Payout Restrictions and Bank Risk-Shifting

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Abstract

What are the effects of payout restrictions on bank risk-shifting? To answer this question we exploit the restriction policies imposed during the COVID-crisis on US banks as a natural experiment. Using a high-frequency differences-in-differences empirical strategy, we show that, when share buybacks are banned and dividends restricted, banks' equity prices fall while their CDS spreads and bond yields decline. These results indicate that payout restrictions shift risk from debtholders into equityholders. Consistent with a risk-shifting channel, we find that these effects revert once restrictions are lifted. Moreover, banks that are ex-ante more reliant on share buybacks than dividends in their payout policies, decrease risk-taking relative to banks that are ex ante more dividends reliant, with those effects reverting when the restrictions are relaxed. These results indicate that payout and risk-taking choices are complementary and that regulatory payout restrictions endogenously affect bank risk-shifting incentives.

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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 raised concerns on excessive risk-taking. By paying out safe cash flows, managers and shareholders might shift risk from shareholders onto debtholders. Hence, the question looms on how to align incentives across the different claim holders of the firm. Restrictions on corporate payouts have been proposed as a way to limit risk-shifting motives. In this paper, we 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 enhancing banks resiliency amid the uncertain economic environment and concerns that large losses may materialize.

Beside being a tool to preserve banks' capital at times of stress, we argue that payout restrictions represent also a way to prevent the type of risk-shifting behaviors that emerged during 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 debtholders and shareholders. Yet, only shareholders run the bank and make decisions about payouts and risk-taking. High leverage, in turn, reinforces agency frictions. 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 own a claim on the remaining assets after the capital distribution. Government guarantees on deposits and expectations of government bailouts in times of crisis further increase the incentives to risk shift. Payout restrictions as a policy intervention can mitigate these 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, we analyze how payout restrictions affect bank equity and debt prices during the 2020 COVID-crisis and how payout restrictions affect risk-taking decisions in lending. First, we lay out a theoretical framework to analyze payout restrictions. Second, we test the theoretical predictions in the data.

The first part of the paper presents 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. We assume that payout restrictions are unexpectedly imposed by the regulator after asset and liability choices have already been made. In this setup, payout restrictions prevent shareholders from paying out cash if they are binding, hereby halting risk-shifting from shareholders onto debtholders.[1] 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 larger equity cushion that shields debtholders from default. In sum, our first hypothesis is that binding payout restrictions lower the value of equity.

The response of debt is theoretically ambiguous. If risk-shifting is at work, payout restrictions prevent the bank from paying out funds and transferring the risk of the remaining assets onto debtholders. In that case, the debt value increases while the equity value declines. Alternatively, payout restrictions may convey the regulator's private information and signal to the market that bank assets are worse than previously thought. This argument reflects a potential negative news effect on both debt and equity values. Thus, the response of debt provides evidence regarding which channel is dominating. Consequently, our second hypothesis is that the bank debt value should appreciate following the imposition of the payout restrictions if the risk-shifting channel dominates, while it should depreciate if the negative news channel dominates.

Risk-shifting can occur via two margins: on the liability side through payout (and thus leverage) decisions and on the asset side through taking on riskier investments whose payoff structure favors equityholders. To analyze the joint choice of payout and risk-taking policies, we extend the model and allow the bank 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 certain threshold, an unrestricted bank would select high payouts and the riskier assets; however, when restricted in its ability to pay out, the bank would reduce risk-taking on the assets side.

To test these hypothesis empirically, we 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. Our 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 prices data and an event-study methodology, we document that the CCAR banks lose more than 2% in equity value relative to a control group

[1]Agency frictions à la Jensen and Meckling (1976) can also arise from frictions between shareholders and managers. This paper abstracts from such frictions and focuses on agency conflicts between shareholders and debtholders.

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 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 payout restrictions were largely unanticipated and not fully priced in ex-ante.

Since the announcements on payout restrictions were released after regular stock market trading hours, when liquidity of smaller stocks is low, the control group is wide and includes non-financial firms. A natural question is whether the observed announcement effects are driven by a different behavior of banks versus non-financial firms, rather than by the subset of CCAR subject to the restrictions. To mitigate this concern and, additionally, provide evidence for persistence in the equity responses, we implement the Campbell et al. (2012) cumulative abnormal returns methodology over a wider horizon and restrict the control group to smaller publicly listed banks. The differential response of equity prices of CCAR banks relative to those of smaller banks persists over the 10 trading days after the announcements and slightly strengthens over time. This tighter identification reveals that the results in the high-frequency event-studies are not driven by the selected control group nor by the different market microstructure in after-hours trading.

To test our second hypothesis and resolve the identification challenge between risk-shifting and the negative news channel, we use data on unsecured debt values, as captured by CDS spreads and corporate bond yields, to perform a series of event studies comparing CCAR banks to a control group of financial firms. Focusing on unsecured debt ensures that we remove valuation effects coming from the collateral backing debt or, in the case of convertible bonds, the value of equity. In the event-study regressions, we find that daily CDS spreads fall by 2 basis points for CCAR banks relative to other financial firms when payout restrictions are imposed on 06/25/2020 and, conversely, rise by 1 basis point relative to the control group 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 when the restrictions are announced and rise when the restrictions are relaxed.

Next, we analyze whether payout restrictions interact with risk-taking decisions of banks. Shareholder-debtholder conflicts affect not only the liability side of banks' balance sheets, but also the asset side through asset substitution between safer and riskier assets (Acharya et al., 2017). The exogenously imposed payout restrictions by the Federal Reserve provide an ideal laboratory to study risk-shifting on both sides of banks' balance sheets. In terms of data, the ideal data source to examine this question is the Federal Reserve's Y-14Q collection, which provides, among others, detailed information on the lending portfolio of large banks. Since this data covers banks subject to the supervisory stress tests only, we need to identify a metric capturing the intensity of payout restrictions within the set of CCAR banks. To this end, we exploit specific features of the payout restrictions under study, namely the fact that share buybacks are fully banned, whereas dividend payouts are only capped. This means that banks that were ex-ante more reliant on share buybacks relative to dividends for the purpose of paying shareholders were effectively more constrained by the restrictions than banks that primarily relied on dividends. We, thus, exploit this heterogeneity to test if CCAR banks with a higher ex-ante reliance on share buybacks decrease lending to riskier borrowers relative to CCAR banks with a lower ex-ante reliance when the payout restrictions are introduced, and vice versa when the restrictions are lifted.

Using data on new originations from the corporate loan schedule H1 of the Federal Reserve's Y-14Q and a triple differences-in-differences specification, we show empirically that banks more reliant on share buybacks in their payout policies prior to 2020 grant 3.8% smaller loans to firms with a one standard deviation greater probability of default relative to bank with an ex-ante lower propensity to use share buybacks. This effect reverts when payout restrictions are lifted and banks with a greater ex-ante reliance on share buybacks grant 9.7% larger loans to firms with a one standard deviation larger probability of default compared to the other banks. Our results indicate that payout restrictions are effective in limiting banks' risk-taking incentives, hereby improving their equity buffers in times of crisis. At the same time, these findings are in contrast with a risk management channel à la Froot et al. (1993), which suggests that a higher availability of relatively cheap internal funding should incentivize risk-taking.

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 these four, both theoretically and, in particular, empirically. Acharya et al. (2011), Acharya et al. (2016), and Acharya et al. (2017) propose policies resembling a covenant with automatic payout restrictions when certain thresholds are crossed due to moral hazard concerns (Acharya et al., 2016) and the externalities from bank payout policy (Acharya et al., 2017). Vadasz (2021) shows that payout restrictions suffer from a time inconsistency problem that may limit their usage to sufficiently bad states. Acharya et al. (2017), Floyd et al. (2015) and Hirtle (2014) document payout patterns for the 2008 financial crisis. We contribute to this literature by estimating the quantitative effects of payout restrictions on 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. Our model exhibits a similar feature while considering the specific policy of payout restrictions and the complementarity between payout restrictions and risk-taking. 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 we consider a prudential regulatory tool: payout restrictions.

Second, our 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 while Fahlenbrach et al. (2024) show how regulation and politics drive large lower-frequency changes in bank payout policy. Our paper provides evidence from a direct regulatory intervention regarding payouts in the banking sector. Recently, the literature on payout policy has seen a revival with a focus on explaining aggregate trends (Farre-Mensa et al. (2020), Kahle and Stulz (2020), Kroen (2021), Ma (2019), Mota (2020)). This paper complements the literature by analyzing the effects of payout restriction policies with a pure focus on the banking sector, risk-shifting incentives, and risk-taking effects in lending decisions.

Finally, this study adds to the 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). Mücke (2023) discusses the impact of payout restrictions on banks' investor composition. Hardy (2021) considers payout restrictions internationally while Ampudia et al. (2023) and Sanders et al. (2024) focus on the Euro area, showing that overall lending of banks subject to the payout restrictions increases, and embed the restrictions in a dynamic equilibrium model (Ampudia et al., 2023). Our paper adds high-frequency identification for the United States ruling out concerns about other industry-wide shocks from both the imposition and subsequent relaxation of the payout restrictions, theory and empirical evidence for redistribution between bank shareholders and debtholders, and a detailed analysis of the impact of payout restrictions on banks' risk-taking decisions using loan-level data. The loan-level analysis highlights that the composition of lending is affected by the payout restrictions, which has important macroprudential implications. Relative to Dautovic et al. (2023), who analyze credit provision after the introduction of payout restrictions in the Euro area, we focus on the risk-taking margin. While they show some evidence on lending to distressed firms with recent impairments, we analyse bank risk-taking for the full universe of firms using as an ex-ante metric of risk (the probability of default estimated by the bank). Moreover, we focus on new loans to precisely measure active risk-taking, rather than changes in the stock of loans which may also capture the passive expiration of existing loans.

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.

We 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 (e.g. FDIC deposit insurance). Second, we 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, we 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, we 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 $t = 0$. we assume that there is non-trivial ex-ante default risk: $\ell \in [c + \underline{a}, c + \bar{a}]$. Finally, the bank equityholders 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:

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

Bank	
Cash c	Liabilities ℓ
Assets a	

Figure 1: Bank Assets and Liabilities

for the bank is its dividend[2]. For tractability, we 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 equityholders to realize the franchise value V.

Finally, we assume that there is a government guarantee on debt, which captures in reduced-form explicit and implicit public sector guarantees on banks' liabilities.[3] If the bank fails to meet its solvency threshold, that is $a < \hat{a}(d)$, debtholders' loss is given by $\ell + d - c - a$. Fraction $\phi < 1$ of the loss is reimbursed to debtholders through the public sector guarantee.

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:

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

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

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

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

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

[3]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.

corner solution. The corner depends on a threshold V^* that is increasing in ℓ, which one can interpret as leverage, because more levered banks face greater risk-shifting incentives. Since several CCAR banks are among the most levered banks in the United States[4], one can interpret proposition 2.1 as that the CCAR banks would choose high payouts in the absence of regulatory intervention, a pattern we 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, we 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. We 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.

[4] https://www.federalreserve.gov/publications/2023-october-financial-stability-report-leverage.htm

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.

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

Proposition 2.5 shows how payout restrictions would affect the expected transfer from the government to bank 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. Importantly, 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, we 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, we partly endogenize risk-taking on the asset side. This allows us to study theoretically the interaction between risk-shifting incentives on the liability side of banks' balance sheet and on the asset side. On the liability side, shareholders can risk-shift through payouts, which affect bank leverage. On the asset side, shareholders can risk-shift by taking on riskier projects, whose payoff structure benefits shareholders at the expense of debtholders.

We extend the model by allowing the bank to select, at no cost, 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. We 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, 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.

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 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 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.

3.1.1 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, we remove foreign banking organizations (FBOs) since regulation and payout restrictions in their home countries, where the parent organizations are based, are critical for them. Throughout, we will refer to this sample of 20 domestic BHCs subject to the CCAR as "CCAR banks".

3.1.2 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. These restrictions would be re-evaluated on a quarterly basis in light of economic uncertainty. ”As a result, a bank cannot increase its dividend and can pay dividends if it has earned sufficient income.”[5]

The restrictions uniformly affected all CCAR banks and were the first time that the Fed issued wide-ranging payout restrictions across all CCAR banks. In the announcement, 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. Appendix D provides further anecdotal evidence. This announcement represents the first natural experiment to be exploited in the empirical analysis.

3.1.3 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.[6] 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 quarter.

While total payouts were still capped by average quarterly earnings after the 12/18/2020 announcement, it is worth noting that the highest payout ratios prior to Covid hovered around 1.2 times the value of net income and that the bulk of bank payouts occurred via share buybacks, not dividends. Hence, the relaxation of payout restrictions was substantial and the remaining constraints were not very binding.

We show in the next section that several banks restarted share buyback programs in 2021 Q1 following the relaxation of the previous restrictions. This evidence suggests that the payout restrictions were binding, at least for some banks, and effectively led banks to pay out less than what they would have done absent of the restrictions.

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[5] In particular: ”In light of these results, the Board took several actions following its stress tests to ensure large banks remain resilient despite the economic uncertainty from the coronavirus event. For the third quarter of this year, the Board is requiring large banks to preserve capital by suspending share repurchases, capping dividend payments, and allowing dividends according to a formula based on recent income. [...] The Board will conduct additional analysis each quarter to determine if adjustments to this response are appropriate.” https://www.federalreserve.gov/newsevents/pressreleases/bcreg20200625c.htm

[6] Appendix D provides several pieces of anecdotal evidence to support this notion. For example: “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

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

3.2 Main Hypotheses

Based on the model presented in the previous section, we formulate the following three hypotheses to test empirically.

Hypothesis 3.1. *The imposition of payout restrictions on US banks lowers their equity values and, conversely, the lifting the restrictions increases equity values.*

Equity values are predicted to decline after the imposition of payout restrictions under both the risk-shifting channel (Lemma 2.3) and the bad news channel (Proposition 2.6). Nonetheless, it is important to test the equity response for three reasons. First, if equity values change after the announcements, this suggests that the imposition of payout restrictions was not (fully) anticipated. Second, this would indicate that the potential benefit of payout restrictions for equityholders through lower costs of debt rollover do not play a prominent role.

Hypothesis 3.2. *If the payout restrictions primarily reflect bad news about bank assets, bank debt values should decline. If payout restrictions transfer risk from bank debtholders to equity-holders, debt values should appreciate when the restrictions are imposed and decline when the restrictions are lifted.*

The response of debt values allows us to separate between the risk-shifting channel identified in Proposition 2.2 and the bad news channel identified in Proposition 2.6. On the one hand, an increase in debt values after the imposition of payout restrictions would indicate that debtholders benefit from those policies, consistent with the idea of a risk redistribution between equityholders and debtholders, That is because the higher equity cushion driven by payout restrictions would provide more safety to bondholders, who only bear losses when equity is wiped out. On the other hand, a decline in debt values would provide support to the bad news channel, By restricting bank payouts, the Fed could be signaling its (negative) private information about future bank prospects to the market. Negative news about the value of bank assets would reduce the expected payoff of the bank while raising its default risk.

Hypothesis 3.3. *The imposition of payout restrictions reduces bank risk-taking while lifting the restrictions increases risk-taking.*

Hypothesis 3.3 derives from proposition 2.7. 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, these banks do not tend to operate close to their regulatory constraints, such as capital ratios, but rather keep a certain capital buffer. Consequently, we interpret 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.

Importantly, the complementarity between payout and risk-taking decisions has relevant implications for policy makers. Beside shoring up banks' equity buffers and, thus, reducing the likelihood of a default, payout restrictions have a second effect: they can reduce risk-taking incentives of banks. When payout restrictions are in place, equityholders have a higher stake in the bank if the franchise value is large enough. As a consequence, they may reduce their risk-taking behavior in order to increase the survival probability of the bank and secure the franchise value.

Overall, hypotheses 3.1 - 3.3 highlight two potential financial stability benefits from restricting bank payouts during a crisis period. First, capital buffers rise when restrictions bind, hereby forcing banks to retain earnings that otherwise would have been paid out. Second, banks may endogenously cut back on their risk-taking, hence, lowering their risk-weighted assets. Higher capital and lower risk-weighted assets both lead to higher risk-based capital ratios.

3.3 Data

We test our hypotheses using granular data on equity values, debt values, and bank lending.

To test hypothesis 1 about the impact of payout restrictions on equity values, we use US stock-market data from TAQ and CRSP. TAQ has tick-by-tick data for the major American stock exchanges (NYSE, NASDAQ, AMEX), reported with millisecond timestamps. When proceeding with the estimation, we aggregate this data by the minute, using the average stock price for each firm within a given minute. This time aggregation allows for the inclusion of time fixed effects for each minute in the econometric specification to absorb any time-varying macro factors affecting the dynamics of stock prices. We use TAQ data over a 2-hour time window (4pm to 6pm Eastern) on 06/25/2020, 12/18/2020 and 03/25/2021. For ease of comparison, we normalize the price to one for all stocks at 4.00 pm Eastern. As for CRSP, we use daily quotes on US stock prices.

For stock market data covering the Eurozone and the UK, we use Compustat Global Security Daily. This contains daily stock prices for publicly traded firms worldwide.

Next, to test hypothesis 2 about the debt response, we use data on credit default swap (CDS) pricing from IHS Markit and data on secondary market corporate bond transactions from TRACE. TRACE contains daily summaries of bond trades for corporate bonds at the CUSIP level. We complement this data with information on the size of the issuance from Mergent FISD. Data construction is described in Appendix A.4.

The reason why we look at credit-default swap (CDS) beside bond prices to analyze changes in debt values is because not all corporate bonds are traded on a daily basis and prices in the OTC corporate bond market partly depend on liquidity conditions and buyer/seller identities, In addition, CDS spreads provide a more clean measure of credit risk relative to corporate bond prices, as the latter embed a liquidity risk premium as well. Another advantage is that 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 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. Importantly, we only keep CDS spreads for senior unsecured debt. This ensures that the CDS response we measure is not driven by valuation effects pertaining to the value of the underlying collateral, in the case of secured bonds, or the value of equity, in the case of convertible bonds.

Data on balance sheet variables comes from the Federal Reserve's Y-9C data and Compustat. The FR Y-9C data provides great detail of information on bank balance sheets and income statements at the bank holding company (BHC) level.

Finally, to test our third hypothesis about bank risk-taking, we rely on the Federal Reserve's Y-14Q data. This data is collected to support the Dodd-Frank Act Stress Tests (DFAST) and the Comprehensive Capital Analysis and Review (CCAR). The data includes detailed information on various asset classes, capital components, and categories of the pre-provision net revenue (PPNR) for banks subject to the supervisory stress tests on a quarterly basis. The respondent panel includes all U.S. bank holding companies, intermediate holding companies of foreign banking organizations, and savings and loan holding companies exceeding \$100 billion in total consolidated asset.[7] We use the corporate loan schedule H1, which covers commercial and industrial (C&I) loans exceeding \$1 million in committed amount. In contrast to other data sources on corporate credit, such as DealScan or the Shared National Credit Program (SNC), which report syndicated loans only, the FR Y-14Q data is characterized by a much broader coverage, including loans to small businesses (see Chodorow-Reich et al. (2022) and Greenwald et al. (2020)). We drop banks that entered the panel of respondents after 2019-Q4 and start from a similar sample of banks as in Chodorow-Reich et al. (2022). Since foreign banks were primarily affected by payout restrictions in the jurisdictions where their parents are located, we also drop foreign CCAR banks, leaving us with a balanced panel of 20 banks. The data contains rich loan-level characteristics including size, interest rate, maturity, origination date. and, importantly for our analysis, the internal probability of default (PD) assigned by the bank to the borrower. In addition, it includes information on firm conditions from borrowers' financial statements on a yearly basis or at origination/renewal of the loan. We restrict the data to new loan originations and non-financial borrowers. Finally, we aggregate the loan-level data at the firm-bank relationship level within each quarter.

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

3.4 Summary Statistics

Tables 1 and 2 report summary statistics for the high-frequency tick-by-tick TAQ data. Each table summarizes the data for all listed stocks in the 4.00 pm ET to 6.00 pm ET time window. Although this time window is outside of regular market hours (the regular market

[7]The size threshold was increased from \$50 to \$100 billion in 2020Q2.

closes at 4.00 pm ET), there is significant trading activity in the after-hours market. For June 25, 2020 there are 57295 observations. On December 18, 2020 there are 85372. Hence, there is a sufficient amount of observations to estimate the impact of the announcements about the Fed's payout restrictions over a narrow high-frequency time window. While the after-hours market skews towards larger and more liquid stocks, the market value of a company at the 10-th percentile of the size distribution is around $30 million on June 25, 2020 and around $85 million on December 18, 2020.

Variable	Obs	Mean	Std. Dev.	P10	P50	P90
Normalized Price	57295	1.001	.038	.986	1	1.011
Shares Outstanding in 1,000s	57295	410542	989621.1	12934	108796	951647
Size of Trade	57295	4541.726	32242.83	2	75	4692.5
Market Value in $1,000	57295	3.03e+07	1.30e+08	30186.69	1063632	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 1: 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	85372	368535.3	1044442	19022	99505	795350
Size of Trade	85372	24146.8	156202.9	3	125	18061.67
Market Value in $1,000	85372	3.20e+07	1.34e+08	89052.95	2746720	6.61e+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 2: TAQ Summary statistics; December 18, 2020

Summary statistics for the final lifting of the payout restrictions on March 25, 2021 are in Table C.2.

The second set of data for the analysis are CDS spreads from IHS Markit summarized in tables C.3 and C.4 for the period around 06/25/2020 and 12/18/2020 respectively. For the estimation, we will compare CCAR banks to other financial sector firms that are not subject to payout restrictions. Tables C.3 and C.4 show that CCAR banks on average have 40-60 basis points lower CDS spreads. Across the distribution of both CCAR banks and other financial sector firms, spreads decline by about 10-15 basis points on average between June and December 2020, reflecting the improvement in the economic outlook over that time period.

Table C.5 contains summary statistics for corporate bonds.

Finally, to test whether bank payout restrictions during the pandemic affected risk-taking behavior in lending, we use data from Schedule H1 of the Federal Reserve's Y-14Q combined with data from the Y-9C.

Panel A and Panel B of Table 5 contain summary statistics of new corporate loans extended by CCAR banks a the firm-bank level, as well as bank-level financial conditions around the introduction and subsequent relaxation of the payout restrictions. We focus on new loan

	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 3: 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 the 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 4: CDS spreads around 12/18/2020

originations rather than changes in the stock of lending of CCAR banks to examine their risk-taking behavior in a neat way, While banks may shift the risk profile of their lending portfolio by making decisions on i) new loans to grant and ii) existing loans to renew, existing loans may mature or be terminated without an extension also because of a borrower's decision that is independent from credit supply conditions.

The sample has a total of 32,196 quarterly firm-bank observations over the 2020Q1 - 2021Q2 period with an average loan volume of $ 30 million. The average firm has $12.9 billion of assets. However, there is sizable variation in the firms covered, with the 10th percentile being $3.5 million and the 90th percentile being $16.7 billion. Likewise, our key metric of risk, firms' probability of default displays sizable variation. The 10th percentile PD is 0.1% while the 90th percentile PD is 3.3%. This variation in PDs allows us to test whether banks change their risk-taking decisions when the restrictions are introduced and when they are lifted.

While our sample only consists of 20 banks, those are heterogeneous in size (with the mean being $809 billion, 10th percentile $139 billion, and the 90th percentile $2.4 trillion) and Tier-1 capital ratio (with the mean at 13%, the 10th percentile 10.7% and the 90th percentile

Panel A: Firm-Bank-Quarter Level								
	N	mean	st. dev.	10th pct	25th pct	median	75th pct	90th pct
Committed amount ($000,000)	32196	30.195	135.281	1.163	1.750	4.072	19.240	64.850
PD	27941	0.016	0.031	0.001	0.003	0.008	0.017	0.033
Interest rate	23806	0.030	0.015	0.014	0.021	0.029	0.037	0.046
Firm assets t-4 ($000,000)	21978	12,921.978	112,037.855	3.524	14.499	116.113	2,153.679	16,691.000
Firm ROA t-4 (%)	19049	7.479	8.161	(0.247)	2.045	5.424	10.680	18.874
Panel B: Bank-Quarter Level								
	N	mean	st. dev.	10th pct	25th pct	median	75th pct	90th pct
Bank assets t-1 ($000,000)	120	808,501.801	933,389.115	139,081.856	171,704.989	421,742.438	1,102,810.500	2,374,172.500
Bank ROE t-1 (%)	120	9.398	5.985	3.426	6.454	9.538	12.759	15.670
Bank Liquidity ratio t-1	120	0.135	0.099	0.038	0.073	0.106	0.156	0.315
Bank Tier 1 ratio t-1 (%)	120	12.972	2.113	10.658	11.167	12.638	14.354	15.433
Panel C: Bank Level								
	N	mean	st. dev.	10th pct	25th pct	median	75th pct	90th pct
Buyback/Payout (2017-19)	20	0.667	0.093	0.528	0.607	0.678	0.737	0.783

Table reports summary statistics for firm-bank-quarter credit relationships (Panel A) and bank-quarter level data around the introduction of the payout restrictions (Panel B) from 2020Q1 to 2021Q2. The lower number of observations for the probability of default, PD, compared to the committed amount on Panel A is due to one bank in the sample which does not rely on the internal rating based approach. Panel C reports average share buyback to payout ratio over 2017-19 for each bank in the sample.

Table 5: Summary Statistics of FR Y-14Q corporate loan data

being 15.4%). Finally, we exploit variation in pre-Covid buyback to payout ratios across banks calculated as 2017-19 averages. The 10th percentile bank conducted 53% of capital distributions via share buybacks (and 47% via dividends). At the 90th percentile, share buybacks dominated with a 78% share.

3.5 Estimation

We now outline the empirical specifications. We, first, examine how the imposition, and subsequent relaxation, of payout restrictions affect bank equity prices. We, next, focus on the impact on debt values. Lastly, we explore if the lending margin is affected.

3.5.1 Equity Response

To test hypothesis 3.1 about the equity response to the imposition and stepwise removal of payout restrictions onto US banks, we 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, we 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. we normalize P_{it} to 1 at 4.00 ET, e.g. divide by P_{it} at t = 4pm, 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. $\mathit{CCAR\ Bank}_i$ 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, Section 4.2.3 will provide evidence on daily equity market data with a tighter control group that only consists of publicly traded non-CCAR banks.

Equation 5 is a direct test of hypothesis 3.1, 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.

3.5.2 Debt Response

To test hypothesis 3.2 about the debt response, we rely 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. In particular, we estimate the following econometric model:

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

CDS spreads of 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 between a time dummy for each day and 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, we will estimate Equation 6 for all available frequencies of CDS spreads.

An alternative approach to test the effects on debt values consists in using data on corporate bond yields. In our baseline model we rely on CDS spreads data as those allow to capture default risk in a neat way, while corporate bond yields include a premium for liquidity risks. However, we present a series of robustness tests using data on corporate bond yields.

3.5.3 Effects on Risk-Taking in Lending

To test hypothesis 3.3 on the impact of payout restrictions on bank risk-taking, we use data from the corporate loan schedule H1 of the Federal Reserve's Y-14Q. We focus on new loan originations (aggregated at the firm-bank-quarter level) by US-based CCAR banks from 2 quarters before the introduction of the payout restrictions until 2 quarters after their lifting,

Our baseline model is a triple differences-in-differences specification with multiple treatments, one in June 2020 and one in December 2020. For the introduction of payout restrictions, we test if banks that are more affected by the restrictions cut their risk-taking after the June 2020 announcement relative to banks that were less affected. Conversely, when the restrictions are lifted, we test if banks that were more affected increase their risk-taking behavior after the December 2020 announcement relative to the other CCAR banks.

To this end, we estimate the model outlined in Equation 7:

$$log(Loans_{ibstc}) = \alpha_{b,t} + \alpha_{s,t} + \alpha_{c,t} + \beta_1 Post_t^{Jun2020} PD_{ibt} Z_i + \beta_2 PD_{ibt} Z_i + \beta_3 Post_t^{Jun2020} Z_i + \beta_4 PD_{ibt} Post_t^{Jun2020} + \gamma_1 \beta_1 Post_t^{Dec2020} PD_{ibt} Z_i + \gamma_2 Post_t^{Dec2020} Z_i + \gamma_3 PD_{ibt} Post_t^{Dec2020} + \delta_1 X_{i,t-4} + \delta_2 W_{b,t-1} + \epsilon_{ibstc} \quad (7)$$

$Loans_{ibstc}$ is the volume of new loans granted by bank b to firm i located in county c and operating in industry s in quarter t. $Post_t^{Jun2020}$ is a dummy for the period after the first regulatory announcement on June 25, 2020. $Post_t^{Dec2020}$ is a dummy for the period after the relaxation of the payout restrictions on December 18, 2020. PD_{ibt} is the probability of default of firm i at time t. Z_i is a measure of how constrained banks are by the payout restrictions. $\alpha_{b,t}$ is a bank-quarter fixed effect, $\alpha_{s,t}$ is an industry-quarter fixed effect, and $\alpha_{c,t}$ is a county-quarter fixed effect. $X_{i,t-4}$ are lagged firm-level controls (size, RoA). $W_{b,t-1}$ are lagged bank-level controls (size, RoE, Tier-1 capital ratio, liquidity ratio).

To measure which banks are more affected by the payout restrictions, we use banks' propensity to use buybacks (relative to dividends) as a means of paying out funds. Payout restrictions banned share buybacks for CCAR banks while dividends were capped at the minimum of past dividends and the average quarterly net income from the past 4 quarters. In practice, the binding constraint on dividends consisted in the fact that dividends could not be increased. Since the literature has long shown that firms smooth dividends (Leary and Michaely, 2011), banks that were ex-ante more reliant on share buybacks (relative to dividends) would be more constrained by the restrictions.

Concretely, we compute each bank's average buyback to total payout ratio for 2017-19 and run the triple-differences specification (7) with $Z_i = \overline{\frac{Buybacks_{it}}{Buybacks_{it} + Dividends_{it}}}_{2017-19}$, i.e., the average buyback to payout ratio over the time period 2017-2019. Since the payout restrictions affected more strongly those banks which disproportionately relied on share buybacks, we conjecture that these banks are more affected by the imposition and subsequent relaxation of the restrictions. Using the 2017-19 average ensures that we are capturing banks that have a consistently higher propensity to use share buybacks, rather than banks that idiosyncratically used more share buybacks in one particular time period. Narrow location-time fixed effects absorb variation in local demand conditions, which is particularly important during the pandemic.

The main coefficients of interest in this triple differences-in-differences specification are the coefficient on the interaction term of PD, post-policy change dummy, and banks' average buyback to payout ratio - β_1 and γ_1. β_1 captures any differential effect in bank risk-taking - measured as borrowers' PD - after the introduction of payout restrictions depending on banks' exposure to those policies. γ_1 measures any differential impact on risk-taking after the relaxation of restrictions.

Our methodological approach builds on the literature on differences-in-differences models with staggered or multiple treatments (De Chaisemartin and D'haultfœuille, 2023; Sun and Abraham, 2021). In our setup, the set of treated and control units is identical for both treatment periods, hereby allowing for a staggered differences-in-differences specification.[8]

4 Empirical Results for Payouts, Equity and Debt Prices

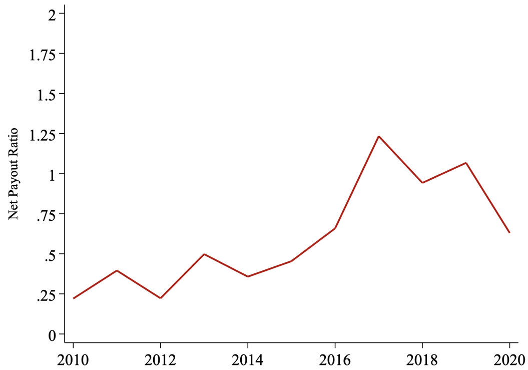
In this section we, first, provide an overview of CCAR banks' financials and payout decisions. Next, we show the results of the high-frequency event studies on equity prices and debt response.

4.1 Overview of CCAR banks

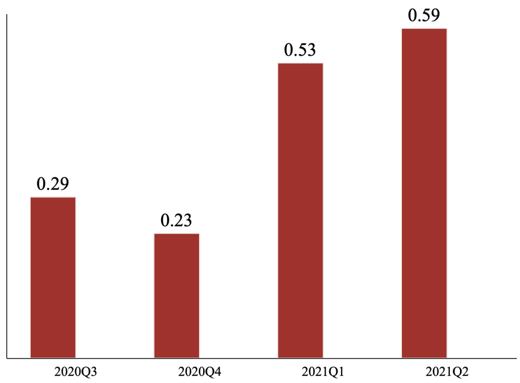
First, we provide an overview of CCAR banks' payout policy. The payout behavior around the announcements is informative because it reveals the direct impact of payout restrictions, or the "first stage". For the analysis, we define the net payout ratio for bank i at time t as follows:

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

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 comparable. In addition, this measure of net payout ratio can be simply interpreted. A net payout ratio of one means that a bank is paying out all of its net income to shareholders. A net payout ratio below one indicates that some earnings are retained, whereas a net payout ratio above one indicates a 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

[8]In other words, our staggered differences-in-differences model does not suffer from the "forbidden comparisons" bias described by Borusyak and Jaravel (2018).

Figure 2 reports the time series of the aggregate net payout ratio of CCAR banks since 2010 in the left-hand panel. Before the COVID-crisis, the aggregate net payout ratio hovers around 1, indicating that 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 aggregate net payout ratio from 2020Q3 to 2021Q2. It confirms that the net payout ratio is low on aggregate (0.29 and 0.23) in the two quarters when payout restrictions are in place. However, once restrictions are relaxed at the end of 2020, we observe a strong increase in the aggregate net payout ratio in the first two quarters of 2021. This is consistent with payout restrictions being binding and that their relaxation was followed by an increase in payouts. Figure E.1 confirms that our findings are robust and, if anything, strengthen when adjusting net income for the impact of loan loss provisions, which fluctuated significantly over the course of the pandemic.[9]

We also show in Figure E.2 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 perimeter. This further suggests that the increase in payouts by CCAR banks in early 2021 is driven by the lifting of payout restrictions and not by other macroeconomic or industry-specific factors.

Since earnings were not paid out, CCAR banks accumulated retained earnings during the period in which payout restrictions were in place. This, in turn, bolstered Tier-1 capital. Domestic CCAR banks exhibit a combined \$73 billion increase (or a 5.8% increase) in Tier 1 capital in 2020Q3-2020Q4, that corresponds closely to the decline in payouts to shareholders (Figure E.3). This was not accompanied by a rise in risk-weighted assets, implying that the Tier-1 capital ratio increased by .62 percentage points for the median CCAR bank (Figure E.4).[10] Upon the lifting of the restrictions, the median CCAR bank saw a 0.43 percentage point decline in its Tier-1 capital ratio over 20201Q1-20201-Q2 when share buybacks were resumed.

4.2 Equity Response

We now report the results our test of hypothesis 3.1 using Equation 1.

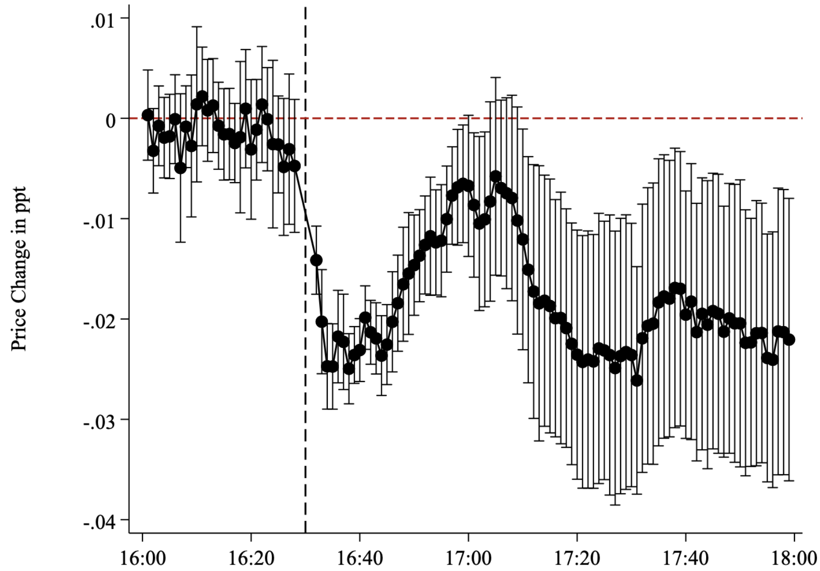
4.2.1 06/25/2020 - Imposing Payout Restrictions

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,

[9]Section E.12 further discusses the time series behavior of loan loss reserves.

[10]Assuming, as a counterfactual, that banks had continued to conduct share buybacks at the same rate as they did in 2019 (when the aggregate buyback to net income ratio for CCAR banks was 81%), CCAR banks would have held \$ 70.9 billion less Tier-1 capital, thus leaving their Tier-1 capital almost constant at its June 2020 level. Conversely, the relaxation of the restrictions was followed by a resumption of share buybacks in 2021 Q1 (USD 30.9 billion) and 2021 Q2 (31.9 billion). If these earnings had been retained, Tier-1 capital ratios would have been .32 percentage points higher in 2021 Q1 and .33 percentage points in 2021 Q2.

will be restricted going forward for an unspecified length of time. Figure 3 displays the results of our high-frequency event studies on equity prices. The vertical dashed line indicates the announcement time at 4.30pm ET:



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.

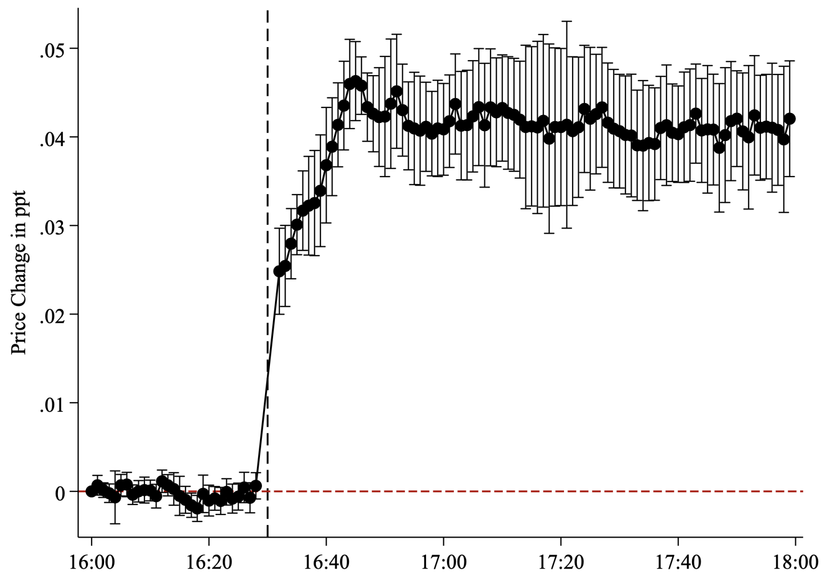
Figure 3: High-frequency Event Studies 06/25/2020 4.00 - 6.00 pm ET

Prior to the announcement, at this very high minutely frequency, CCAR banks and other stocks are trending in parallel, which provides strong support for the identifying parallel trends assumption. However, immediately after the announcement, stock prices fall by about 2% for CCAR banks relative to other stocks suggesting that the payout restrictions depress equity values. 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.

4.2.2 12/18/2020 - Lifting Payout Restrictions

The second event we exploit is the substantial lifting of the payout restrictions on 12/18/2020 by the Fed. As discussed earlier, the restrictions that remained after 12/18/2020 in place were not strongly binding. Figure 4 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 4, we



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

can corroborate the identifying assumption for the event studies that there is no pre-trend. This response contrasts sharply with the response of Euro area banks to the lifting of the Euro area dividend restrictions in late 2021, which appear to have been mostly price in ex-ante (Ampudia et al., 2023). The un-anticipated nature of the relaxation of the restrictions in the US provides us with a second laboratory to study the impact of payout restrictions on banks' risk-taking in section 5.2.

4.2.3 Abnormal Returns around Announcements

One concern about the event studies is that the control group also includes non-financial firms, which may not be a good control group. A second potential concern 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. To address these concerns, we 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. (2012), Acemoglu et al. (2016)). Estimation details are outlined in appendix E.5.

Table 6 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. 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)

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. Source: CRSP and own calculations.

Table 6: CAR after 06/25/2020 Weighted Regression (Banks only)

Table E.6 repeats the same exercise but without weighting regressions by size. The results are very similar. Tables E.7 and E.8 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.

We repeat the same methodology for cumulative abnormal returns following the announcement about relaxing the payout restrictions on 12/18/2020. Table 7 contains the results for the same size-weighted regressions comparing CCAR banks to the control group of smaller banks.

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 E.9, E.10 and E.11 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.

As a further robustness check, we re-estimate cumulative abnormal returns as outlined in equations 11 and 12 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

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)

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. Source: CRSP and own calculations.

Table 7: CAR after 12/18/2020 Weighted Regression (Banks Only)

are reported in Tables E.12, E.13, E.14, E.15 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. Section E.6 further shows that the differential impact on CCAR banks persists over the longer run.

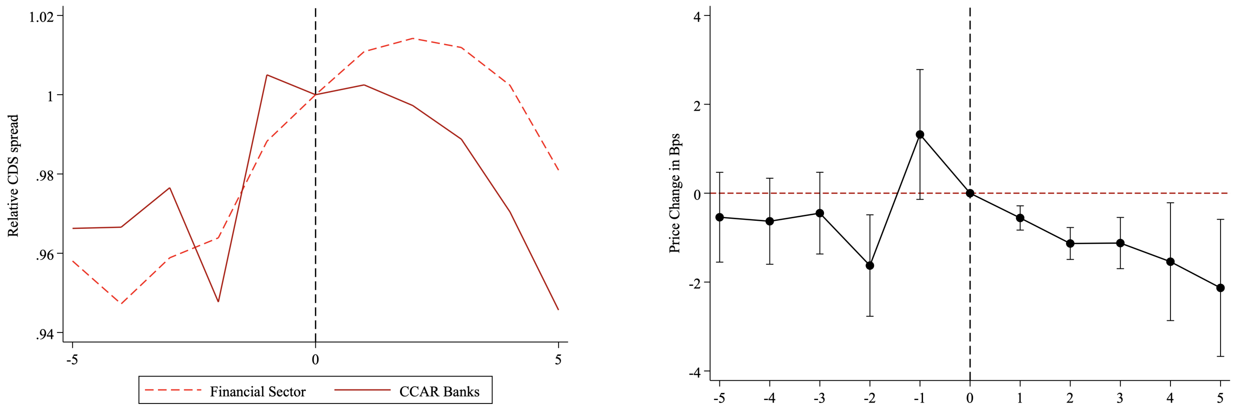
4.3 Debt Values

The decline in equity values could be explained by risk-shifting or by an increase in bank riskiness, reflecting negative news about bank assets. The debt response will now help to discriminate between those two explanations as outlined in hypothesis 3.2.

4.3.1 06/25/2020

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, we 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 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, we formally estimate Equation 6 and report the event-study coefficients with their 95 % confidence bands in Panel b).

CDS spreads trend mostly parallel prior to the announcement of the payout restrictions.



(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

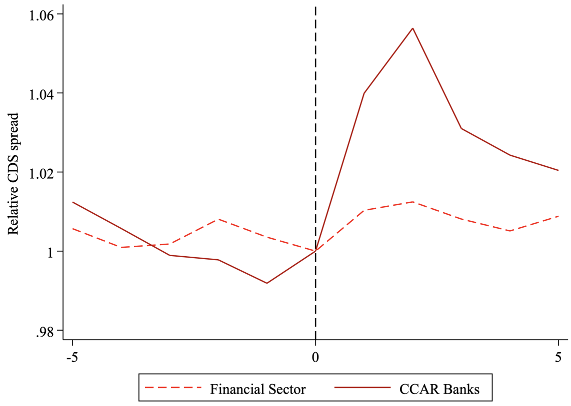
Following the announcement, however, the event study confirms the observation from panel a). CDS spreads fall significantly and differentially for CCAR banks relative to the control group of financial firms. Quantitatively, the effect is about 2 basis points after 5 trading days.

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 the dominant channel. 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 our 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, our results show that the risk-shifting effect dominates but it would have been even larger in the absence of the confounding news effect.

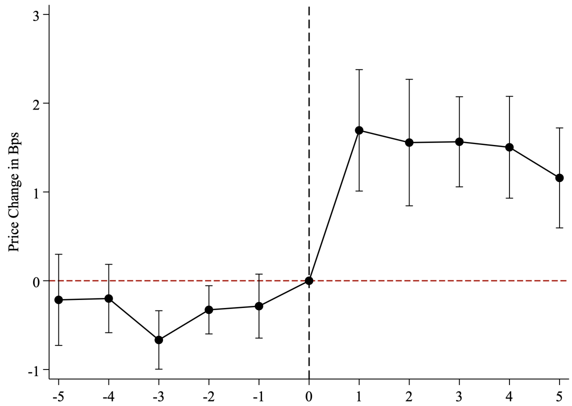
4.3.2 12/18/2020

Panel a) of Figure 6 plots CDS spreads by CCAR banks versus the remainder of the financial sector around the December 18 announcement. For the figure, we 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 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



(a) Raw Data



(b) Event-Study

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 6: Results for 5-year CDS Spreads

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 E.11 again reports the entire term structure of CDS spreads. The rise in CDS spreads affects all listed maturities.

4.4 Additional Results

Additional results are outlined in the appendix: Section E.3 discusses why an agency-theoretic explanation of the effects is unlikely. Section E.6 provides evidence on the persistence of the impact of the payout restrictions on CCAR banks as those continued to underperform for months after the restrictions were imposed.

On 03/25/2021, the Federal Reserve announced that the remaining restrictions would be lifted on 06/30/2021. Section E.7 shows that the equity response after the 03/25/2021 announcement was much smaller as compared to the equity response on 12/18/2020, which supports that the main lifting of the restrictions occurred on 12/18/2020.

Finally, section E.13 reports descriptive statistics for the Eurozone and for the UK, which show substantial banking sector under-performance relative to other financial sector firms after the imposition of payout restrictions in those jurisdictions. Those findings are consistent with the US results documented in the main paper and with the results in Mücke (2023).

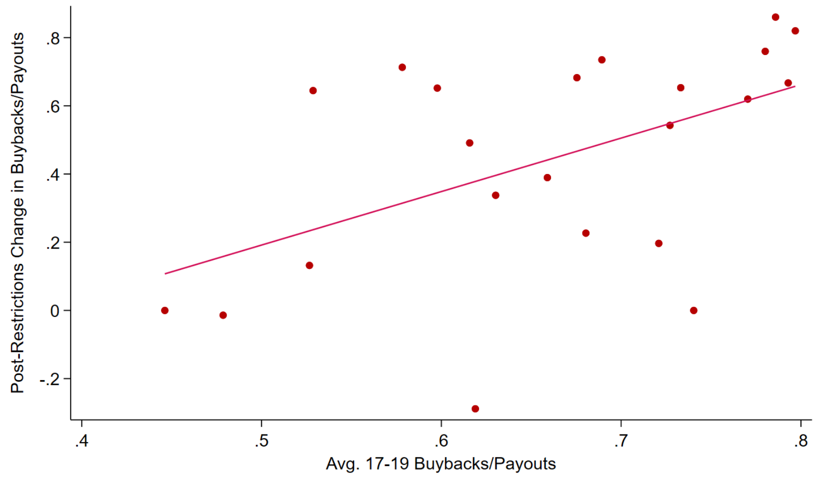
5 Empirical Results for Risk-taking Decisions

In this section, we investigate whether payout restrictions also affect banks' risk-taking decisions. This tests for the effect outlined in Hypothesis 3.3. When payout restrictions are imposed, this shifts risk from debtholders to shareholders and may thus induce shareholders to reduce risk-taking. Conversely, when 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 Heterogeneity in Payout Decisions

Testing whether the regulatory announcements about payout restrictions affect banks risk-taking decisions is empirically challenging because the restrictions affect all CCAR banks uniformly and the Y-14 data does not contain lending data for a control group of non-CCAR banks. To generate variation in the severity of the restrictions within the set of CCAR banks, we rely on the different treatment of share buybacks and dividends under the payout restrictions. While share buybacks are being banned, dividends are only capped. Moreover, dividends are well-known to exhibit stickiness (Leary and Michaely, 2011). Hence, we conjecture that banks that were ex-ante more reliant on share buybacks relative to dividends to pay out funds to shareholders are more affected than banks that primarily relied on dividends. As an example, take a hypothetical bank that only used dividends and was planning on keeping its dividend constant when the payout restrictions were announced. This bank would not be affected at all in its payout decisions. A bank that was only using share buybacks to pay out to shareholders would instead need to reduce payouts towards zero. Our measure for banks' ex-ante reliance on share buybacks relative to dividends is the average ratio of share buybacks to total payouts which we compute over the 2017-19 period, prior to the regulatory intervention in June 2020. Moreover, this measure, constructed over a 3-year time span, is not driven by idiosyncratic payout decisions in one particular quarter. The average bank had a 0.67 share of buybacks in total payouts, with the remainder (0.33) accounted for by dividends. The ex-ante share buybacks to payout ratio ranges from 0.53 (10th percentile) to 0.78 (90th percentile) (as documented in Table 5). Thus, there is sizable ex-ante variation in banks' propensity to use share buybacks relative to dividends.

If this measure indeed captures how constrained banks were by the payout restrictions, one would conjecture that when the payout restrictions are being relaxed those banks that were the most constrained, that is reliant on share buybacks, would increase their payouts differentially stronger than those banks more reliant on dividends. Hence, we plot the change in banks' buyback to payout ratio after the restrictions are relaxed (relative to the ratio under the restrictions) plotted against banks' ex-ante reliance on share buybacks measured by their average buyback to payout ratio over the 2017-19 period in Figure 7.



x-axis show average ratio of share buybacks to total payouts for domestic CCAR banks over the time period 2017-19. y-axis reports difference between 2021 buyback-to-payouts ratio and 2020 Q3 and Q4 buybacks-to-payout ratio. Each dot represents one domestic CCAR bank. Ratios are calculated using information on share buybacks and dividend payouts from the FR Y-9C and Compustat.

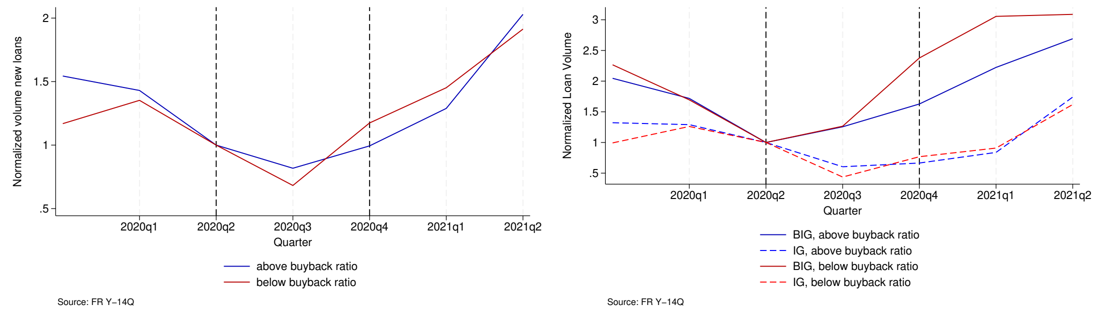
Figure 7: Ex-ante payout ratios and ex-post increase in buybacks

Figure 7 shows that the ex-ante share buyback to payout ratio at the bank level correlates with the bank-level increase in share buybacks after the relaxation of the payout restrictions (comparing 2021Q-Q2 to 2020Q3-Q4). Mathematically, the correlation coefficient is 0.51. This suggests that the ex-ante share buyback to payout ratio captures the extent to which banks were constrained in their ability to pay out while the payout restrictions were in place.

Next we sort banks by their average 2017-19 buyback-to-payout ratio and compare the evolution of bank lending around the introduction and relaxation of the payout restrictions in Figure 8: [11]

Panel a) shows that there is no overall differential impact on bank lending when comparing more restricted banks, with a high ex-ante reliance on share buybacks, to less restricted banks that were ex-ante less buyback-reliant. Hence, the graphical evidence suggests that the restrictions did not induce an aggregate credit crunch but rather a reallocation of lending (panel b)). As a result, lending to risky firms at buyback-reliant banks grew much less than lending to risky firms at not buyback-reliant banks while the restrictions were in place. This pattern reverted once the restrictions were removed in December 2020. Interestingly, and consistent with the risk-taking story, the reallocation of credit was almost entirely driven by below investment grade loans while investment-grade lending evolved nearly in parallel across banks. In the next subsection, we will test this formally.

[11] Figure F.17 reports a version of the figure without normalizing loan volumes



(a) Lending

(b) Riskiness of Lending

Panel a) reports time series of the aggregate volume of new loans extended by banks with an average buyback to payout ratio in 2017-2019 above and below the median, normalized to 1 in 2020Q1. Panel b) reports time series of the aggregate volume of new loans ii) investment grade and ii) below investment grade extended by banks with an average buyback to payout ratio in 2017-2019, respectively, above and below the median, normalized to 1 in 2020Q2. Investment grade loans are identified as those extended to firms with a probability of default below 5% as estimated by the bank; below investment grade loans are identified as those extended to firms with a probability of default above 5% as estimated by the bank. Data is from FR Y14-H1. BIG = below investment grade. IG = investment grade.

Figure 8: Lending around Regulatory Announcements

5.2 Empirical Evidence on Risk-Taking in Lending

To analyze risk-taking, we use quarterly loan-level data from Schedule H1 of the Federal Reserve's Y-14Q. Our sample consists of new facilities to capture the margin of active new risk-taking excluding loan renewals. Subsequently, we estimate the triple differences-in-differences specification 7 to test whether banks that were ex-ante more constrained by the restrictions adjust their lending to riskier borrowers differently from less constrained banks around the regulatory announcements on payout restrictions. We present a compact regression table here; Table F.18 contains more detailed results.

Table 8 reports estimated coefficients for the introduction and lifting of payout restrictions. Banks that are more constrained, as measured by their pre-2020 propensity to use share buybacks relative to dividends, are cutting back more on their risk-taking after the introduction of the payout restrictions. This effect reverses upon the lifting of the restrictions when banks that rely more on share buybacks increased their risk-taking differentially.

Concretely, a bank with a one standard deviation higher pre-2020 propensity to use share buybacks (.091) grants 3.8% smaller loans to borrowers with a one standard deviation (.035) greater probability of default after the payout restrictions are imposed (column 1). Results are fully robust to adding a bank fixed effect to the regressions (column 2). This absorbs time-invariant heterogeneity across banks, effectively only exploiting within-bank variation. Since our measure of banks' exposure to the payout restrictions is invariant at the bank-level, we prefer the specification in column (1).

Another concern is that banks may grant loans and subsequently dispose of them. If that margin would drive our results, one may worry that we are not measuring bank risk-taking but rather risk-taking by those institutions that banks sell loans to. Columns (3) and (4) show,

	(1)	(2)	(3)	(4)
Sample			Excluding disposed loans	
Dependent variable		log(committed amount)		
PD	2.796	4.258	3.733	4.987
	(2.44)	(2.56)	(2.56)	(2.72)
PD x IntroPolicy (20Q3-20Q4)	10.285***	10.122***	10.924***	10.960***
	(1.83)	(1.81)	(2.16)	(1.94)
PD x LiftPolicy (21Q1-21Q2)	-21.129***	-18.031***	-16.620**	-14.501***
	(3.68)	(2.55)	(4.35)	(2.52)
Buyback/Payout (17-19)	0.300		0.305	
	(0.65)		(0.62)	
PD x Buyback/Payout (17-19)	-6.966**	-9.457**	-8.651*	-10.699**
	(2.71)	(2.85)	(3.49)	(3.59)
IntroPolicy (20Q3-20Q4) x Buyback/Payout (17-19)	0.416***		0.483***	
	(0.09)		(0.11)	
LiftPolicy (21Q1-21Q2) x Buyback/Payout (17-19)	-0.355***		-0.243***	
	(0.05)		(0.03)	
PD x IntroPolicy (20Q3-20Q4) x Buyback/Payout (17-19)	-11.890***	-11.562***	-12.717***	-12.711***
	(2.25)	(2.55)	(2.37)	(2.51)
PD x LiftPolicy (21Q1-21Q2) x Buyback/Payout (17-19)	30.354***	26.151***	24.162**	21.181***
	(5.15)	(3.85)	(6.21)	(3.74)
N	14819	14818	14736	14735
R-sqr	0.5139	0.5265	0.5171	0.5288
Adj-R-sqr	0.4366	0.4466	0.4400	0.4489
Bank Controls	x	x	x	x
Firm Controls	x	x	x	x
County x Quarter FE	x	x	x	x
Industry x Quarter FE	x	x	x	x
Bank x Quarter FE		x		x

$***p < .01, **p < .05, *p < .1$. Table reports coefficients from staggered differences-in-differences regression for interaction of banks' buyback-to-payout ratio, borrower PD and a categorical variable identifying three periods (pre-policy, introduction of the policy, lifting of the policy). The pre-period covers 2020Q1-Q2, the introducion of the policy period covers 2020Q3-Q4, the lifting of the policy period covers 2021Q1-Q2. Standard errors are clustered by bank and quarter.

Table 8: Risk-taking around regulatory announcements

however, that our results remain comparable after removing disposed loans from the sample[12] suggesting that factors such as an increase in the demand for securitization do not drive our results.[13]

When the restrictions are being lifted, a bank with a one standard deviation greater propensity to use share buybacks (.091) grants 9.7% larger loans to firms with a one standard deviation (.035) greater probability of default. The effect its statistically and economically significant across all specifications. In particular, it is robust to the inclusion of bank fixed effects and to removing disposed loans from the sample. The latter is particularly important. Positive news about the pandemic and hence the economy during the second half of 2020 could positively affect the demand for loan securitization. In that case, banks may have faced more demand to sell riskier loans for securitization purposes. However, our results are economically comparable and similarly statistically significant when removing disposed loans suggesting that risk-taking on non-disposed loans was differentially affected by the lifting of the restrictions.

Jointly, the results from Table 8 and Figure 7 show that banks that were ex-ante more constrained by the introduction of the payout restrictions are both increasing payouts and risk-taking once the restrictions are being lifted. This is consistent with the theoretical prediction from hypothesis 3.3 that payout and risk-taking decisions can be complementary and that riskier banks may risk shift using both payout and risk-taking in lending.

Taken together with the results on the introduction of the payout restrictions, the overall results show that the payout restrictions do not only affect banks' payouts but also exert an effect on banks' risk-taking decisions. Banks that are more tightly restricted reduce their risk-taking relative to less restricted banks when restriction are introduced. And those same banks that were more restricted due to their higher ex-ante reliance on share buybacks subsequently increase their risk-taking differentially relative to banks that were less affected by the restrictions. In the future, regulators may therefore consider to weigh between the benefits of shoring up bank capital and the risk-taking effect of payout restrictions. Since riskier borrowers are more likely to lose access to credit during a severe downturn, the reduction in bank risk-taking could have unintended effects.

Finally, Figure F.19 reports results for a version of Equation 7 with the interest rate as the dependent variable. We use the interest rate rather than the spread because fixed rate loans do not have a spread. For the introduction of the payout restrictions, there is no statistically discernible effect on the interest rate. However, once the payout restrictions are being lifted, banks with

[12]For the specifications in columns (3) and (4), we remove all loans that are fully disposed within 2 quarters of origination.

[13]Differential ability to intermediate Paycheck Protection Program (PPP) loans could potentially explain our results. Yet, the PPP was rolled on April 3, 2024 - significantly predating the introduction of the payout restrictions. By June 2020, most first and second round PPP loans had already been isused and the share of new PPP loans exceeding the $1 million reporting threshold for the Y-14 data was below 5%, and even lower for the top 4 largest banks (s. Granja et al. (2022)). Moreover, even for the third round in early 2021, median 3rd quartile of the PPP loan distribution were below $100,000 (Fairlie and Fossen, 2022) Hence, PPP loans are likely only a small share of our data and banks' potentially heterogeneous ability to process PPP loans is unlikely to drive our results.

higher buyback-to-payout ratios not only increase lending to riskier firms differentially but the interest rates on these loans also decline differentially, even after controlling for the PD. These two results suggest an increase in risk-taking.

6 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, we further show that the introduction and removal of the payout restrictions affect lending decisions at restricted banks. When the restrictions are introduced, banks that are more affected - as measured by their ex-ante reliance on share buybacks relative to dividends - reduce their risk-taking relative to banks that are less constrained. Upon lifting the restrictions, riskier lending by more constrained banks increases by 9.7% for a one standard deviation increase in borrower PD relative to banks that were ex-ante less constrained. In sum, these results indicate that the payout restrictions not only reduce payouts but also curb risk-taking incentives while relaxing the restrictions is followed by an increase in payouts and greater risk-taking at those banks that were relatively more constrained.

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. 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.[14] This extends measures from the 1991 Prompt Corrective Action Procedure that imposes payout restrictions on US banks that breach capital ratios. Our paper highlights a potential trade-off between lower banking sector risk due to higher capital under payout restrictions and lower bank risk-taking

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

during a recession, which may cut off risky borrowers from credit. 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. we only keep trades from AMEX, Nasdaq and NYSE, the three major American stock exchanges. Observations are identified by their CUSIP. Next, we replace prices by bid-ask spreads for some observations where pricing data is not available.

A.2 TAQ

We 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. We 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, we proceed in two steps. First, we drop all trades that have been corrected later (variable TR_CORR $\neq 00$). Second, we 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. We 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

We access Compustat Global Security Daily from WRDS. We drop observations with missing ISINs, ETFs, mutual funds and US listings. We also drop firms with missing shares outstanding or firms with missing SIC codes. Finally, we 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, we first multiply shares outstanding with the daily closing price. Then we 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, we 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?4c3154a498837f7e7ccf8324ad6f7041. We 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. We 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, we 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. We merge this information with TRACE's daily summaries of corporate bond trading using the CUSIP identifiers. We drop bond trade summaries which cannot be identified precisely because either CUSIP or company ticker is missing. We further drop observations with product type "ELN", which are equity-linked notes.

To mitigate concerns about illiquidity of corporate bonds, we only keep those which have been traded on at least 200 distinct days between January 1, 2019 and September 30, 2020. We use closing yields (variable *close_yld*) as main measure of corporate bond interest rates. We 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. Some banks in our sample are involved in M&A transactions. We combined together 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 jointly formed Truist Financial.

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

A.6 FR Y-14Q

We use data from the corporate loan schedule H1 of the Federal Reserve's Y-14Q collection. We construct a unique firm identifier based on the tax identification number to link borrowers across banks and over time. We restrict the sample to loans defined as i) commercial and industrial (C&I) loans to U.S. addresses, ii) loans secured by owner-occupied nonfarm nonresidential properties, iii) loans to finance agricultural production, and iv) other leases, in schedule HC-C of the FR Y-9C. We exclude likely data errors such as credit exposures with i) a missing or negative committed amount, ii) a missing or negative utilized amount, or iii) loans in good standing with a utilized amount much larger than the committed amount at least in one observation. We also drop loans with a committed amount below the $1 million threshold throughout the sample. We limit the sample to a balanced panel of banks and we exclude borrowers identified as financial firms or real estate brokers. We correct errors related to the reporting units of financial variables. To account for the possibility that, for some large firms, the financial information reported corresponds to a subsidiary rather than the parent company, we only keep values corresponding to the observations with the largest firm total assets for each firm-quarter pair. We correct errors related to the reporting units of the probability of default and we discard observations where the probability of default is negative or above 0.9, to avoid entry mistakes and exclude borrowers considered as defaulted. We also exclude observations where the interest rate is negative or above 25%. For all firm financial variables, we trim values below the 5th percentile and above the 95th percentile. We exclude CCAR banks and restrict the sample to new loan originations. Since banks often extend multiple loans to the same borrower, we generate a weighted average interest rate and PD, with weights corresponding to the loan committed amount, for each bank-firm relationship in each quarter.

B Proofs of Theoretical Model

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, we 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 $\phi = 1$.[15] Re-arranging yields:

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

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:

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

Since, we 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,

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

disagreement between shareholders and debtholders follows immediately.

B.2 Proof of Proposition 2.4

Remember that debt value was given by:

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

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

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:

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

B.4 Proof of Proposition 2.6

Remember that equity and debt value are respectively given by:

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

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

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

Case 1:

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

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:

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

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 & 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 & 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 & 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 & 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 & 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 & (\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 & (-\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 & (\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:

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

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 we now analyse when the following two conditions hold:

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

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

$$\begin{aligned}
& \ell - \underline{a} - \frac{c}{2} + \epsilon > \frac{\ell^2 - \bar{a}\ell - \underline{a}\ell + \bar{a}\underline{a} - \frac{(\bar{a}-\underline{a})\epsilon}{2}}{2\ell - \bar{a} - \underline{a}} \\
\Longrightarrow \quad & (\ell - \underline{a} - \frac{c}{2} + \epsilon)(2\ell - \bar{a} - \underline{a}) > \ell^2 - \bar{a}\ell - \underline{a}\ell + \bar{a}\underline{a} - \frac{(\bar{a}-\underline{a})\epsilon}{2} \\
\Longrightarrow \quad & 2\ell^2 - 2\ell\underline{a} - \ell c - \bar{a}\ell + \bar{a}\underline{a} + \frac{\bar{a}c}{2} - \ell\underline{a} + \underline{a}^2 + \frac{\underline{a}c}{2} + \epsilon(2\ell - \bar{a} - \underline{a}) > \\
& \ell^2 - \bar{a}\ell - \underline{a}\ell + \bar{a}\underline{a} - \frac{(\bar{a}-\underline{a})\epsilon}{2} \\
\Longrightarrow \quad & \ell^2 - 2\ell\underline{a} - \ell c + \frac{\bar{a}c}{2} + \underline{a}^2 + \frac{\underline{a}c}{2} + \epsilon(2\ell - \bar{a} - \underline{a}) > -\frac{(\bar{a}-\underline{a})\epsilon}{2} \\
\Longrightarrow \quad & \ell(\ell - \underline{a} - c) - \ell\underline{a} + \underline{a}^2 + \frac{c(\bar{a}+\underline{a})}{2} + \epsilon(2\ell - \bar{a} - \underline{a}) > -\frac{(\bar{a}-\underline{a})\epsilon}{2} \qquad (9)
\end{aligned}$$

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 9 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 9, ignoring theϵ-term reduces to:

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

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 9 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 9 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 9 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 9 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 $(V3)$:

$$\ell - \underline{a} - \frac{c}{2} + \epsilon > \frac{\frac{(\bar{a}-\underline{a})\epsilon}{2} + (\ell - c - \underline{a})(\bar{a} - \ell + c)}{(\bar{a} + \underline{a} - 2\ell + 2c)}$$

$$\implies (\bar{a} + \underline{a} - 2\ell + 2c)(\ell - \underline{a} - \frac{c}{2} + \epsilon) > \frac{(\bar{a} - \underline{a})\epsilon}{2} + (\ell - c - \underline{a})(\bar{a} - \ell + c)$$

$$\implies \bar{a}\ell - \bar{a}\underline{a} - \frac{\bar{a}c}{2} + \underline{a}\ell - \underline{a}^2 - \frac{\underline{a}c}{2} - 2\ell^2 + 2\ell\underline{a} + c\ell + 2c\ell - 2c\underline{a} - c^2 + \epsilon(\bar{a} + \underline{a} - 2\ell + 2c) >$$

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

$$\implies -\frac{\bar{a}c}{2} - \underline{a}^2 - \frac{\underline{a}c}{2} - 2\ell^2 + 2\ell\underline{a} + 2c\ell - 2c\underline{a} + \epsilon(\bar{a} + \underline{a} - 2\ell + 2c) >$$

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

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

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

$$\frac{\bar{a}c}{2} - \underline{a}^2 - \frac{3\underline{a}c}{2} - \ell^2 + 2\ell\underline{a} + c\ell > 0$$

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

$$\Leftrightarrow \frac{(\bar{a} - \underline{a})c}{2} - \underline{a}c - \underline{a}^2 - \ell(\ell - c - \underline{a}) + \underline{a}\ell > 0 \tag{10}$$

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, we show that complementarity is exhibited if the leverage lower bound is given by $\underline{\ell} = \underline{a} + c$, then we look at the case where $\underline{\ell} = \frac{\underline{a}+\bar{a}}{2}$. Finally, we provide an implicit equation for $\bar{\ell}$. In the first two steps, we 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 10 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 10 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 10, 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 10. 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

Table C.2 summarizes the TAQ data for the high-frequency time window on 03/25/2021.

C.1 TAQ data

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.2: TAQ Summary statistics; March 25, 2021

C.2 CDS Data

Table C.3 and C.4 provide an overview for the CDS Markit data around the 06/25/2020 introduction of the payout restrictions and the 12/18/2020 lifting of the restrictions. Throughout, the average CCAR bank has lower CDS spreads than the average financial sector firm (excluding CCAR banks). For example, CCAR 5-year CDS spreads are on average 77 basis points around 06/25/2020 compared to 144 basis points for financial sector firms (excluding CCAR banks).

	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.3: 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.4: 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.5: Corporate Bond Trade Summary Statistics

D Narrative Evidence around Payout Restriction Announcements

This section provides narrative details from analyst reports, earnings calls, and Bloomberg about the market perception of the payout restrictions yielding two key findings. First, the restrictions were viewed as open-ended with no clear expiration date. Second, the lifting of the restrictions was viewed as contingent on pandemic developments. Third, the relaxation of the restrictions as early as December 2020 clearly came as a surprise to market participants. In sum, the restrictions were viewed as temporary, yet potentially longer-lasting.

The decision on payout restrictions on 06/25/2020 was surrounded by sizable uncertainty about their duration. One financial market participant noted that that ”[it] sounds like buybacks are not going to come back for a long time”.[16] Moreover, one Fed governor dissented from the decision, arguing to additionally ban dividends.[17] Hence, the future scope of the restrictions was potentially uncertain and a future tightening of the restrictions, not just an eventual relaxation, was considered by some policymakers.

Subsequent earnings calls do not provide conclusive evidence about banks' expectations for the duration of the restrictions beyond the previously stated results. During one 2020 Q2 earnings call, a bank CEO mentioned that ”the Federal Reserve stated it reserves the right to extend the limitations as it learns more about the evolution of the COVID event”[18], clearly highlighting that the restrictions were not viewed as permanent but instead as tied to the pandemic. One CCAR bank CFO was quoted as follows on the 2020 Q3 earnings call: ”And we expect a resume share repurchases, once permitted, consistent with our long-standing capital management policy.”[19]

The lifting of the restrictions as soon as 12/18/2020 also came as a surprise. Just hours before the lifting announcement by the Fed at 4.30pm ET, markets expected that ”the Fed is likely to keep a pandemic-induced halt on buybacks and caps on dividends.”[20] Analyst forecasts diverged as to how long the restrictions may remain in place. One analyst thought that the ”Fed won't allow more capital to be returned to shareholders until perhaps the third quarter of 2021”, another one expected that ”the status quo will be extended, with the Fed keeping existing limitations through at least the first quarter” but some ” [saw] the potential for buybacks as soon as April”.[21]

[16] See quote by David Ellison here: https://www.cnbc.com/2020/06/25/fed-puts-restrictions-on-bank-dividends-after-test-finds-some-banks-could-be-stressed-in-pandemic.html

[17] https://www.bloomberg.com/news/articles/2020-06-25/fed-caps-bank-dividends-bans-share-buybacks-through-september

[18] Charlie Scharf, Wells Fargo CEO, on the 2020 Q2 earnings call

[19] Stephen Scherr, CFO, on the 2020 Q3 Goldman Sachs earnings call.

[20] https://www.bloomberg.com/news/articles/2020-12-18/analysts-say-politics-may-outweigh-economics-in-fed-stress-tests

[21] https://www.bloomberg.com/news/articles/2020-12-18/analysts-say-politics-may-outweig

Once the relaxation of the restrictions was announced, this was viewed as an ”unexpected buyback clearance” and ”surprise decision”.[22]

h-economics-in-fed-stress-tests

[22] https://www.bloomberg.com/news/articles/2020-12-21/u-s-banks-jump-after-fed-loosens-share-buyback-restrictions

E Further Results

E.1 Further Evidence on Payouts

Figure E.1 re-computes the net payout ratio but adjusts net income for loan-loss provisioning. Specifically, we 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.

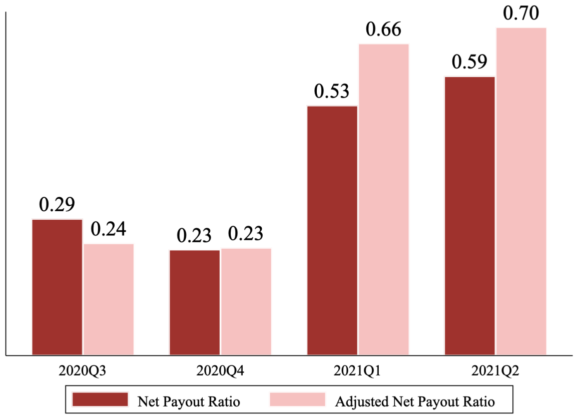


Figure reports net payout ratio for CCAR banks. Net payout ratio is defined as dividends plus net share buybacks, divided by net income. This figure is reported by dark red bars. Light red bars use adjusted net income which adjusts for the contribution of loan loss provisions to net income. Data is from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

Figure E.1: Net Payout Ratio 2020Q3 - 2021 Q2 (using adjusted net payout ratio)

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 E.2 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.

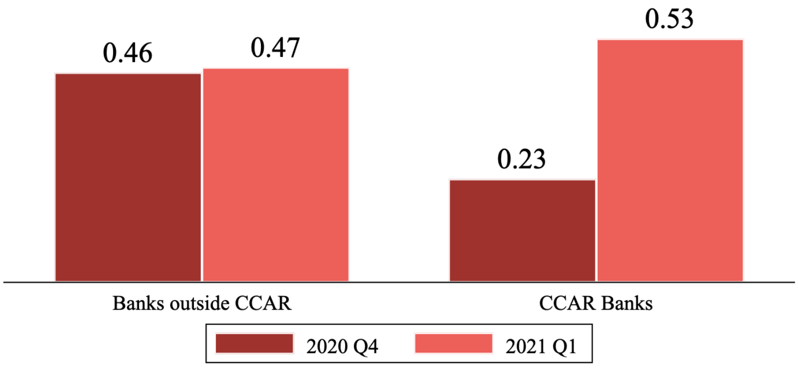


Figure reports net payout ratio for 2020 Q4 and 2021 Q1 for CCAR banks and largest 14 banks outside CCAR. Net payout ratio is defined as dividends plus net share buybacks, divided by net income. Data is from Compustat and FR Y9-C.

Figure E.2: Net Payout Ratio : CCAR banks vs. Others

E.2 Bank Capital around Payout Restriction Announcements

Figure E.3 shows that Tier-1 capital increased sizably by about $ 73 billion while the payout restrictions were in place, driven by an accumulation of retained earnings that bolstered bank equity. This increase in the level of bank capital was not offset by rising risk-weighted assets leading to an increase .62 percentage points in the Tier-1 capital ratio for the median CCAR bank while the payout restrictions were in place (E.4).

(a) CCAR bank Equity and Tier-1 Capital

(b) CCAR bank Net Income and Net Payouts

Figure reports sum of total equity, total Tier-1 regulatory capital, quarterly net income and quarterly net payouts for sample of domestic CCAR banks from 2019 Q1 to 2021 Q2. Data is from FR Y9C.

Figure E.3: Capital and Income Overview

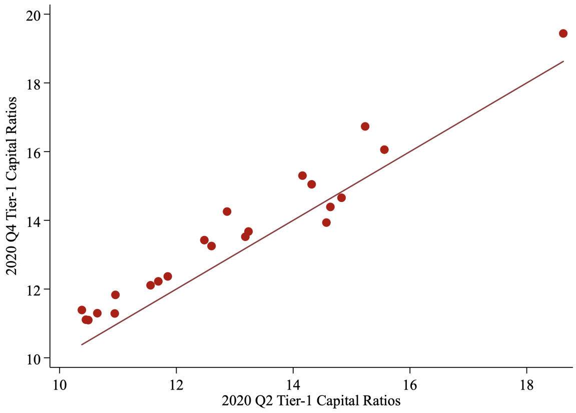


Figure E.4: Tier-1 Capital Ratios 2020 Q2 vs. 2020 Q4

E.3 Further Balance Sheet Variables

Figure E.5 reports the evolution of quarterly return on assets for CCAR and non-CCAR banks.

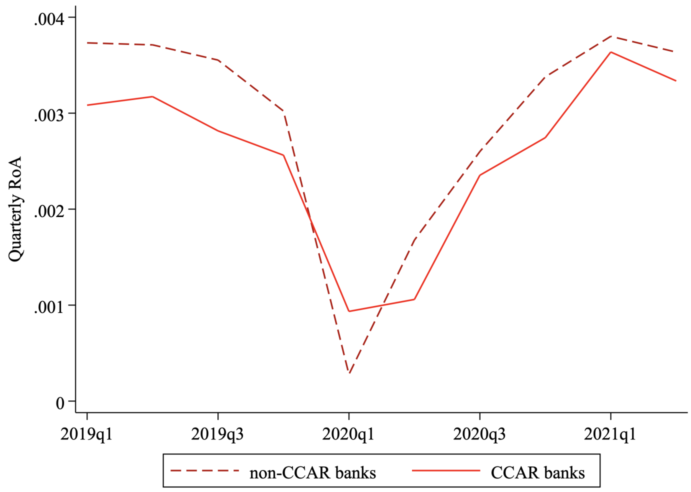


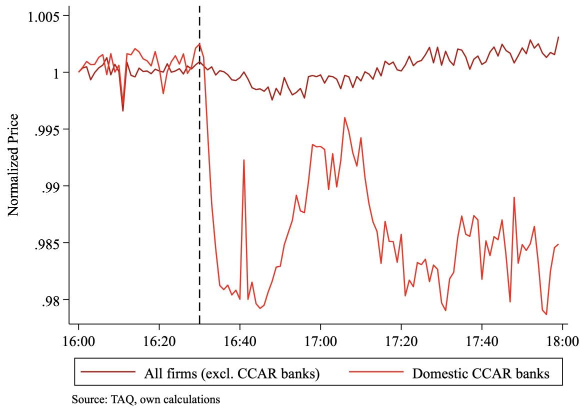
Figure reports return on assets for CCAR banks and largest non-CCAR banks. Profitability is defined as net income over total assets. Data is from FR Y9-C.

Figure E.5: Return on Assets

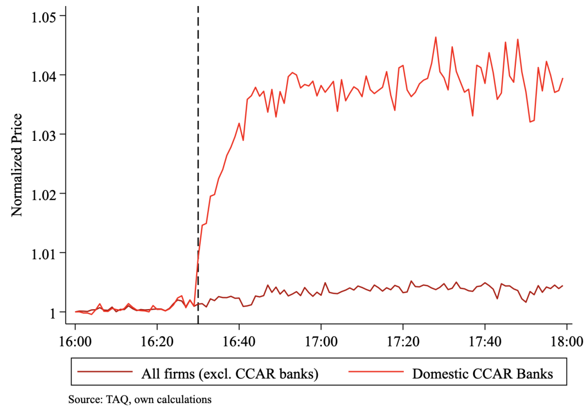
Profitability across CCAR banks and large non-CCAR banks evolves in parallel over the course of 2019 until 2021. In particular, RoA does not seem affected by the announcements of payout restrictions in June and December 2020. This suggests that agency cost theoretic explanations à la Jensen and Meckling (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.

E.4 Parallel Trends around Payout Restriction Announcements

This subsection shows that the parallel trends assumption for the equity price event studies holds in the raw data.



(a) 06/25/2020



(b) 12/18/2020

Figure reports stock price time series for domestic CCAR banks and for other firms excluding CCAR banks. Data is aggregated minute-by-minute and normalized to 1 at 16.00 ET. Data is from TAQ.

Figure E.6: Equity Market Parallel Trends Plots

Figure E.6 reports the time series of CCAR banks and other firms around the announcement time windows. The raw data series look strikingly similar to the estimate high-frequency event studies in Figures 3 and 4.

E.5 Cumulative Abnormal Returns Estimation

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

$$R_{it} = \alpha_i + \beta_i + R_{m,t} + \epsilon_{it} \tag{11}$$

$R_{m,t}$ denotes the market return on day t. Following the literature, we 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, we infer abnormal returns for the event window as the difference between actual returns and those predicted by Equation 11:

$$AR_{it} = R_{it} - (\hat{\alpha}_i + \hat{\beta}_i R_{m,t}) \tag{12}$$

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.

$$CAR_{it} \quad = \sum_{\tilde{t}=1}^{10} AR_{i,\tilde{t}} \tag{13}$$

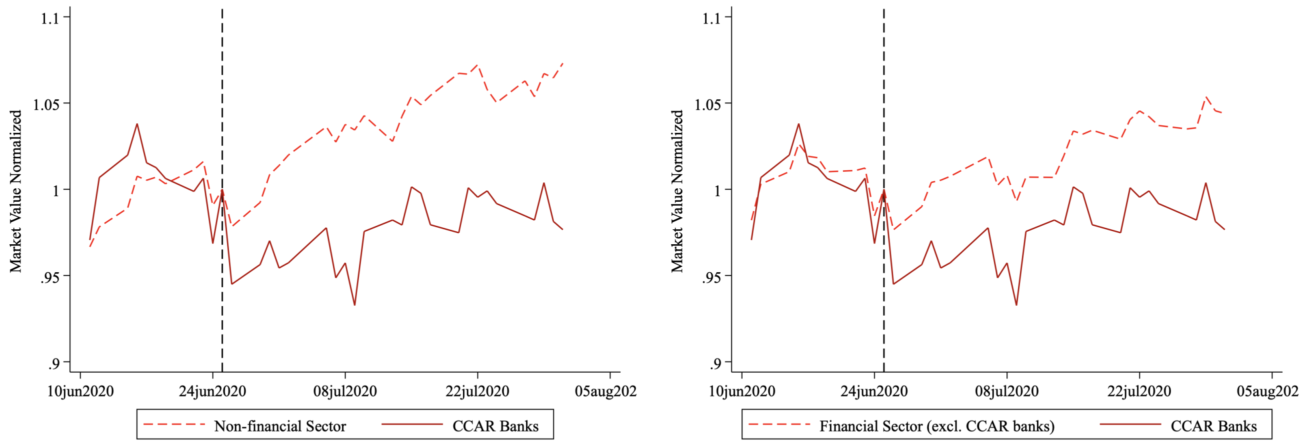
The advantages of estimating daily event studies are at least fourfold. First, the methodology allows to account for beta heterogeneity. Comparing purely returns over time can be misleading as banks with different leverage should see different equity price reactions to the same news. Abnormal returns 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. We 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.

E.6 Longer-run Evidence

This subsection provides evidence that the effects identified before persist also over longer time horizons. In particular, we 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 E.7 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

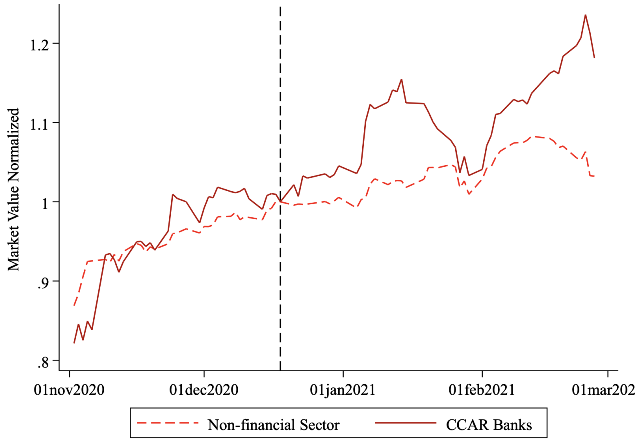
Source: CRSP and own calculations. Market values are normalized to 1 on 06/25/2020, indicated by vertical dashed line. Panel a) compares market value of CCAR banks to the non-financial corporate sector (excluding SIC 6000-6999). Panel b) compares market value of CCAR banks to the financial sector excluding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

Figure E.7: 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 E.7.

The pattern around the 12/18/2020 announcement is similar in Figure E.8. 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.

While these long-run impacts are suggestive of long-term effects, we prefer our estimates over a shorter time window as the identification around the announcement of payout restrictions becomes weaker as the time horizon is lengthened.



(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).

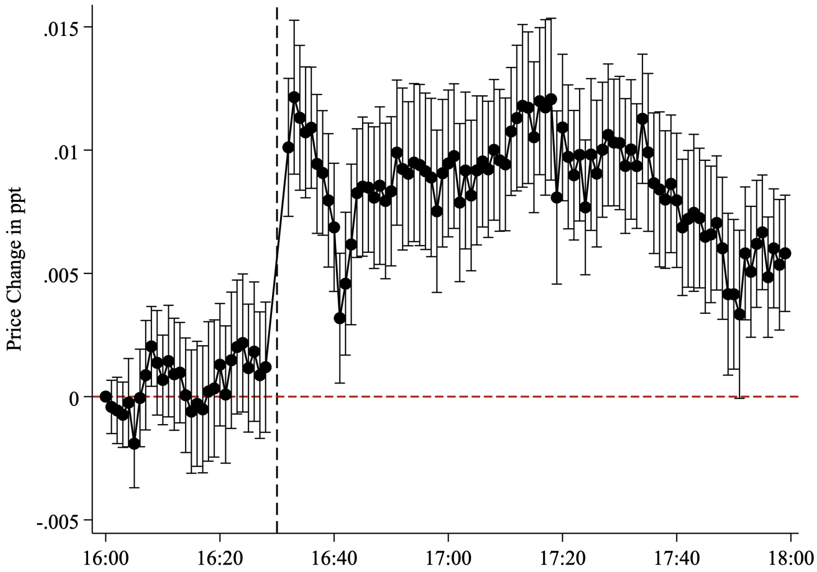
Figure E.8: Market values around 12/18/2020

E.7 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. we repeat the estimation of Equation 5 for 03/25/2021 over the same 4pm to 6pm ET time window. Figure E.9 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 E.9: High-frequency stock market response 03/25/2021

E.8 Term Structure of CDS Response

Figure E.10 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 E.11 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.

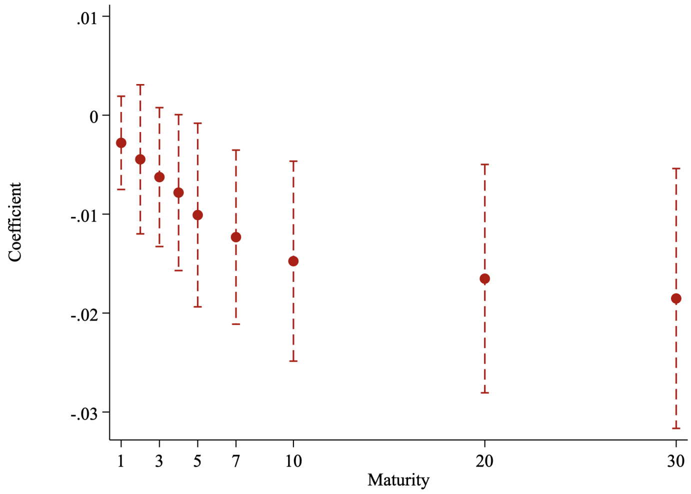


Figure reports point estimate and 95 % confidence interval for differences-in-differences coefficient in a regression of CDS spread at maturity as indicated by x-axis onto post-dummy interacted with flag for CCAR banks using a +/- 5 trading day window around 06/25/2020.

Figure E.10: Term Structure of CDS Response around 06/25/2020

E.9 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)

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. Source: CRSP and own calculations.

Table E.6: 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)

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. Source: CRSP and own calculations.

Table E.7: 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)

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. Source: CRSP and own calculations.

Table E.8: 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)

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. Source: CRSP and own calculations.

Table E.9: 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)

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. Source: CRSP and own calculations.

Table E.10: 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)

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. Source: CRSP and own calculations.

Table E.11: CAR after 12/18/2020 Unweighted Regression (Financial Firms Only)

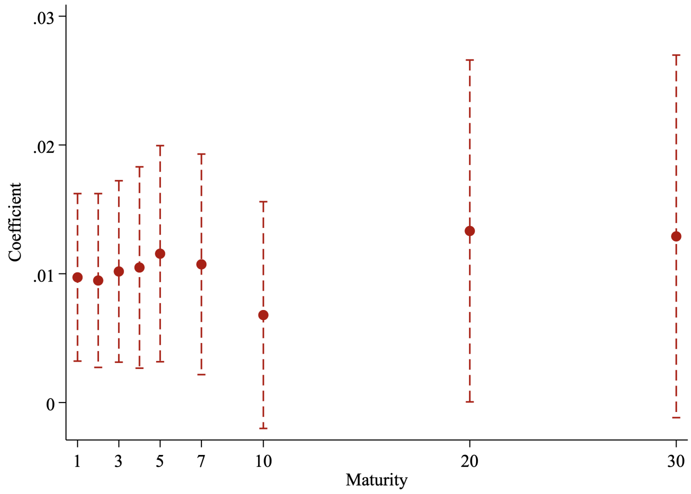


Figure reports point estimate and 95 % confidence interval for differences-in-differences coefficient in a regression of CDS spread at maturity as indicated by x-axis onto post-dummy interacted with flag for CCAR banks using a +/- 5 trading day window around 06/25/2020.

Figure E.11: Term Structure of CDS Response around 12/18/2020

E.10 Results from Fama-French 3-factor model

As an additional robustness check for cumulative abnormal returns, we 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 as CCAR banks' stock prices decline differentially across all specifications. These results address concerns that the one-factor model CAR results shown in the main text may be sensitive to omitted factors.

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 E.12: 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 E.13: 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 E.14: 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)

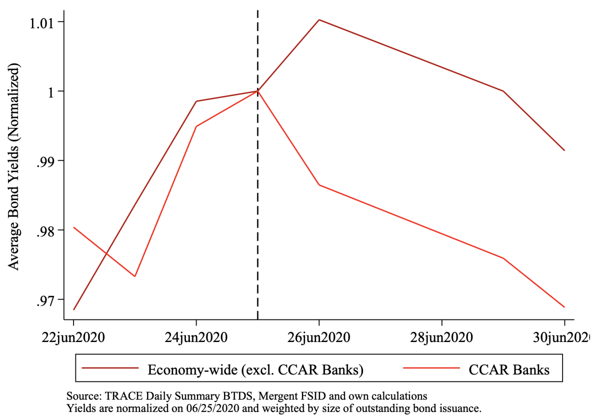
Source: CRSP and own calculations. Table reports coefficients from daily regressions for the 10 days after the announcement date following 12/18/2020. Each daily regression regresses cumulative abnormal returns up to that day onto an indicator for the CCAR banks. Abnormal returns are computed based on 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 E.15: CAR after 12/18/2020 Unweighted Regression (Banks Only)

E.11 Corporate Bond Results

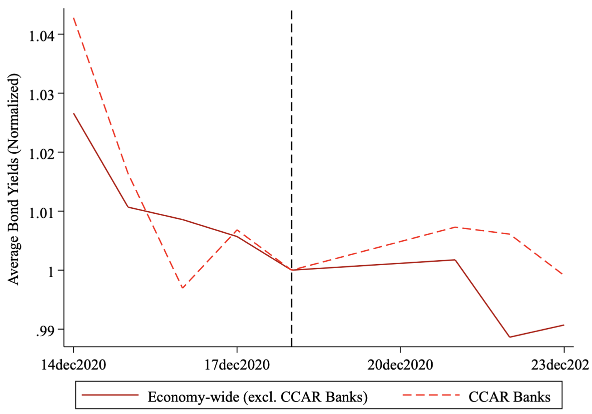
In addition to looking indirectly at the response of debt prices through CDS spreads, one can also directly estimate the response of corporate bond yields around the announcements about payout restrictions. While CDS capture pure default risk, corporate bond implied credit spreads contain both liquidity and default risk (Chen et al., 2018). Hence, CDS spreads are our primary measure of changes to debt values and default risk in the main text.

Figures E.12 and E.13 report average corporate bond yields for the CCAR banks relative to the remainder of the economy around the announcement of payout restrictions. For the figures, yields are normalized to one on the respective announcement day.



Source: TRACE Daily Summary BTDS, Mergent FISD and own calculations. Yields are normalized to one on 06/25/2020 and weighted by size of the outstanding bond issuance. Dashed line represents CCAR banks, solid line are economy-wide corporate bond yields excluding CCAR banks.

Figure E.12: Corporate Bond Yields around 06/25/2020



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

Figure E.13: Corporate Bond Yields around 12/18/2020

While corporate bond yields trend relatively in parallel until the respective announcements, they diverge afterwards. In particular, the yields for CCAR banks fall differentially relative to the remainder of firms on 06/25/2018 while they rise differentially after the the relaxation of the payout restrictions on 12/18/2020.

Next, we test econometrically for a differential effect:

$$\mathit{Yield\ Spread}_{it} = \alpha_i + \alpha_t + \beta \mathit{Post}_t \mathit{CCAR\ Bank}_i + \gamma X_{it} + \delta X_{it} \mathit{CCAR\ Bank}_i + \epsilon_{it} \quad (14)$$

All variable definitions are identical to the previous equations. $\mathit{Yield\ Spread}_{it}$ is the daily yield reported in the TRACE daily summary minus the yield of the closest Treasury. Regressions are weighted by the amount outstanding of each issuance so that results are representative of the overall corporate bond market. Finally, we omit bonds that trade less than every 6 days on average to avoid that illiquid bonds drive the results. The main coefficient of interest is β, which tests whether bond yields for CCAR banks evolve differentially around the respective payout restriction announcements.

Table E.16 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) around 06/25/2020:

	(1)	(2)	(3)	(4)
Post	0.0380**		0.0272***	
	(0.0191)		(0.0091)	
CCAR Bank	-0.8885***	-0.8889***		
	(0.1873)	(0.1873)		
CCAR Bank x Post	-0.0922***	-0.0924***	-0.0841***	-0.0842***
	(0.0289)	(0.0290)	(0.0216)	(0.0217)
Constant	3.0158***	3.0319***	2.9414***	2.9529***
	(0.0931)	(0.0961)	(0.0036)	(0.0008)
N	47171	47171	47126	47126
R^2	.009	.0091	.7921	.7921
Firm FE			x	x
Time FE		x		x

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

Table E.16: 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 8.4 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. Table E.17 shows results from estimating Equation 14 around the 12/18/2020 announcement.

Corporate bond yields rise differentially for the subset of CCAR banks. Consistent with

	(1)	(2)	(3)	(4)
Post	-0.0347**	-0.0321***		
	(0.0141)	(0.0094)		
CCAR Bank	-0.4201***		-0.4201***	
	(0.1485)		(0.1485)	
CCAR Bank x Post	0.0448**	0.0484***	0.0451**	0.0486***
	(0.0197)	(0.0164)	(0.0197)	(0.0165)
Constant	2.1636***	2.1228***	2.1512***	2.1114***
	(0.0648)	(0.0031)	(0.0661)	(0.0006)
N	33576	33574	33576	33574
R^2	.0037	.6439	.0038	.644
Firm FE		x		x
Time FE			x	x

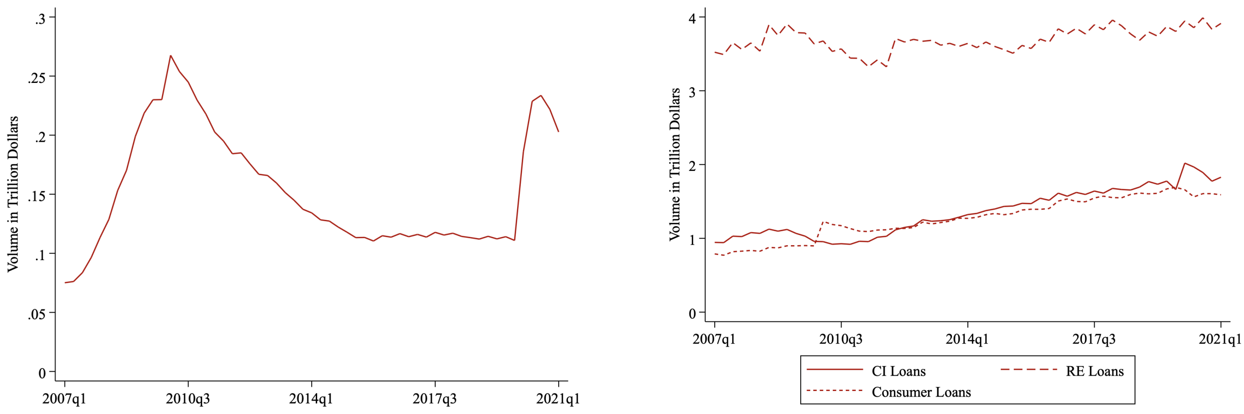
$***p < .01, **p < .05, *p < .1$

Table E.17: Corporate Bonds: Daily Differences-in-Differences Estimation around 12/18/2020

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 4.9 basis points in the preferred specification, suggesting that lifting payout restrictions has made bank debt riskier.

E.12 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 E.14. 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.



(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 E.14: Bank Balance Sheet Items

Comparing the Covid-crisis to the Great Recessions, two features stand out. First, loan loss reserves almost reached financial crisis levels in 2020. Second, this accumulation was very fast as compared to the financial crisis. This seemingly prudent bank behavior might suggest that banks have other considerations than risk-shifting.

There are, however, some caveats with this argument. First, 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). The Federal Reserve implemented these new accounting rules with the CECL (current expected credit loss) standard. These measures, intended to address procyclicality, likely explain parts of the build-up of loan loss reserves in the early times of the Covid-pandemic. Loudis et al. (2021) show that CECL adopters ramped up loan loss reserves more quickly than non-adopters during the pandemic. Second, Section 4013 of the CARES Act exempts bank from reporting certain delinquent loans as troubled debt restructurings, which leads to a delayed reporting of explicit losses until the CARES Act provision expired at the end of 2021.

These two arguments can explain the large build-up of loan loss reserves by the major banks even in the presence of a risk-shifting motive.

E.13 Evidence from other Jurisdictions

The United States is not 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, we 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[23], not a rule, but the implicit understanding is that banks would expose themselves to regulatory action if not adhering to the recommendation.[24]

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.[25] 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.

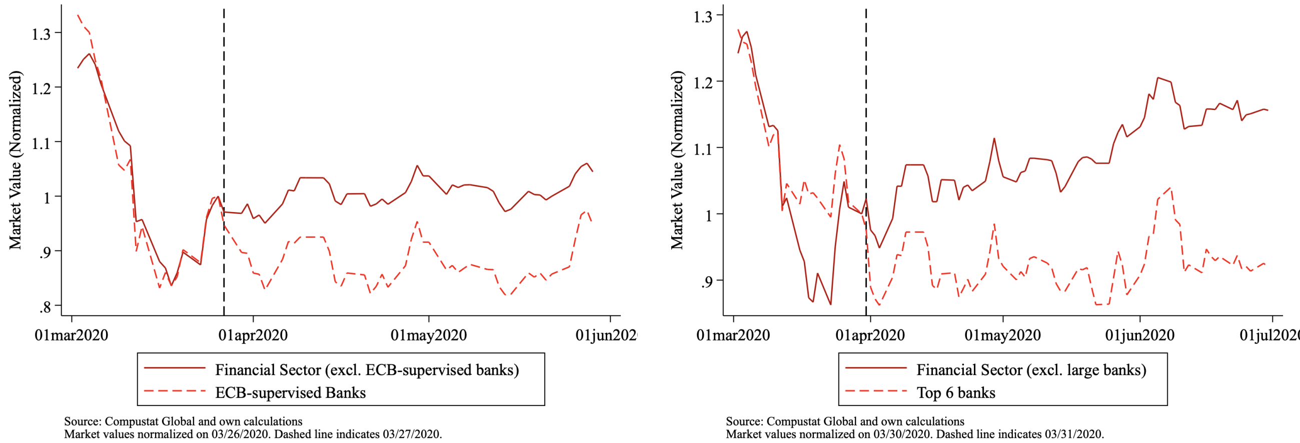
Figure E.15 reports how equity values evolve around the respective announcement data in the Eurozone (Panel a) and in the UK (Panel b).

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

[23] 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

[24] See for example: https://www.wsj.com/articles/european-bank-dividend-ban-lifted-but-restrictions-remain-11608060995

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



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

Figure E.15: Market values of large UK banks relative to economy

Figure E.16 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. Results are very similar to panel a) in Figure E.15.

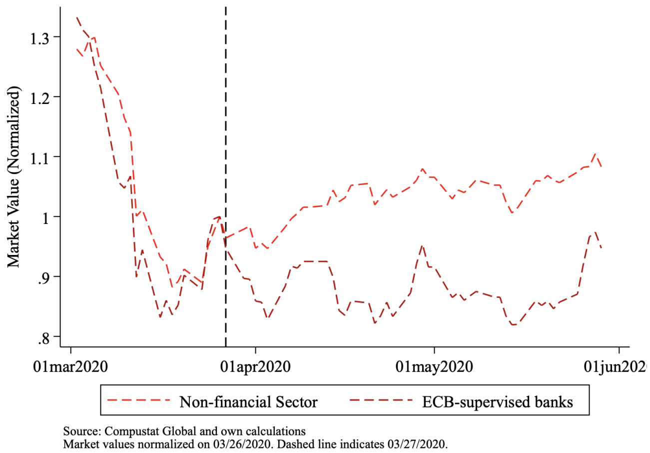


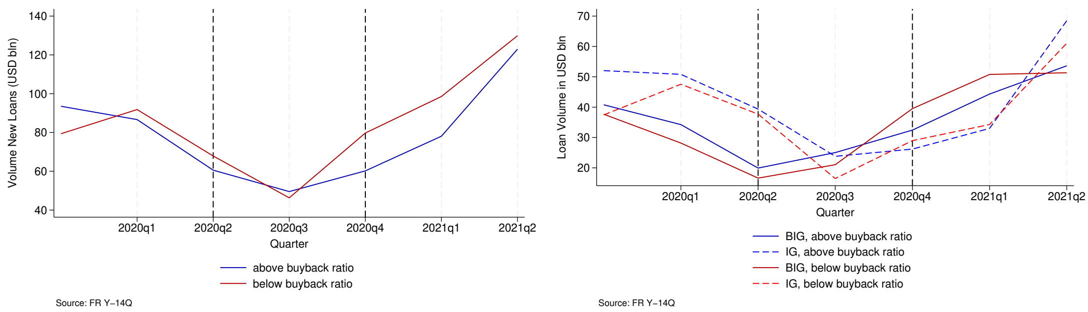
Figure reports market values for ECB-supervised banks (solid line) and non-financial firms (dashed line, excludes SIC codes 6000 - 6799). Market values are normalized to one on 03/26/2020. The vertical dashed line indicates 03/27/2020. Source: Compustat Global and own calculations.

Figure E.16: Robustness for DiD Plot

F Additional Lending Results

F.1 Raw Triple DiD plot

Figure 8 reports normalized plots. Figure F.17 reports the raw version of these figures without the normalization in 2020 Q2:



(a) Lending **(b)** Riskiness of Lending

Panel a) reports time series of the aggregate volume of new loans extended by banks with an average buyback to payout ratio in 2017-2019 above and below the median. Panel b) reports time series of the aggregate volume of new loans ii) investment grade and ii) below investment grade extended by banks with an average buyback to payout ratio in 2017-2019, respectively, above and below the median. Investment grade loans are identified as those extended to firms with a probability of default below 5% as estimated by the bank; below investment grade loans are identified as those extended to firms with a probability of default above 5% as estimated by the bank. Data is from FR Y14-H1. BIG = below investment grade. IG = investment grade.

Figure F.17: Evolution of Lending Robustness

The relative decline in below investment grade lending at banks that very share buyback reliant relative to less share buyback reliant banks is evident.

F.2 Detailed Regression Tables from Equation 7

	(1)	(2)	(3)	(4)
Sample			Excluding disposed loans	
Dependent variable		log(committed amount)		
PD	2.796	4.258	3.733	4.987
	(2.44)	(2.56)	(2.56)	(2.72)
PD x IntroPolicy (20Q3-20Q4)	10.285***	10.122***	10.924***	10.960***
	(1.83)	(1.81)	(2.16)	(1.94)
PD x LiftPolicy (21Q1-21Q2)	-21.129***	-18.031***	-16.620**	-14.501***
	(3.68)	(2.55)	(4.35)	(2.52)
Buyback/Payout (17-19)	0.300	0.000	0.305	0.000
	(0.65)	(0.00)	(0.62)	(0.00)
PD x Buyback/Payout (17-19)	-6.966**	-9.457**	-8.651*	-10.699**
	(2.71)	(2.85)	(3.49)	(3.59)
IntroPolicy (20Q3-20Q4) x Buyback/Payout (17-19)	0.416***	0.000	0.483***	0.000
	(0.09)	(0.00)	(0.11)	(0.00)
LiftPolicy (21Q1-21Q2) x Buyback/Payout (17-19)	-0.355***	0.000	-0.243***	0.000
	(0.05)	(0.00)	(0.03)	(0.00)
PD x IntroPolicy (20Q3-20Q4) x Buyback/Payout (17-19)	-11.890***	-11.562***	-12.717***	-12.711***
	(2.25)	(2.55)	(2.37)	(2.51)
PD x LiftPolicy (21Q1-21Q2) x Buyback/Payout (17-19)	30.354***	26.151***	24.162**	21.181***
	(5.15)	(3.85)	(6.21)	(3.74)
Firm size$_{t-4}$	0.290***	0.292***	0.288***	0.292***
	(0.02)	(0.02)	(0.02)	(0.02)
Firm ROA$_{t-4}$	0.001	0.001	0.001	0.001
	(0.00)	(0.00)	(0.00)	(0.00)
Bank size$_{t-1}$	0.075		0.061	
	(0.05)		(0.04)	
Bank ROE$_{t-1}$	0.004		0.004	
	(0.01)		(0.01)	
Bank Liquidity ratio$_{t-1}$	0.017		-0.234	
	(0.56)		(0.54)	
Bank Tier1 ratio$_{t-1}$	0.098*		0.114**	
	(0.04)		(0.04)	
Constant	2.455**	5.433***	2.542**	5.432***
	(0.79)	(0.25)	(0.75)	(0.25)
N	14819	14818	14736	14735
R-sqr	0.5139	0.5265	0.5171	0.5288
Adj-R-sqr	0.4366	0.4466	0.4400	0.4489
County x Quarter FE	x	x	x	x
Industry x Quarter FE	x	x	x	x
Bank x Quarter FE		x		x

$***p < .01, **p < .05, *p < .1$. Table reports coefficients from staggered differences-in-differences regression for interaction of banks' buyback-to-payout ratio, borrower PD and a categorical variable identifying three periods (pre-policy, introduction of the policy, lifting of the policy). The pre-period covers 2020Q1-Q2, the introduction of the policy period covers 2020Q3-Q4, the lifting of the policy period covers 2021Q1-Q2. Standard errors are clustered by bank and quarter.

Table F.18: Detailed Risk-taking Results

F.3 Results for Interest Rate

	(1)	(2)	(3)	(4)
Sample			Excluding disposed loans	
Dependent variable		Interest rate		
PD	-0.043	-0.042	-0.046	-0.048
	(0.06)	(0.06)	(0.07)	(0.06)
PD x IntroPolicy (20Q3-20Q4)	0.107	0.104	0.176	0.170
	(0.07)	(0.09)	(0.09)	(0.12)
PD x LiftPolicy (21Q1-21Q2)	0.276**	0.371**	0.305**	0.390**
	(0.10)	(0.09)	(0.11)	(0.11)
Buyback/Payout (17-19)	0.003	0.000	0.003	0.000
	(0.01)	(0.00)	(0.01)	(0.00)
PD x Buyback/Payout (17-19)	0.215	0.213*	0.218	0.220*
	(0.11)	(0.10)	(0.11)	(0.10)
IntroPolicy (20Q3-20Q4) x Buyback/Payout (17-19)	0.013*	0.000	0.014*	0.000
	(0.01)	(0.00)	(0.01)	(0.00)
LiftPolicy (21Q1-21Q2) x Buyback/Payout (17-19)	0.019	0.000	0.019	0.000
	(0.01)	(0.00)	(0.02)	(0.00)
PD x IntroPolicy (20Q3-20Q4) x Buyback/Payout (17-19)	-0.178	-0.177	-0.289*	-0.283
	(0.12)	(0.15)	(0.14)	(0.18)
PD x LiftPolicy (21Q1-21Q2) x Buyback/Payout (17-19)	-0.425**	-0.563***	-0.461**	-0.588***
	(0.14)	(0.12)	(0.15)	(0.14)
Firm size t-4	-0.001***	-0.001***	-0.001***	-0.001***
	(0.00)	(0.00)	(0.00)	(0.00)
Firm ROA t-4	-0.000**	-0.000***	-0.000***	-0.000***
	(0.00)	(0.00)	(0.00)	(0.00)
Bank size t-1	-0.001		-0.001	
	(0.00)		(0.00)	
Bank ROE t-1	0.000		0.000	
	(0.00)		(0.00)	
Bank Liquidity ratio t-1	-0.002		-0.003	
	(0.01)		(0.01)	
Bank Tier1 ratio t-1	0.001		0.001	
	(0.00)		(0.00)	
constant	0.040***	0.041***	0.041***	0.041***
	(0.01)	(0.00)	(0.01)	(0.00)
N	10981	10980	10900	10899
R-sqr	0.2894	0.3517	0.2891	0.3510
Adj-R-sqr	0.1524	0.2178	0.1516	0.2164
County x Quarter FE	x	x	x	x
Industry x Quarter FE	x	x	x	x
Bank x Quarter FE		x		x

$***p < .01, **p < .05, *p < .1$. Table reports coefficients from staggered differences-in-differences regression for interaction of banks' buyback-to-payout ratio, borrower PD and a categorical variable identifying three periods (pre-policy, introduction of the policy, lifting of the policy). The pre-period covers 2020Q1-Q2, the introducion of the policy period covers 2020Q3-Q4, the lifting of the policy period covers 2021Q1-Q2. Standard errors are clustered by bank and quarter.

Table F.19: Results for Interest Rate