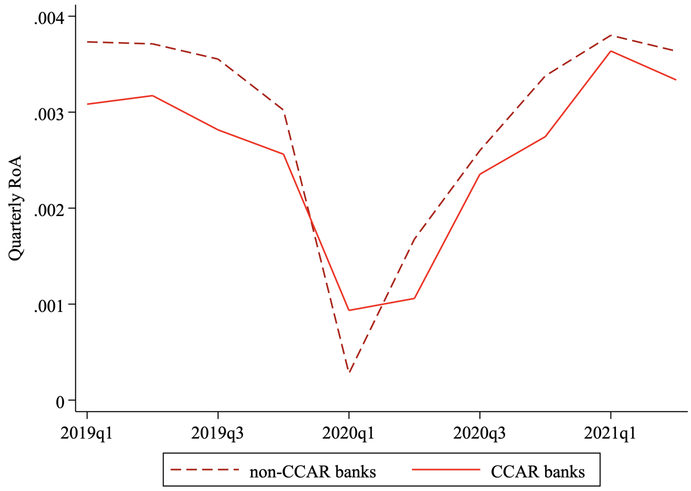


Figure reports return on assets for CCAR banks and largest non-CCAR banks. Profitability is defined as net income over total assets. Data is from FR Y9-C.

Figure D.4: Return on Assets

Figure D.4 reports the evolution of quarterly return on assets for CCAR and non-CCAR banks. We can see that return on assets evolves in parallel over the course of 2020. In particular, RoA does not seem affected by the announcements of payout restrictions in June and December 2020.

D.2 Further Evidence on Payouts

Figure D.5 re-computes the net payout ratio but adjusts net income for loan-loss provisioning. Specifically, I use adjusted net income by subtracting the contribution of loan-loss provisioning from unadjusted net income. This robustness check ensures that the time series of the net payout ratio is not driven by loan-loss provisioning, which underwent substantial fluctuations over the course of the Covid recession.

The dark red bars report the net payout ratio using unadjusted net income, the light red bars report the adjusted net payout ratio computed using adjusted net income. One can see that the release of loan loss reserves dampens the net payout ratio in early 2021. Measured as a fraction of adjusted net income, the increase in payouts after the relaxation of payout restrictions in December 2020 is even more pronounced since the release of loan loss reserves contributed substantially to banks' net income in early 2021.

Figure D.6 compares the net payout ratios of the CCAR banks on the right-hand side to those of non-CCAR banks on the left-hand side around the relaxation of payout restrictions in December 2020.

The increase in CCAR banks net payout ratio is not mirrored by non-CCAR banks. This lends further credence to the interpretation that the relaxation of payout restrictions drives the surge in CCAR banks' payouts in early 2021, and not macroeconomic or industry-wide factors.

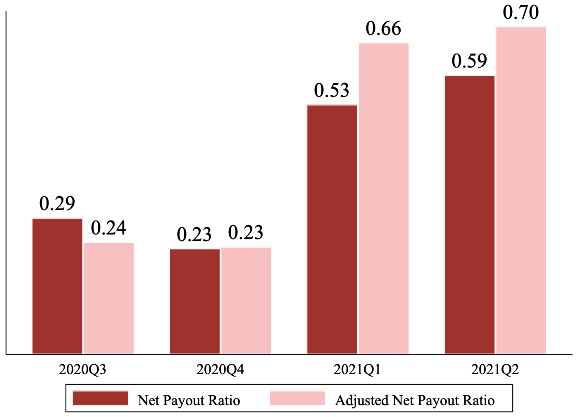


Figure reports net payout ratio for CCAR banks. Net payout ratio is defined as dividends plus net share buybacks, divided by net income. This figure is reported by dark red bars. Light red bars use adjusted net income which adjusts for the contribution of loan loss provisions to net income. Data is from Compustat and FR Y9-C.

Figure D.5: Net Payout Ratio 2020Q3 - 2021 Q2 (using adjusted net payout ratio)

D.3 Individual Bank Leverage

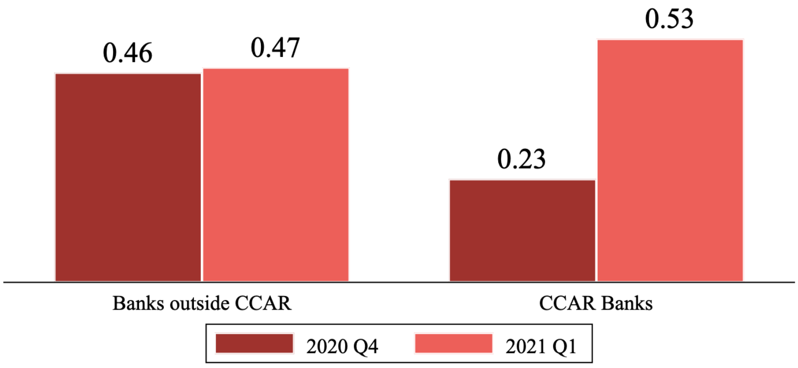


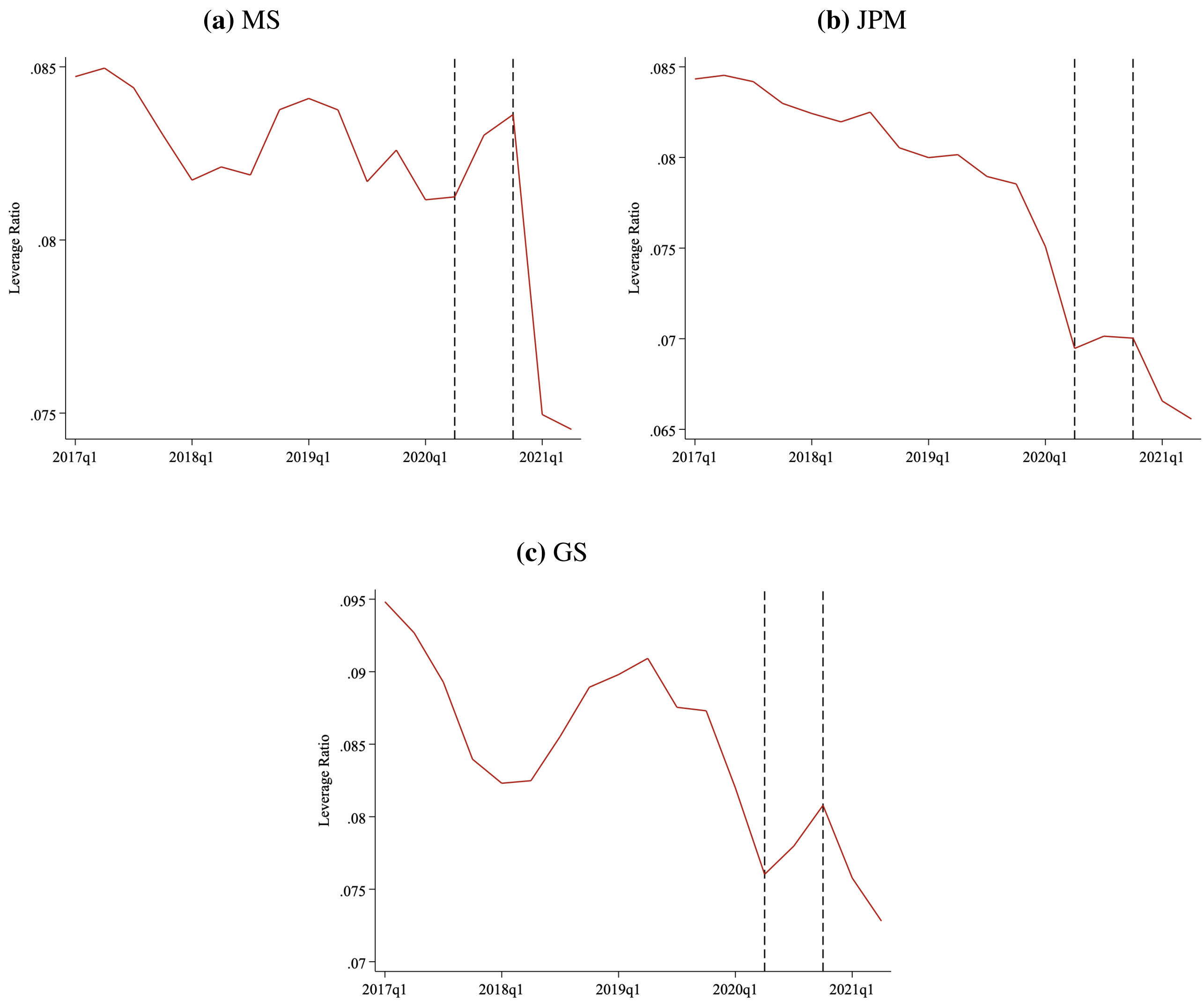
Figure reports net payout ratio for 2020 Q4 and 2021 Q1 for CCAR banks and largest 14 banks outside CCAR. Net payout ratio is defined as dividends plus net share buybacks, divided by net income. Data is from Compustat and FR Y9-C.

Figure D.6: Net Payout Ratio : CCAR banks vs. Others

D.4 Term Structure of CDS Response

Figure D.8 reports the entire term structure of estimated CDS responses around the announcement of payout restrictions on 06/25/2020 along with 95 % confidence bands.Limiting payouts lowers CDS spreads for CCAR-banks across all maturities of CDS spreads. The estimated coefficient is highly significant and hovers between 2 and 3 basis points.

Figure D.9 reports the term structure for CDS spreads for financial firms around 12/18/2020 when payout restrictions are partly being lifted. The point estimate is around 1.2 basis points for shorter maturities and approaches 1.5 basis points at longer time horizons. Across the entire term structure, we observe a statistically significant increase in CDS spreads.



Figures report quarterly leverage ratio for Morgan Stanley (Panel A), JP Morgan (Panel B) and Goldman Sachs (Panel C). Leverage is defined as Tier1 capital over total assets for the leverage ratio. Data is from FR Y9C.

Figure D.7: Leverage Ratio of selected banks

D.5 Robustness Checks for Cumulative Abnormal Returns

Date	Coefficient	SE
06/26/2020	-.0117***	(.0044)
06/29/2020	-.0451***	(.0045)
06/30/2020	-.0444***	(.0059)
07/01/2020	-.0387***	(.0067)
07/02/2020	-.0386***	(.0073)
07/06/2020	-.0324***	(.0081)
07/07/2020	-.0337***	(.0094)
07/08/2020	-.0258**	(.0108)
07/09/2020	-.0215*	(.0114)
07/10/2020	-.0194*	(.0110)

Source: CRSP and own calculations. Table reports coefficients from daily regressions for the 10 days after the announcement date following 06/25/2020. Each daily regression regresses cumulative abnormal returns up to that day onto an indicator for the CCAR banks. Sample includes only banks with market capitalization exceeding USD 1 billion (SIC 6020, 6021, 6022, 6029, 6081, 6141, 6163, 6211, 6711, 6712) and regressions are unweighted.

Table D.9: CAR after 06/25/2020 Unweighted Regression (Banks only)

Date	Coefficient	SE
06/26/2020	-.0263***	(.0032)
06/29/2020	-.0353***	(.0029)
06/30/2020	-.0358***	(.0040)
07/01/2020	-.0530***	(.0042)
07/02/2020	-.0519***	(.0041)
07/06/2020	-.0446***	(.0056)
07/07/2020	-.0523***	(.0062)
07/08/2020	-.0504***	(.0075)
07/09/2020	-.0543***	(.0074)
07/10/2020	-.0232***	(.0080)

Source: CRSP and own calculations. Table reports coefficients from daily regressions for the 10 days after the announcement date following 06/25/2020. Each daily regression regresses cumulative abnormal returns up to that day onto an indicator for the CCAR banks. Sample includes only financial firms (SIC 6000-6999, excl. 6726) and regressions are weighted by market value.

Table D.10: CAR after 06/25/2020 Weighted Regression (Financial Firms Only)

Date	Coefficient	SE
06/26/2020	-.0347***	(.0039)
06/29/2020	-.0486***	(.0041)
06/30/2020	-.0394***	(.0054)
07/01/2020	-.0578***	(.0062)
07/02/2020	-.0581***	(.0066)
07/06/2020	-.0494***	(.0072)
07/07/2020	-.0560***	(.0083)
07/08/2020	-.0507***	(.0096)
07/09/2020	-.0607***	(.0099)
07/10/2020	-.0378***	(.0099)

Source: CRSP and own calculations. Table reports coefficients from daily regressions for the 10 days after the announcement date following 06/25/2020. Each daily regression regresses cumulative abnormal returns up to that day onto an indicator for the CCAR banks. Sample includes only financial firms (SIC 6000-6999, excl. 6726) and regressions are unweighted.

Table D.11: CAR after 06/25/2020 Unweighted Regression (Financial Firms Only)

Date	Coefficient	SE
12/21/2020	.02311***	(.0045)
12/22/2020	.01699***	(.0042)
12/23/2020	.01343***	(.0046)
12/24/2020	.01159***	(.0044)
12/28/2020	.00967***	(.0043)
12/29/2020	.01751***	(.0044)
12/30/2020	.01648***	(.0041)
12/31/2020	.02339***	(.0042)
01/04/2021	.02135***	(.0048)
01/05/2021	.01703***	(.0058)

Source: CRSP and own calculations. Table reports coefficients from daily regressions for the 10 days after the announcement date following 12/18/2020. Each daily regression regresses cumulative abnormal returns up to that day onto an indicator for the CCAR banks. Sample includes only banks with market capitalization exceeding USD 1 billion (SIC 6020, 6021, 6022, 6029, 6081, 6141, 6163, 6211, 6711, 6712) and regressions are unweighted.

Table D.12: CAR after 12/18/2020 Unweighted Regression (Banks Only)

Date	Coefficient	SE
12/21/2020	.03429***	(.0046)
12/22/2020	.01924***	(.0043)
12/23/2020	.03626***	(.0048)
12/24/2020	.02906***	(.0045)
12/28/2020	.02957***	(.0045)
12/29/2020	.03102***	(.0049)
12/30/2020	.02862***	(.0043)
12/31/2020	.03186***	(.0044)
01/04/2021	.04002***	(.0057)
01/05/2021	.04571***	(.0057)

Source: CRSP and own calculations. Table reports coefficients from daily regressions for the 10 days after the announcement date following 12/18/2020. Each daily regression regresses cumulative abnormal returns up to that day onto an indicator for the CCAR banks. Sample includes only financial firms (SIC 6000-6999, excl. 6726) and regressions are weighted by market value.

Table D.13: CAR after 12/18/2020 Weighted Regression (Financial Firms Only)

Date	Coefficient	SE
12/21/2020	.02450***	(.0043)
12/22/2020	.01272***	(.0040)
12/23/2020	.02375***	(.0043)
12/24/2020	.01929***	(.0042)
12/28/2020	.02136***	(.0041)
12/29/2020	.02411***	(.0041)
12/30/2020	.02284***	(.0039)
12/31/2020	.03107***	(.0040)
01/04/2021	.03478***	(.0046)
01/05/2021	.03262***	(.0054)

Source: CRSP and own calculations. Table reports coefficients from daily regressions for the 10 days after the announcement date following 12/18/2020. Each daily regression regresses cumulative abnormal returns up to that day onto an indicator for the CCAR banks. Sample includes only financial firms (SIC 6000-6999, excl. 6726) and regressions are unweighted.

Table D.14: CAR after 12/18/2020 Unweighted Regression (Financial Firms Only)

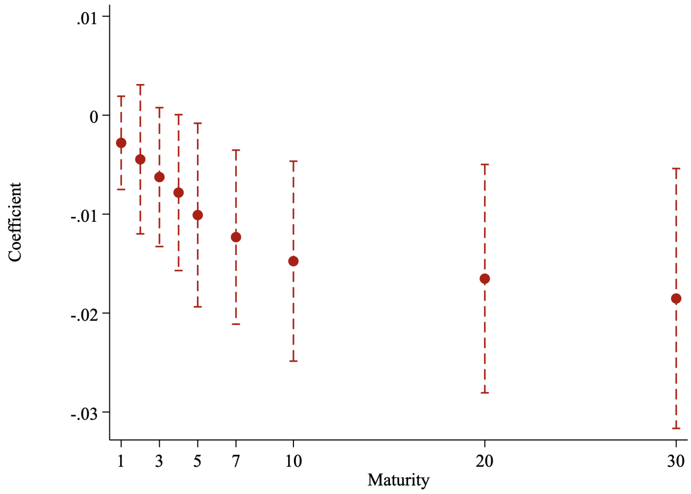


Figure reports point estimate and 95 % confidence interval for differences-in-differences coefficient in a regression of CDS spread at maturity as indicated by x-axis onto post-dummy interacted with flag for CCAR banks using a +/- 5 trading day window around 06/25/2020.

Figure D.8: Term Structure of CDS Response around 06/25/2020

D.6 Results from Fama-French 3-factor model

As an additional robustness check for cumulative abnormal returns, I employ the previous two-step methodology with a Fama and French (1992) 3-factor model to infer abnormal returns. Results are qualitatively similar to the ones from a one-factor model:

For ease of exposition, only the regressions for the sample consisting of banks are included. Those contain the tightest control group. Results for the broader control groups consisting of financial firms and of all firms are available upon request. Qualitatively those results are also consistent with the mechanism outlined in the paper.

Date	Coefficient	SE
06/26/2020	-.0098**	(.0048)
06/29/2020	-.0278***	(.0034)
06/30/2020	-.0315***	(.0046)
07/01/2020	-.0306***	(.0046)
07/02/2020	-.0334***	(.0050)
07/06/2020	-.0334***	(.0065)
07/07/2020	-.0391***	(.0067)
07/08/2020	-.0372***	(.0082)
07/09/2020	-.0337***	(.0084)
07/10/2020	-.0216**	(.0086)

Source: CRSP and own calculations. Table reports coefficients from daily regressions for the 10 days after the announcement date following 06/25/2020. Each daily regression regresses cumulative abnormal returns up to that day onto an indicator for the CCAR banks. Abnormal returns are computed based on a Fama-French 3-factor model. Sample includes only banks with market capitalization exceeding USD 1 billion (SIC 6020, 6021, 6022, 6029, 6081, 6141, 6163, 6211, 6711, 6712) and regressions are weighted by market value.

Table D.15: CAR after 06/25/2020 Weighted Regression (Banks only)

Date	Coefficient	SE
06/26/2020	-.0087**	(.0043)
06/29/2020	-.0375***	(.0054)
06/30/2020	-.0380***	(.0065)
07/01/2020	-.0369***	(.0061)
07/02/2020	-.0364***	(.0064)
07/06/2020	-.0344***	(.0071)
07/07/2020	-.0372***	(.0079)
07/08/2020	-.0276***	(.0090)
07/09/2020	-.0267***	(.0085)
07/10/2020	-.0269***	(.0094)

Source: CRSP and own calculations. Table reports coefficients from daily regressions for the 10 days after the announcement date following 06/25/2020. Each daily regression regresses cumulative abnormal returns up to that day onto an indicator for the CCAR banks. Abnormal returns are computed based on a Fama-French 3-factor model. Sample includes only banks with market capitalization exceeding USD 1 billion (SIC 6020, 6021, 6022, 6029, 6081, 6141, 6163, 6211, 6711, 6712) and regressions are unweighted.

Table D.16: CAR after 06/25/2020 Unweighted Regression (Banks only)

Date	Coefficient	SE
12/21/2020	.03262***	(.0050)
12/22/2020	.02883***	(.0049)
12/23/2020	.03230***	(.0055)
12/24/2020	.02946***	(.0051)
12/28/2020	.02562***	(.0051)
12/29/2020	.02286***	(.0053)
12/30/2020	.02452***	(.0050)
12/31/2020	.02526***	(.0057)
01/04/2021	.02600***	(.0070)
01/05/2021	.02865***	(.0075)

Source: CRSP and own calculations. Table reports coefficients from daily regressions for the 10 days after the announcement date following 12/18/2020. Each daily regression regresses cumulative abnormal returns up to that day onto an indicator for the CCAR banks. Abnormal returns are computed based on a Fama-French 3-factor model. Sample includes only banks with market capitalization exceeding USD 1 billion (SIC 6020, 6021, 6022, 6029, 6081, 6141, 6163, 6211, 6711, 6712) and regressions are weighted by market value.

Table D.17: CAR after 12/18/2020 Weighted Regression (Banks Only)

Date	Coefficient	SE
12/21/2020	.02405***	(.0045)
12/22/2020	.02612***	(.0042)
12/23/2020	.02505***	(.0048)
12/24/2020	.02115***	(.0046)
12/28/2020	.01494***	(.0046)
12/29/2020	.01429***	(.0048)
12/30/2020	.01978***	(.0044)
12/31/2020	.02145***	(.0046)
01/04/2021	.02215***	(.0053)
01/05/2021	.02526***	(.0063)

Source: CRSP and own calculations. Table reports coefficients from daily regressions for the 10 days after the announcement date following 12/18/2020. Each daily regression regresses cumulative abnormal returns up to that day onto an indicator for the CCAR banks. Abnormal returns are computed based on a Fama-French 3-factor model. Sample includes only banks with market capitalization exceeding USD 1 billion (SIC 6020, 6021, 6022, 6029, 6081, 6141, 6163, 6211, 6711, 6712) and regressions are unweighted.

Table D.18: CAR after 12/18/2020 Unweighted Regression (Banks Only)

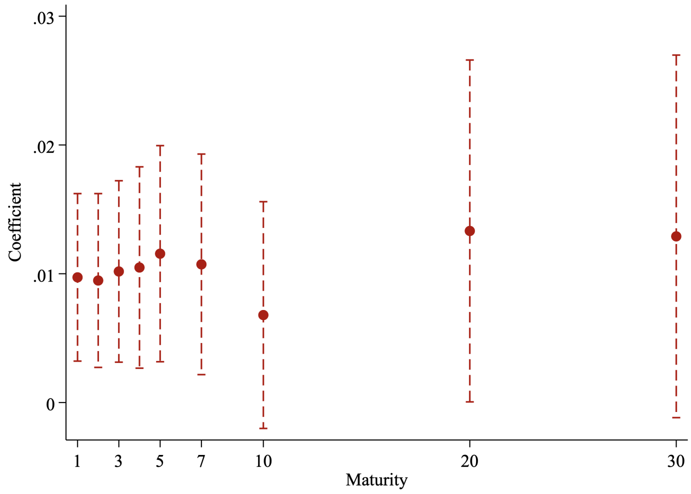
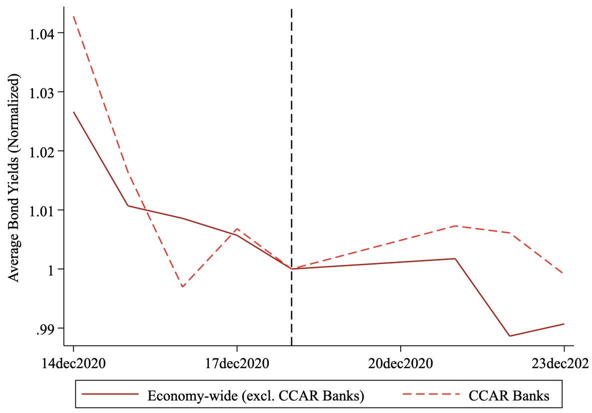


Figure reports point estimate and 95 % confidence interval for differences-in-differences coefficient in a regression of CDS spread at maturity as indicated by x-axis onto post-dummy interacted with flag for CCAR banks using a +/- 5 trading day window around 06/25/2020.

Figure D.9: Term Structure of CDS Response around 12/18/2020

D.7 More Corporate Bond Results



Source: TRACE Daily Summary BTDS, Mergent FSID and own calculations. Yields are normalized to one on 12/18/2020 and weighted by size of outstanding bond issuance. Dashed line represents CCAR banks, solid line are economy-wide corporate bond yields excluding CCAR banks.

Figure D.10: Corporate Bond Yields around 12/18/2020

D.8 Further Results on Lending Margin

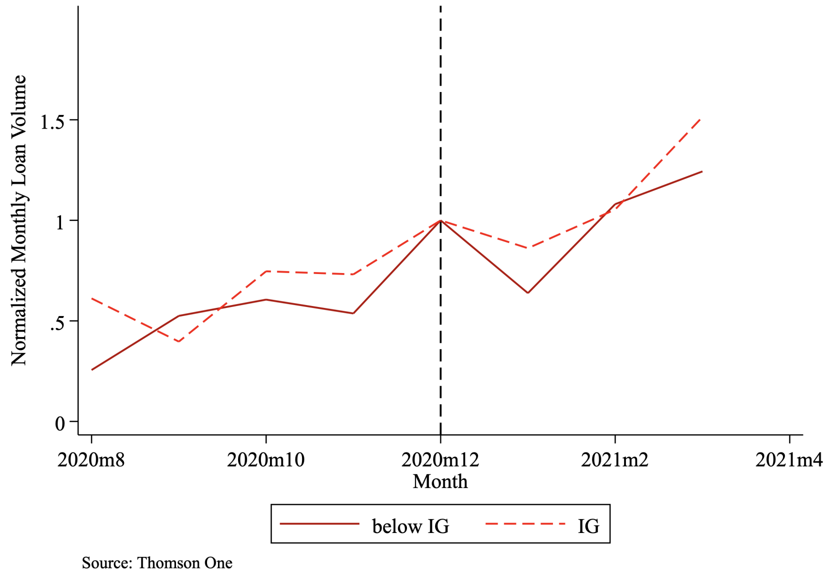


Figure D.11: Lending by non-CCAR banks around December 2020

Next, I collapse investment grade and non-investment grade lending by bank and month and then compute the ratio of new risky, i.e. below investment-grade lending, to total new lending:

$$\theta = \frac{\textit{Below IG Lending}_{it}}{\textit{Below-IG Lending}_{it} + \textit{IG Lending}_{it}} \tag{17}$$

Figure D.12 reports the empirical CDF of θ for 2020 Q3 and Q4 compared to 2021 Q1. We can see that after the liberalization of payouts, the new empirical CDF comes close to first-order stochastically dominating the pre-reform empirical CDF. Economically, this implies that across the distribution, banks select slightly riskier lending portfolios.

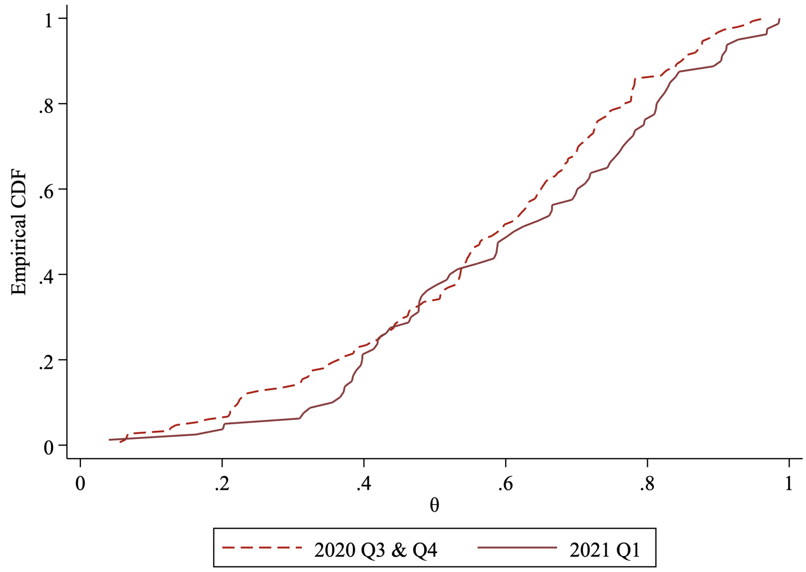


Figure reports $\theta = \frac{\textit{Below IG Lending}_{it}}{\textit{Below-IG Lending}_{it} + \textit{IG Lending}_{it}}$, the fraction of below-investment grade syndicated lending to total syndicated lending for CCAR banks. Dashed line reports θ for 2020 Q3 and Q4, solid line reports θ for 2021 Q1. Data is from Thomson One.

Figure D.12: Empirical CDF of θ across CCAR-banks

D.9 Eurozone 03/27 DiD Plot

Figure D.13 repeats the exercise in the Eurozone comparing the ECB-supervised banks to the entire non-financial sector (SIC codes not between 6000 and 6999) around March 27.

D.10 Details for Government Savings Calculation

D.10.1 Accounting

Here, I use data from the aggregate balance sheet of all CCAR banks to obtain the amount of equity, fully insured deposits, partly insured short-term debt and long-term debt:

June 25, 2020 Table D.14 contains balance sheet variables for the aggregate of the domestic CCAR banks:

December 18, 2020 Table D.15 contains balance sheet variables for the aggregate of the domestic CCAR banks:

D.10.2 Mapping to data

I map this to my framework as follows:

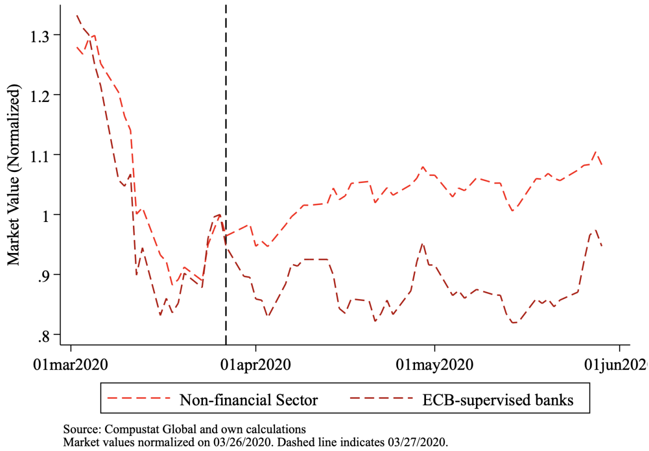


Figure reports market values for ECB-supervised banks (solid line) and non-financial firms (dashed line, excludes SIC codes 6000 - 6799). Market values are normalized to one on 03/26/2020. The vertical dashed line indicates 03/27/2020. Source: Compustat Global and own calculations.

Figure D.13: Robustness for DiD Plot

Aggregate B/S of domestic CCAR Banks after 2020Q1 (in billion $)	
16460 (Total Assets)	5202 (Insured Deposits)
	4385 (Uninsured Deposits)
	3732 (Other Debt)
	1438 (LT debt)
	1559 (Equity)

Total Assets and Equity from FR-Y9C. Deposit information from Call Reports. All quantities in billions of US dollars.

Figure D.14: Balance Sheet 2020 Q1

$$\begin{aligned} EV &= \textit{Equity} \\ DV^{fullyinsured} &= \textit{Insured Deposits} \\ DV^{ST,partlyinsured} &= \textit{Uninsured Deposits} + \textit{Other Debt} \\ DV^{LT} &= \textit{LT debt} \end{aligned}$$

Calculations for June 25, 2020 This gives me the following:

$$\begin{aligned} \Delta EV &= \textit{2\% x EV} = \textit{31.1} \\ \Delta DV^{LT} &= \textit{.045 \% x 6.35 x 1438} = 4.11 \\ \Delta DV^{ST,partlyinsured} &= \textit{.02 \% x 8117} = 1.62 \end{aligned}$$

Finally, I exploit the following two equations implicit in Equation 14:

Aggregate B/S of domestic CCAR Banks after 2020Q3 (in billion $)	
16672 (Total Assets)	5605 (Insured Deposits)
	4550 (Uninsured Deposits)
	3560 (Other Debt)
	1357 (LT debt)
	1560 (Equity)

Total Assets and Equity from FR-Y9C. Deposit information from Call Reports. All quantities in billions of US dollars.

Figure D.15: Balance Sheet 2020 Q3

$$\Delta DV^{ST,partlyinsured} = (1-\phi^{ST})\frac{\Delta EV}{DV} DV^{ST,partlyinsured}$$

$$\Delta DV^{LT} = (1-\phi^{LT})\frac{\Delta EV}{DV} DV^{LT}$$

Calculations for December 18, 2020

$$\Delta EV = \textit{2.7\% x EV} = 41.99$$

$$\Delta DV^{LT} = \textit{.049 \% x 6.35 x 1357} = 4.22$$

$$\Delta DV^{ST,partlyinsured} = \textit{.02 \% x 8110} = 1.62$$