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Abstract

This paper studies the effects of regulatory payout restrictions on bank risk-shifting. Using policies imposed during the Covid-crisis on U.S. banks as a natural experiment and a high frequency differences-in-differences approach, we show that, when payouts are restricted, banks' equity prices fall while their debt values appreciate. Moreover, banks that are ex-ante more exposed to the payout restrictions decrease risk-taking in lending relative to less exposed banks. Consistent with a risk-shifting channel, these effects revert once restrictions are lifted. These results indicate that payout and risk-taking choices are complementary and that regulatory payout restrictions endogenously affect bank risk-shifting.

JEL classification: G21, G28, G35, G38
Key words: banking, payout restrictions, risk-shifting, prudential regulation

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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 about 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 a 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 banking sector.

In June 2020, 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, and Canada. Payout restrictions were aimed at enhancing banks' resilience amid the uncertain economic environment and concerns that large losses may materialize.

Besides 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 Global 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 shareholder payouts 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 over the course of the Global Financial Crisis.

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, managers run the bank and make decisions about payouts and risk-taking only on behalf of shareholders. High leverage, in turn, reinforces agency frictions between debtholders and shareholders. 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 capital distributions. Government guarantees on deposits and expectations of government bailouts in times of crisis may further increase the incentives to risk shift. Payout restrictions, as a policy intervention, can mitigate these risk-shifting forces and shore up equity buffers, hereby contributing to preserve financial stability when the banking sector is under stress.

In this paper, we analyze the impact of payout restrictions on bank risk-shifting. We address this research question by analyzing how payout restrictions in the US affect bank equity and debt values, as well as risk-taking decisions in lending. First, we lay out a theoretical framework to study payout restrictions. Next, we exploit the 2020 Covid crisis to test empirically 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 risk from shareholders onto debtholders. In that case, debt value increases while 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's debt value should appreciate following the imposition of payout restrictions if the risk-shifting channel dominates, while it should depreciate if the negative news channel dominates.

[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.

Risk-shifting can occur via two margins: on the liability side through payout (and thus leverage) decisions and on the asset side through 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 threshold, an unrestricted bank would select high payouts and a risky asset distribution; however, when restricted in its ability to pay out, the bank would reduce risk-taking on the asset side. In other words, for an intermediate range of leverage values, the imposition of payout restrictions limits bank's incentives to take on risk. While this prediction reflects a risk-shifting channel à la Jensen and Meckling (1976), it contrasts a risk management channel à la Froot et al. (1993) where the increase in internal funds under a payout restriction could incentivize greater risk-taking.

To test these three hypotheses empirically, we exploit the imposition of explicit payout restrictions for the subsample of 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 and their risk-taking behavior over the course of 2020.

Using high-frequency tick-by-tick equity price data and an event-study methodology, we document that the CCAR banks lose on average more than 2% in equity value relative to a control group of other financial and non-financial firms within minutes of the restrictions being announced. This corresponds to a \$26 billion decline in CCAR bank market value. Conversely, equity prices jump by 4% relative to the same control group within minutes of the announcement that the restrictions would be relaxed, a \$ 64 billion increase in market value. 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 banks subject to the restrictions. To mitigate this concern and provide evidence on the equity response's persistence, 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 neither driven by the selected control group nor by the different market microstructure in after-hours trading. Moreover, the differential performance of CCAR banks relative to other banks and financial firms persists over the longer-run in the months following the respective regulatory announcements.

To test our second hypothesis and resolve the identification challenge between the risk-shifting and the negative news channel, we use data on unsecured debt, 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.[2] Using corporate bond yields as the dependent variable 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 banks' risk-taking decisions. Agency conflicts between shareholders and debtholders affect not only the liability side of banks' balance sheets, but also the asset side through asset substitution between safer and riskier assets

[2]These effects are relative to a pre-announcement level of 5-year CDS spreads for CCAR banks of 77 basis points before the 06/25/2020 announcement and 65 basis points before the 12/18/2020 announcement.

(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. The ideal source to examine the impact on the asset-side is the Federal Reserve's Y-14Q data, which provides 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 suspended, 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 shareholder distributions were effectively more constrained by the restrictions than banks that primarily relied on dividends. We 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 3.4% smaller loans to firms with a one standard deviation greater probability of default relative to banks 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 8.8% larger loans to firms with a one standard deviation larger probability of default compared to the other banks. These results reflect a differential shift in the composition of new lending between more affected and less affected banks in response to the payout restrictions, but not a significantly different shift in their total credit supply.

Taken together, our results indicate that the imposition of payout restrictions in times of crisis makes banks safer. This effect is driven not only by the mechanical increase in equity buffers over the short run, but also, and more importantly, by the ability of payout restrictions to curb banks' risk-taking incentives in an effective and persistent way. This is consistent with the risk-shifting channel highlighted in our theoretical framework, where the imposition of payout restrictions reduces the call option feature of equity compensation resulting in lower risk-taking, an effect that reverts once the restrictions are lifted.

In sum, payout restrictions are a novel regulatory tool. Our study of US banks during the pandemic suggests that payout restrictions lead banks to accumulate retained earnings and shift their lending towards safer firms, while leaving overall credit supply unaffected. This contrasts with the evidence on the effects of higher capital requirements. Ex ante, higher capital buffers can be met either by increasing equity or by reducing risk-weighted assets. The literature shows evidence that stricter capital requirements lead to a decline in credit supply as banks comply by reducing risk-weighted assets (Carlson et al. (2013), Jackson et al. (1999), Kashyap et al. (2010), Fraisse et al. (2020), Gropp et al. (2019)). Payout restrictions differ also relative to hybrid capital instruments such as convertible debt. Unlike debt-to-equity conversion, which is contractually determined ex-ante (Herring and Calomiris (2011), Martynova and Perotti (2018)) and may occur only in extreme circumstances, payout restrictions provide more regulatory discretion.

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. A large literature analyzes 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)). Another strand focuses on liquidity requirements (Bosshardt and Kakhbod (2020), Calomiris et al. (2015), Diamond and Kashyap (2016)) and 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)). Payout restrictions are a relatively less explored area in this literature, both theoretically and, in particular, empirically. Acharya et al. (2011) and Acharya et al. (2016) propose policies resembling a covenant with automatic payout restrictions when certain thresholds are crossed due to moral hazard concerns, while Acharya et al. (2017) analyze the systemic externalities from bank payout policy. Vadasz (2021) shows that payout restrictions suffer from a time inconsistency problem that may limit their usage to sufficiently bad states, whereas Schroth (2021) and Schroth (2023) study time-consistent dividend restrictions in the context of financial crises. Acharya et al. (2017), Floyd et al. (2015)

and Hirtle (2016) document payout patterns during the 2008 financial crisis. Goodhart et al. (2010) show how dividend restrictions during the financial crisis stimulated interbank market activity. We contribute to this literature by investigating the impact of payout restrictions on banks' risk profile both theoretically and empirically. Our study unveils the quantitative effects of payout restrictions on banks' equity prices, debt values, and lending behavior during the Covid-crisis.

Our 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 may forfeit the continuation value by taking on excessive risk. Our model exhibits a similar feature while considering the specific policy of payout restrictions and studying the complementarity between payout and risk-taking decisions. This closely relates to the literature on the risk-taking channel of monetary policy (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 strands of corporate finance literature on payout policies, 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. Recent literature on payout policy has focused on explaining aggregate trends (Farre-Mensa et al. (2020), Kahle and Stulz (2020), Kroen (2021), Ma (2019), Mota (2020)). With specific regard to the banking sector, Fahlenbrach et al. (2024) show how regulation and politics drive large changes in bank payout policy. As for risk-shifting, empirical evidence in support, or against, this phenomenon can be found in Eisdorfer (2008), Rauh (2009), Landier et al. (2015) and Gilje (2016). Gropp et al. (2011) document the impact of public guarantees on banks' risk-taking. Our paper contributes to the literature by studying a regulatory intervention on payouts with a pure focus on the banking sector. It complements the literature by analyzing the effects of payout restrictions on banks' risk-shifting incentives.

Finally, this study adds to the literature on banking during the Covid-crisis and the regulatory response by quantifying the empirical effects of explicit payout restrictions on banks.

Other papers have considered the "dash-for-cash" phenomenon (Acharya et al., 2021), the Fed's interventions in the corporate bond market (Haddad et al., 2020), and the broader set of policy measures on liquidity support, borrower assistance and monetary easing (Demirgüç-Kunt et al., 2020). More closely related to our work, Mücke (2023) discusses the impact of payout restrictions on banks' investor composition. Hardy (2021) reviews the imposition of payout restrictions on banks internationally, while Ampudia et al. (2023) and Sanders et al. (2024) focus on the Euro area and show that banks subject to payout restrictions supported aggregate lending during the pandemic. Our paper adds theoretical and empirical evidence on the risk redistribution between bank shareholders and debtholders in response to payout restrictions, a high-frequency identification allowing to study the effects of the imposition and relaxation of payout policies on US banks ruling out concerns about other concurrent industry-wide shocks, 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 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 risk-taking decisions in lending, rather than changes in the stock of pre-existing loans.

2 Conceptual Framework

We develop a theoretical model building on the framework by Acharya et al. (2017) and featuring a single bank that has assets and liabilities in place and lives for two periods. The only decision that bank shareholders make is about the payout policy. This involves a tradeoff: higher payouts secure safe cash flows to shareholders in the initial period but raise the default probability of the bank in the second period.

We add two additional features to the model. First, a reduced-form government guarantee on bank debt, which captures the fact that many banking sector liabilities are insured 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 on the asset-side of its balance sheet. 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, and the reversal (i.e., removing payout restriction increases both payouts and risk-taking 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 that 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, equityholders derive the franchise value $V > 0$ if the bank does not default in period $t = 1$. Figure 1 summarizes the bank's assets and liabilities at $t = 0$. ℓ and c are constant parameters. a is a random variable:

Bank	
Cash c	Liabilities ℓ
Assets a	

Figure 1: Bank Assets and Liabilities

The fundamental question for the bank is whether it generates enough assets in period $t = 1$ to cover its liabilities and remain solvent. Otherwise, it defaults. The only choice variable for the bank is its dividend.[3] For tractability, we assume $d \in [0, c]$.

From here, the solvency threshold of the bank $\hat{a}(d) = \ell + d - c$ can be derived. It captures the minimum amount of assets the bank needs to generate so that it remains solvent and shareholders realize the franchise value V.

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

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.[4] 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 shareholders' payout policy, 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:

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

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' payoff. As a result, the first-order condition does not return the maximum but rather a 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 some large banks are among the

[4] 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.

most levered banks in the United States[5], based on proposition 2.1, one can hypothesize that CCAR banks would choose higher payouts in the absence of regulatory restrictions, 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 have a preference for a zero dividend payout. This means that the value of debt is maximized under the restriction $d \in [0, c]$, $d = 0$. Intuitively, at the margin, any increase in payouts raises the probability that the bank will not generate enough assets to cover its liabilities, implying a (partial) default on debt. Since any marginal payout lowers the value of debtholders' claim, 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, therefore, restrictions on payouts imposed by an exogenous regulator re-distribute risk between shareholders and debtholders. Note that the expected payment to debtholders from the public sector also increases in d for $\phi > 0$, as higher payouts imply higher default risk for which debtholders are partly insured by the government (s. Proposition B.3).

The next two propositions capture the theoretical response of equity and debt values to payout restrictions and outline how our empirical tests can help discriminate between different potential channels.

Proposition 2.3. *For equity value, the following two statements hold:*

1) For $V < V^* = \ell - \frac{c}{2} - \underline{a}$, equity value is increasing in payouts and a binding regulatory payout restriction lowers equity value.

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

2) A decline of the upper bound of the asset distribution, $\bar{a}$, lowers equity value. Formally: $\frac{dEV}{d\bar{a}} \geq 0$

The first part of Proposition 2.3 directly follows from the two previous propositions and is critical since it enables us to think about payout restrictions exogenously imposed by a 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 as shareholders are forced to assume more of the risk of bank assets and the call option feature of equity compensation is mitigated. This prediction reverses if a previously imposed payout restriction is lifted. In that case, equity value appreciates.

An alternative channel through which payout restrictions could operate is by conveying news about bank assets. When the regulator issues a payout restriction, this may communicate the regulator's private information that bank assets are worse than previously believed. The second part of Proposition 2.3 provides comparative statics in the asset payoff. A reduction in the upper bound of the assets' distribution $\bar{a}$ lowers the value of equity due to an increase in the default likelihood and a lower expected payoff to shareholders conditional on survival.

One limitation of the result in Proposition 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 payout restrictions have been imposed and the prediction that debt values appreciate through payout restrictions implies a lower cost of debt rollover, which would eventually benefit shareholders. The presence of government guarantees on bank liabilities, ϕ, which attenuates the response of debt value to payout restrictions (s. Proposition B.4), mitigates the empirical importance of this rollover costs channel.

A second competing channel that is outside of the model is the potential stigma that may be associated with individual banks suspending payouts (Güntay et al. (2024)), similar to the stigma related to individual banks non-anonymously accessing the central bank discount window (Bagehot (1873), Gorton and Ordonez (2016)). Imposing public payout restrictions removes this stigma and that may raise equity values. However, the fact that some banks announced a suspension of their share repurchases in March 2020, before the introduction of payout restrictions by the regulators, mitigates this channel.[6]

While Proposition 2.3 shows that payout restrictions depress equity prices under a risk-shifting or negative news channel, proposition 2.4 lays out how the risk-shifting and negative news channels have opposing predictions for the value of debt under payout restrictions:

Proposition 2.4. *The following two statements hold for debt value:*

1) For $V < V^* = \ell - \frac{c}{2} - \underline{a}$, debt value is decreasing in payouts and a binding regulatory payout restriction raises debt value.

2) A decline of the upper bound of the asset distribution, $\bar{a}$, lowers debt value for $\phi < 1$. Formally: $\frac{dDV}{d\bar{a}} \geq 0$

Since debt value declines in payout for $V < V^*$ and unrestricted shareholders choose a positive payout in that region, an exogenous binding payout restriction raises the value of debt when imposed (part 1 of the proposition). In essence, binding payout restrictions redistribute risk from debtholders towards shareholders. The second part of the proposition is the mirror image of the second part of proposition 2.3. Negative news about the upper bound of banks' assets increase the likelihood of bank default and thus lower debt values as long as debtholders are imperfectly insured by public guarantees, $\phi < 1$.

As before, the first part of Proposition 2.4 directly follows from the first two propositions in this section. All remaining 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 both the liability side and the asset side of banks' balance sheet. 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.

[6] https://www.bloomberg.com/news/articles/2020-03-15/eight-giant-u-s-banks-to-suspend-stock-buybacks-through-june

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 2.5. *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 2.5 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. By shifting risk from debtholders back onto shareholders, a binding payout restriction incentivizes shareholders to take on less risk.

The result critically depends on 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 is funded with higher debt for the same level of 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 choose switching from the risky to the safe project. For $\ell \leq \underline{\ell}$, the opposite emerges. In that case, shareholders have a very high stake in the firm. Hence, they refrain from taking on risk and the payout restriction has no bite. For intermediate values of leverage, the risk allocation between shareholders and debtholders 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.

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

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.

An alternative to Proposition 2.5 would be a risk management channel à la Froot et al. (1993). A bank that has greater internal funds available under the payout restrictions and benefits from a lower cost of debt may engage in greater risk-taking as funding for risk-shifting has become cheaper. This channel does not show up in our modeling framework as we assume that all debt is in place at $t = 0$. Nevertheless, this mechanism is likely dominated by the risk-shifting channel to the extent that changes in the cost of debt rollover are softened by the presence of government guarantees on debt.

3 Empirical Strategy

In this section we formulate a set of hypotheses on the impact of payout restrictions based on the theoretical predictions outlined in the previous section and we conduct an empirical analysis to test those hypotheses. 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 Global Financial Crisis of 2008, US regulators introduced a wide range of new financial regulations. The most important ones were imposed through the Dodd-Frank Act enacted in 2010. Section 165 of this 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 Federal Reserve 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 CCAR, the Federal Reserve reviews banks' proposed distributions of dividends and share buybacks and authorizes 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, CCAR is conducted once per year. During the Covid pandemic, two rounds of testing were performed 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 organization is based, are critical for them. Throughout, we will refer to this sample of 20 domestic BHCs subject to CCAR as "CCAR banks".

3.1.2 June 25 2020 Announcement

On June 25, 2020 at 4:30 pm EDT, the Federal Reserve 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."[7]

The restrictions uniformly affected all CCAR banks marking the first time that the Federal Reserve issued wide-ranging payout restrictions across all CCAR banks. In the announcement, the Federal Reserve stated that the payout restrictions would be re-evaluated on a quarterly basis, but no set end date for the restrictions was given.[8] 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 is the first natural experiment we exploit in the empirical analysis.

3.1.3 December 18 2020 Announcement

On 12/18/2020 at 4:30 pm EDT, the Federal Reserve 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.[9] Much less stringent restrictions remained in place. Specifically, the sum of quarterly dividend and share buyback payouts could not exceed average quarterly earnings from the past four quarters.[10]

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 of CCAR banks 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.[11] Hence, the relaxation of payout restrictions was substantial

[7] 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

[8] In practice, the binding constraint on dividends was that they could not be increased. Yet, if some bank had suffered prolonged losses, the constraint that dividends cannot exceed average quarterly profits would have become binding.

[9] Appendix D provides several pieces of anecdotal evidence to support this argument. 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

[10] The wording was "In light of the ongoing economic uncertainty and to preserve the strength of the banking sector, the Board is extending the current restrictions on distributions, with modifications. For the first quarter of 2021, both dividends and share repurchases will be limited to an amount based on income over the past year. If a firm does not earn income, it will not be able to pay a dividend or make repurchases" https://www.federalreserve.gov/newsevents/pressreleases/bcreg20201218b.htm

[11] As outlined in Hirtle (2016), CCAR banks paying out more than 30 percent of after-tax net income via dividends

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.

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 CCAR banks lowers their equity values and, conversely, the lifting of the restrictions increases their equity values.*

Equity values are predicted to decline after the imposition of payout restrictions under both the risk-shifting channel and the bad news channel (Proposition 2.3). 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 did not play an important role. Third, it would also rule out the stigma channel.

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

The response of debt values allows us to separate between the risk-shifting channel and the bad news channel, as outlined in Proposition 2.4. On the one hand, an increase in debt values after the imposition of payout restrictions would indicate that debtholders benefit from those

face particular regulatory scrutiny while there is no such threshold for share buybacks. This explains why share repurchases represent the most relevant way of CCAR banks' payout to shareholders.

policies, consistent with the idea of a risk redistribution between equityholders and debtholders. That is because the higher equity cushion generated by payout restrictions provides more safety to debtholders, 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 Federal reserve could be signaling negative information about the value of banks' assets implying higher default risk.

Hypothesis 3.3. *The imposition of payout restrictions reduces bank risk-taking on the asset-side of the balance sheet, while the lifting of restrictions increases bank risk-taking.*

Hypothesis 3.3 derives from proposition 2.5. CCAR banks were levered at the onset of the Covid-crisis, but to a significantly lower 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 equity buffer. Consequently, we interpret CCAR banks as being moderately but not extremely levered through the lenses of the model, which is consistent with the parameter restrictions necessary for Proposition 2.5.

A potential 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: 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 (4:00 pm to 6:00 pm ET) 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 ET. As for CRSP, we use daily quotes on US stock prices.[12]

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.

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.

To test our third hypothesis about bank risk-taking, we rely on the Federal Reserve's Y-

[12]For stock market data covering the Eurozone and the UK used in Appendix E.12, we rely on Compustat Global Security Daily. This contains daily stock prices for publicly traded firms worldwide.

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 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.[13] 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. We aggregate the loan-level data at the firm-bank relationship level within each quarter.

Finally, data on banks' balance sheet and income statement comes from the Federal Reserve's Y-9C data and Compustat. Further details on the data construction are outlined in Appendix A.

3.4 Summary Statistics

Table 1 reports summary statistics for the high-frequency tick-by-tick TAQ data for all listed stocks in the 4:00 pm ET to 6:00 pm ET time window around each announcement. Although

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

this time window is outside of regular market hours (the regular market 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. Summary statistics for the final lifting of the payout restrictions on March 25, 2021, are in Table C.2.

Panel A: June 25, 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
Panel B: December 18, 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 i) 06/25/2020 in panel A and ii) 12/18/2020 in panel B, for the 4:00 to 6:00 ET time window. Prices are normalized to 1 at 4:00 ET.

Table 1: TAQ summary statistics

Data on daily CDS spreads from IHS Markit is summarized in Table 2. Our sample covers CDS spreads of CCAR banks and other financial sector firms for a 10-day time window around each announcement. CDS spreads exhibit a decline by about 13-17 basis points on average between June and December 2020, reflecting the improvement in the economic outlook over that time period. Table C.3 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 collection combined with data from the Y-9C. Panel A and Panel B of Table 3 contain summary statistics of new corporate loans extended by CCAR banks at the firm-bank level, as well as bank-level financial conditions around the introduction and subsequent relaxation of the payout restrictions.

	June 25, 2020		December 18, 2020	
	Mean	Std. Dev.	Mean	Std. Dev.
Spread - 1Y	0.75	1.37	0.62	1.22
Spread - 2Y	0.91	1.43	0.76	1.28
Spread - 3Y	1.08	1.56	0.92	1.43
Spread - 5Y	1.40	1.70	1.23	1.61
Spread - 10Y	1.70	1.70	1.54	1.60
Spread - 20Y	1.70	1.55	1.58	1.50
Spread - 30Y	1.72	1.52	1.59	1.46
Observations	5847		8195	

CDS spread data from Markit. Table reports means and standard deviations of CDS spreads i) for the time window starting 5 trading days before 06/25/2020 and ending 5 trading days after, and ii) for the time window starting 5 trading days before 12/18/2020 and ending 5 trading days after. CDS spreads are reported in percentages. Financial sector includes SIC codes 6000-6999.

Table 2: CDS spreads summary statistics

We focus on new loan 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 (PD) 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.

Panel C shows that, 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 being 15.4%). In our empirical study, 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.

Finally, Panel D reports pairwise correlations between the pre-Covid buyback to payout ratio and other key bank characteristics at the bank-quarter level. Larger banks and, to a lower extent, more profitable, more liquid and better-capitalized banks have higher buyback-to-payout ratios on average.

3.5 Estimation

We now outline the empirical specifications used to test our hypotheses. We, first, describe how we test the effects of the imposition, and subsequent relaxation, of payout restrictions on bank equity prices. We, next, focus on the way we test the impact on debt values. Lastly, we describe our tests on the lending margin.

3.5.1 Equity Response

To test hypothesis 3.1 about the equity response to the imposition and removal of payout restrictions on CCAR banks, we use the aggregated minute-by-minute stock level data and 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 pm ET (i.e., divide by P_{it} at t = 4pm) to facilitate comparison of prices across stocks. $\mathit{CCAR\ Bank}_i$ 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. α_i and α_t are firm and minute fixed-effects that capture any time-invariant factors at the firm level and remove macro-level time variation. The coefficients of interest are the sequence of β_τ. Standard errors are double-clustered at the firm and minute 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 that stock price reactions can be precisely estimated. The identifying assumptions are the absence of pre-trends and the lack of other announcements over the 2-hour time window which may 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

	Obs.	Mean	Std. Dev.	P10	P25	Median	P75	P90
Panel A: Firm-Bank-Quarter Level								
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								
	Obs.	Mean	Std. Dev.	P10	P25	Median	P75	P90
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								
	Obs.	Mean	Std. Dev.	P10	P25	Median	P75	P90
Buyback/Payout (2017-19)	20	0.667	0.093	0.528	0.607	0.678	0.737	0.783

Panel D: Correlation Bank-Quarter Level

	Buyback/Payout (2017-19)	Bank assets ($000,000)	Bank ROE	Bank Liquidity ratio	Bank Tier 1 ratio
Buyback/Payout (2017-19)	1				
Bank assets ($000,000)	0.3191	1			
Bank ROE	0.0815	0.0546	1		
Bank Liquidity ratio	0.0435	-0.0700	0.1319	1	
Bank Tier 1 ratio	0.0967	0.3321	0.3218	0.2600	1

Table reports summary statistics for firm-bank-quarter credit relationships (Panel A) and bank-quarter level data around the introduction and lifting 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 the average buyback to payout ratio over 2017-19 for each bank in the sample. Panel D reports a correlation matrix between the average buyback to payout ratio over 2017-19 and key bank variables at the bank-quarter level.

Table 3: FR Y-14Q H1 schedule and FR Y-9C summary statistics

infrequently traded over the time window. To mitigate concerns about the choice of the control group, Section 4.2.2 provides evidence using daily equity market data with a tighter control group that only consists of publicly traded non-CCAR banks.

3.5.2 Debt Response

To test hypothesis 3.2 about the debt response, we rely on daily CDS spreads data and an event-study approach using a 10-day window around each Fed announcement. In particular, we estimate the following econometric model:

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

Spread$_{it}$ is the CDS spread of firm i on day t. X_{it} are contract-level controls. $\alpha_{t,r}$ are day-rating fixed effects. The main coefficients of interest are the series of γ_τ on the interaction between a time dummy for each day and the treatment CCAR-bank dummy, *CCAR Bank*$_i$. In this specification the control group includes other financial firms, implying a tighter set of firms relative to the event studies on equity prices. Standard errors are again double-clustered by firm and day. We estimate Equation 6 for all available frequencies of CDS spreads.

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

3.5.3 Effects on Risk-Taking in Lending

To test hypothesis 3.3 on the impact of payout restrictions on bank risk-taking on the asset-side of their balance sheet, we focus on lending activities and use data from the corporate loan schedule H1 of the Federal Reserve's Y-14Q collection. This dataset is the ideal source to study this question as it provides granular information on the C&I portfolio of CCAR banks. We focus on new loan originations aggregated at the firm-bank-quarter level and spanning six quarters from 2020:Q1 to 2021:Q2.

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 ex-ante more affected by the restrictions cut their risk-taking after in 2020:Q3-2020:Q4 relative to banks that were less affected. Conversely, when the restrictions are lifted, we test if banks that were ex-ante more affected increase their risk-taking behavior in 2021:Q1-2021:Q2 relative to the other CCAR banks. Specifically, we estimate the model outlined in Equation 7:

$$\begin{aligned} log(Loans_{ibstc}) = \alpha_{s,t} + \alpha_{c,t} + \beta_1 \mathit{Post}_t^{Jun2020} \mathit{PD}_{ibt} Z_b + \beta_2 \mathit{PD}_{ibt} + \\ \beta_3 \mathit{PD}_{ibt} Z_b + \beta_4 \mathit{Post}_t^{Jun2020} Z_b + \beta_5 \mathit{PD}_{ibt} \mathit{Post}_t^{Jun2020} + \gamma_1 \mathit{Post}_t^{Dec2020} \mathit{PD}_{ibt} Z_b + \\ \gamma_2 \mathit{Post}_t^{Dec2020} Z_b + \gamma_3 \mathit{PD}_{ibt} \mathit{Post}_t^{Dec2020} + \delta_1 X_{i,t-4} + \delta_2 W_{b,t-1} + \epsilon_{ibstc} \end{aligned} \tag{7}$$

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. $\mathit{Post}_t^{Jun2020}$ is a dummy for the period 2020:Q3-2020:Q4 after the first regulatory announcement on June 25, 2020. $\mathit{Post}_t^{Dec2020}$ is a dummy for the period 2021:Q1-2021:Q2 after the relaxation of the payout restrictions on December 18, 2020. PD_{ibt} is the probability of default of firm i estimated by bank b at time t. Z_i is a measure of how constrained the bank is by payout restrictions. $\alpha_{s,t}$ are industry-quarter fixed effects and $\alpha_{c,t}$ are county-quarter fixed effects. $X_{i,t-4}$ 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 payout restrictions, we use banks' propensity to rely on 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 four quarters. In practice, the binding constraint on dividends consisted in the fact that these could not be increased. Since the literature has long shown that firms tend to smooth dividends over time (Leary and Michaely, 2011), banks that were ex-ante more reliant on share buybacks (relative to dividends) were more constrained by the restrictions. Concretely, we 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.

Firm-level controls, firm industry-quarter fixed effects and narrow location-time fixed effects absorb variation in local demand conditions, allowing us to focus on the supply of credit. In a more restrictive specification, we go as far as to saturate Equation 7 with bank-quarter fixed effects to absorb any time-varying bank-specific characteristic that may affect its lending behavior beside the extent to which the bank is ex-ante constrained by payout restrictions.

The main coefficients of interest in this triple differences-in-differences specification are β_1 and γ_1. β_1 captures the differential effect on bank risk-taking, as measured by the borrowers' PD, after the introduction of payout restrictions depending on banks' exposure to those policies. γ_1 measures the differential impact on bank 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.[14]

4 Empirical Results on Payouts, Equity and Debt Prices

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

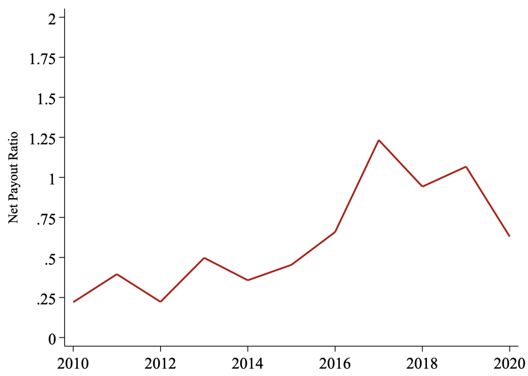
4.1 Overview of CCAR banks

We start by presenting empirical evidence on CCAR banks' aggregate payout behavior in response to the introduction and relaxation of payout restrictions. For the analysis, we define the net payout ratio of bank i at time t as follows:

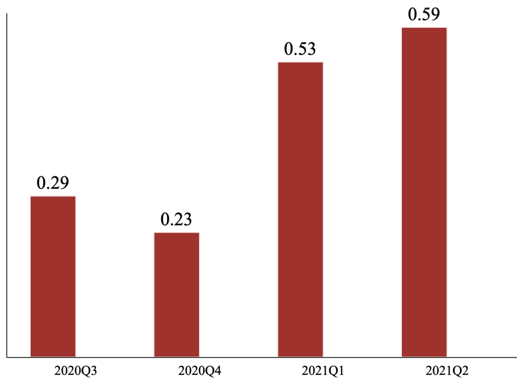
$$Net\ Payout\ Ratio_{it} = \frac{Div_{it} + BB_{it} - Iss_{it}}{Net\ Income_{it}} \tag{8}$$

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

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 normalized by net income $Net\ Income_{it}$. The normalization ensures comparability across banks and a simple interpretation. 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 the time series of the yearly aggregate net payout ratio of CCAR banks over 2010-2020. Net payout ratio is defined as dividends plus share buybacks minus issuances, divided by net income. Panel b) reports the quarterly aggregate net payout ratio of CCAR banks from 2020:Q3 to 2021:Q2. Data is from Compustat and FR Y9C.

Figure 2: CCAR Banks Net Payout Ratio

Panel (a) of Figure 2 reports the time series of the aggregate net payout ratio of CCAR banks over 2010-2020. Before the Covid-crisis, the aggregate net payout ratio hovered around 1, indicating that CCAR banks were on average paying out all of their net income. In 2020, there was a sharp reduction in net payouts. Panel (b) zooms into the evolution of the aggregate net payout ratio from 2020:Q3 to 2021:Q2. It confirms that the net payout ratio was low on aggregate (0.29 and 0.23) in the two quarters when payout restrictions were in place. However, once restrictions were relaxed at the end of 2020, the aggregate net payout ratio experienced an upward jump 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.[15]

We also show in Figure E.2 that the net payout ratio rose for CCAR banks after the relaxation

[15] Appendix E.11 further discusses the time series behavior of loan loss reserves.

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 2020:Q3-2020:Q4, 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).[16] Upon the lifting of the restrictions, the median CCAR bank saw a 0.43 percentage point decline in its Tier-1 capital ratio over 2021:Q1-2021:Q2 when share buybacks were resumed.

4.2 Equity Response

We now report the results our test of hypothesis 3.1 using Equation 5.

4.2.1 High Frequency Event Studies

The first empirical test exploits the June 25, 2020, announcement on the introduction of payout restrictions. At 4:30 pm ET, the Federal Reserve announced that payouts of large US banks, those taking part in CCAR, would be restricted going forward for an unspecified length of time.

Panel (a) of Figure 3 reports the average minute-by-minute stock price for i) CCAR banks and ii) other firms excluding CCAR banks around the June 25, 2020, announcement. The vertical dashed line indicates the announcement time at 4:30 pm ET. Following the announcement, a persistent gap emerges between the two time series, with prices of CCAR banks declining more

[16] 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.

than those of other firms. To remove time-invariant heterogeneity across equity issuers and account for time-varying factors via time fixed effects, we formally estimate Equation 5 and report the event-study coefficients with their 95 % confidence bands in Panel (c).

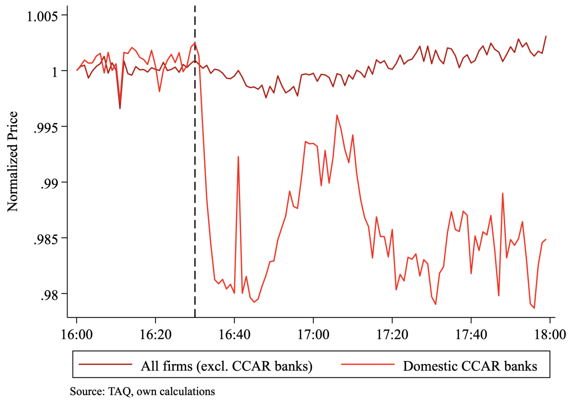
Prior to the announcement, at this very high minutely frequency, prices of CCAR banks and other firms trended in parallel, providing strong support to the identifying parallel trends assumption. However, immediately after the announcement, stock prices fell by about 2% for CCAR banks relative to other stocks suggesting that payout restrictions depress equity values. This effect only took 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 reveals that any benefit to shareholders from payout restrictions in terms of lower the cost of debt rollover are dominated by risk-shifting or negative news effects.

The second event we exploit is the substantial lifting of payout restrictions on December 18, 2020. As discussed earlier, the restrictions that remained in place after December 2020 were not particularly binding. Panel (b) and panel (d) of Figure 3 report the equity response for CCAR banks relative to the remainder of public firms on 12/18/2020.

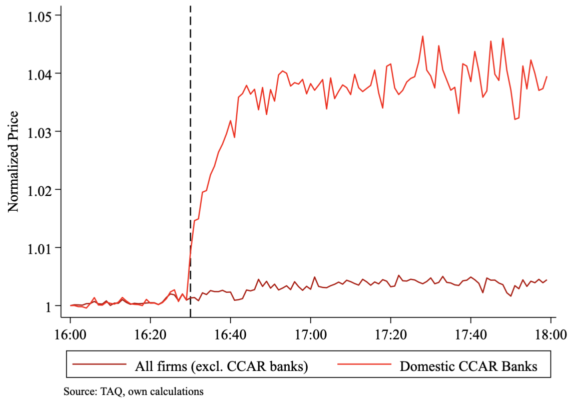
The identifying assumption of a lack of a pre-trend is corroborated by panel (b). Importantly, within minutes of the announcement that payout restrictions would be loosened, equity values rose by about 4% for CCAR banks relative to other stocks. The effect is both statistically and economically highly significant, showing that the lifting of payout restrictions was partly unexpected and, therefore, not priced in ex-ante. This response contrasts sharply with that of European banks to the lifting of the Euro area dividend restrictions in late 2021, which appears to have been mostly priced in ex-ante (Ampudia et al., 2023). The un-anticipated nature of the relaxation of payout restrictions in the US allows us to go one step further and investigate the impact of payout policies on banks' risk-taking more holistically, as discussed in section 5.2.

4.2.2 Abnormal Returns around Announcements

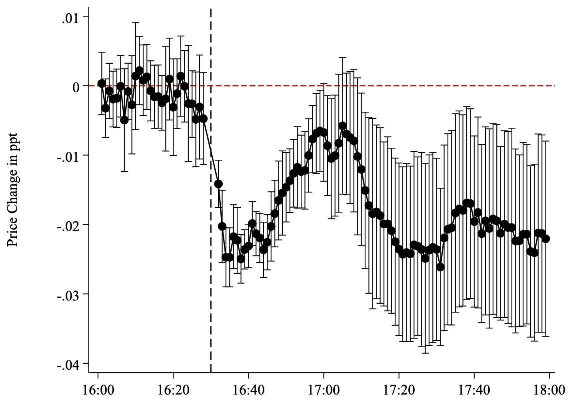
One concern about the event studies presented so far is that the control group includes both financial and non-financial firms, with the latter not being an ideal set of control units for CCAR banks. A second potential concern is that liquidity in the after-hours market around



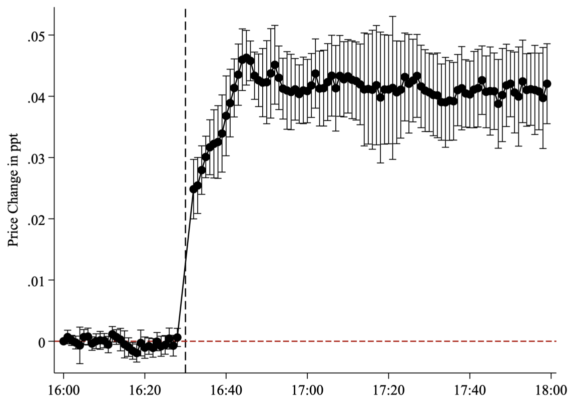
(a) June 25, 2020 - Raw Data



(b) December 18, 2020 - Raw Data



(c) June 25, 2020 - Event Study



(d) December 18, 2020 - Event Study

Panel (a) and panel (b) report the time series of the average stock price for domestic CCAR banks and other firms excluding CCAR banks around i) the 06/25/2020 announcement (panel a) and ii) the 12/18/2020 announcement (panel b). Prices are at the minute level and normalized to 1 at 4:00 pm ET. Panel (c) and panel (d) report the β_τ coefficients of the interaction terms between the CCAR bank indicator and minute dummies of Equation 5, along with their 95 % confidence bands, estimated in event study regressions around i) the 06/25/2020 announcement (panel c) and ii) the 12/18/2020 announcement (panel d). Prices are normalized to 1 at 4:00 pm ET. Standard errors are double-clustered at the firm and time level. Source: TAQ data.

Figure 3: Equity Response: High-frequency Event Studies

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)). The use of data on daily stock prices allows us to restrict the control group to a set of smaller banks. Estimation details are described in Appendix E.4. Importantly, this robustness exercise is also relevant to test whether the announcements on the introduction and relaxation of payout restrictions had lasting effects.

Panel A of Table 4 reports the results from a size-weighted regression of cumulative abnormal returns at the bank-level onto the CCAR bank indicator for each of the ten trading days after the June 25, 2020, announcement about the introduction of payout restrictions. CCAR banks experienced significantly lower abnormal returns after the announcement relative to a control group that only consists of smaller banks. Thus, the decline in equity values documented in the high-frequency event studies of Figure 3 is robust to a much tighter control group and persists at least over a 10-day horizon.

We repeat the same methodology for cumulative abnormal returns following the announcement about the relaxation of payout restrictions on December 18, 2020. Panel B of Table 4 contains the estimates of the size-weighted regressions comparing CCAR banks to the control group of smaller banks around this announcement. Results confirm that the positive effect of the December 2020 announcement on equity values of CCAR banks is robust to a tighter control group and extends to the beginning of January. This highlights that the high-frequency responses identified by using minute-by-minute stock prices have economic relevance over a longer time frame, hereby hinting to a non-transitory impact of payout restrictions on bank equity values. This is corroborated by the evidence presented in Appendix E.5, which documents persistent effects over the longer run.

Panel A: June 25, 2020			Panel B: December 18, 2020		
Date	Coefficient	SE	Date	Coefficient	SE
6/26/2020	-.0135***	(0.0050)	12/21/2020	.03196***	(0.0049)
6/29/2020	-.0305***	(0.0037)	12/22/2020	.01844***	(0.0047)
6/30/2020	-.0336***	(0.0047)	12/23/2020	.02493***	(0.0055)
7/1/2020	-.0351***	(0.0047)	12/24/2020	.02299***	(0.0051)
7/2/2020	-.0380***	(0.0053)	12/28/2020	.02279***	(0.0053)
7/6/2020	-.0350***	(0.0066)	12/29/2020	.02646***	(0.0055)
7/7/2020	-.0423***	(0.0073)	12/30/2020	.02332***	(0.0054)
7/8/2020	-.0423***	(0.0090)	12/31/2020	.02873***	(0.0053)
7/9/2020	-.0422***	(0.0099)	1/4/2021	.02893***	(0.0067)
7/10/2020	-.0211**	(0.0087)	1/5/2021	.02701***	(0.0072)

Table reports coefficients from daily regressions of cumulative abnormal returns at the bank-level onto the CCAR bank indicator for each of the 10 days after i) the 06/25/2020 announcement (panel A) and ii) the 12/18/2020 announcement (panel B). Cumulative abnormal returns are calculated up to the corresponding date. 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 size-weighted by market value. Source: CRSP and own calculations.

Table 4: Equity Response: CAR Weighted Regression (Banks only)

Tables presented in Appendix E.8 show that our findings on cumulative abnormal returns are robust to running equal-weighted regressions, as well as to running weighted and unweighted regressions comparing CCAR banks to the broader control group of other financial firms (SIC codes 6000-6999, excluding 6726). We consider size-weighted regressions more appropriate as they are representative of the overall market, ensuring that the responses are not driven by small entities.

In a further set of robustness checks, we re-estimate cumulative abnormal returns, as outlined in equations 11 and 12, by replacing the model for returns with a Fama and French (1992) 3-factor model. Results for weighted and unweighted regressions encompassing the control group of small banks are reported in Appendix E.9. The estimates are qualitatively and quantitatively comparable to those of Table 4.

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 channels as outlined in hypothesis 3.2. In what follows, we test this hypothesis relying on the event studies framework of Equation 6.

4.3.1 Event Studies

Panel (a) of Figure 4 reports the average 5-year CDS spread for i) CCAR banks and ii) other financial firms around the June 25, 2020, announcement. Panel (c) displays the results of the corresponding high-frequency event study run by estimating Equation 6. CDS spreads are normalized to 1 on the announcement date, which is reported as day 0 in the plots.

CDS spreads trended mostly parallel prior to the announcement of the imposition of payout restrictions. Following the announcement, CDS spreads fell significantly for CCAR banks relative to the control group of financial firms. Quantitatively, the effect is about 2 basis points after 5 trading days. Figure E.9 shows that a similar effect is observed across the entire term structure of CDS spreads.

These results support the risk-shifting channel, while rejecting the negative news channel. If payout restrictions mostly communicated negative unexpected information about bank assets to the market, CDS spreads of CCAR banks should have risen consistent with higher default risk. However, we observe that CDS spreads of CCAR banks declined relative to CDS spreads of other financial firms. This indicates that risk is shifted from debtholders onto equityholders when a binding payout restriction is imposed on banks. We should caveat, though, that our results may only reflect a lower bound in the magnitude of risk-shifting if both a negative news effect and a risk-shifting effect occurred simultaneously. In other words, our results show that the risk-shifting channel dominated, but the negative impact of payout restrictions on CDS spreads could have been even larger absent of the confounding news effect.

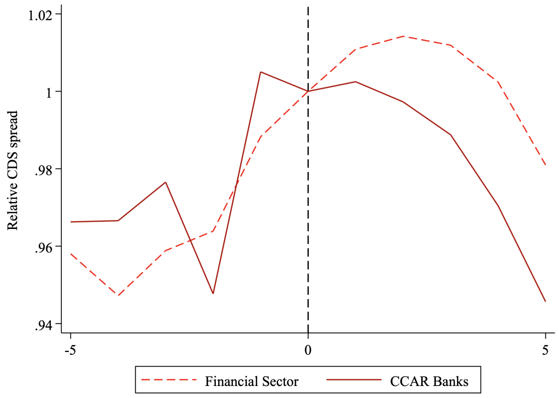
Panel (c) and panel (d) of Figure 4 present the results for the December 18, 2020, announcement. In this case, CDS spreads are normalized to 1 on 12/18/2020 to facilitate comparison. While spreads trended relatively in parallel until December 18, 2020, they sharply diverged after the announcement. CDS spreads of CCAR banks increased by more than 1 basis point relative to those of other financial firms after the lifting of payout restrictions. Since the average CDS spread of CCAR banks hovered around 106 basis points prior to the announcement, this corresponds to at least a .94% increase. Overall this is suggestive of equityholders shifting risk back into debtholders, leading to a rise in default risk. Figure E.10 shows that the rise in CDS spreads affects the entire term structure of CDS spreads.

4.4 Additional Results

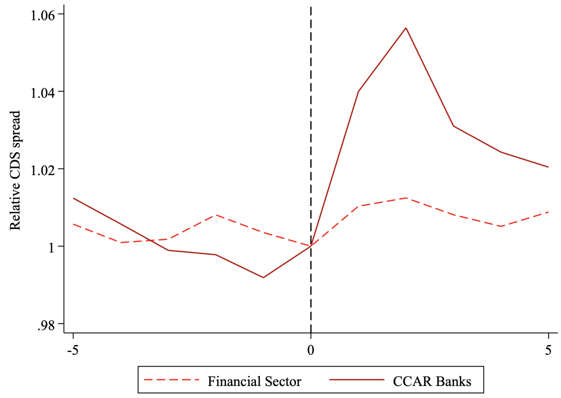
Additional results are outlined in the appendix. Appendix E.3 discusses why an agency-theoretic explanation of the effects is unlikely.

Appendix E.5 provides evidence on the persistence of the impact of payout restrictions on equity prices of CCAR banks, as those continued to underperform for months after the restrictions were imposed. This finding, together with the lasting negative impact of payout restrictions on CDS spreads weeks after the June 2020 announcement, represents an important piece of evidence. In fact, it suggests that the almost "mechanical" decline in bank risk due to improved capital buffers as a result of the restrictions is not counteracted by an increase in risk-taking on the asset-side of banks' balance sheet. We explore this point in the next section.

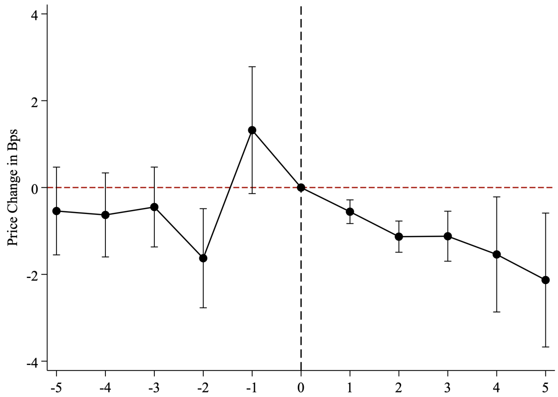
Appendix E.6 looks at the announcement on March 25, 2021, when the Federal Reserve stated that the remaining restrictions would be lifted on June 30, 2021. Results reveal that the equity response after the 03/25/2021 announcement was much smaller compared to the



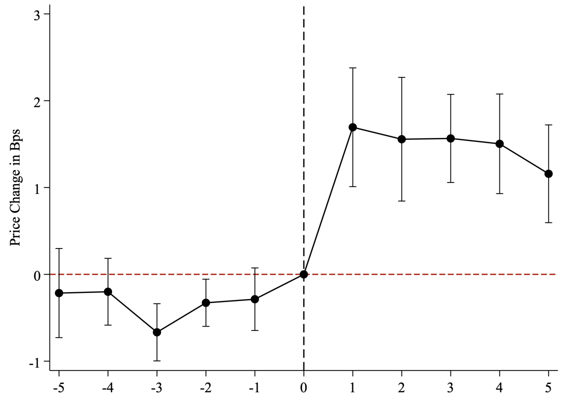
(a) June 25, 2020 - Raw Data



(b) December 18, 2020 - Raw Data



(c) June 25, 2020 - Event Study



(d) December 18, 2020 - Event Study

Panel (a) and panel (b) report the time series of the average CDS spread for domestic CCAR banks and other firms excluding CCAR banks around i) the 06/25/2020 announcement (panel a) and ii) the 12/18/2020 announcement (panel b). Average CDS spreads are normalized to 1 on the announcement date. Panel (c) and panel (d) report the γ_τ coefficients of the interaction terms between the CCAR bank indicator and day dummies of Equation 6, along with their 95 % confidence bands, estimated in event study regressions around i) the 06/25/2020 announcement (panel c) and ii) the 12/18/2020 announcement (panel d). CDS spreads are normalized to 1 on the announcement date. Standard errors are clustered at the firm-level. Source: IHS Markit.

Figure 4: Debt Response: Event Studies

equity response on 12/18/2020, supporting the argument that the main lifting of the restrictions occurred on 12/18/2020.

Appendix E.11 discusses why risk-shifting of CCAR banks amid the relaxation of payout restrictions is not inconsistent with the substantial increase in loan loss provisioning observed during the pandemic.

Finally, Appendix E.12 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 we document in this paper and with the evidence presented by Mücke (2023).

5 Empirical Results on Risk-taking Decisions in Lending

In this section, we investigate if payout restrictions also affect banks' risk-taking decisions on the asset-side of their balance sheet, as outlined in hypothesis 3.3. The introduction of payout restrictions shifts risk from debtholders into 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. That is, risky projects that would be optimally turned down with payout restrictions in place, because shareholders would bear too much risk, become appealing when a sufficient portion of the downside risk is transferred to debtholders.

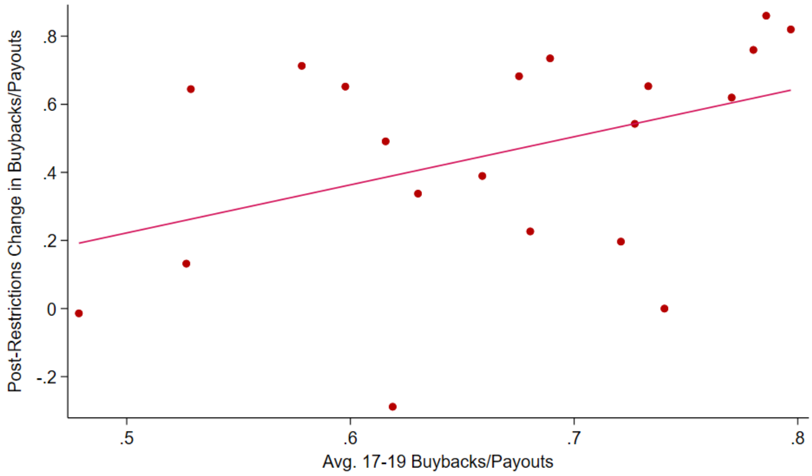
5.1 A Measure for Bank Exposure to Payout Restrictions

To test hypothesis 3.3 we focus on banks' lending activities and use corporate loan data from the Federal Reserve's Y-14Q collection. Testing whether the regulatory announcements about payout restrictions affect banks risk-taking in lending is empirically challenging because the restrictions affect all CCAR banks uniformly and the Y-14 data we use does not contain information for non-CCAR banks. As we mention in Section3.5.3, we overcame this issue relying on the different treatment of share buybacks and dividends under the payout restrictions implemented in the US to generate variation in the severity of the policies within the set of CCAR banks. While share buybacks were banned, dividends were 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 were 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 have not been affected at all in its payout decisions. A bank that was only using share buybacks to pay out to shareholders, instead, would have needed 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 2017-2019 period, prior to the regulatory intervention in June 2020. This measure is constructed over a 3-year time span so that it is not driven by idiosyncratic payout decisions in one particular quarter. The average bank had a 0.67 share of total payouts in the form of buybacks over 2017-2019, with the remainder (0.33) being accounted for by dividends. There is, though, a sizable variation in banks' ex-ante propensity to use share buybacks relative to dividends. The buybacks to payout ratio ranges from 0.53 (10th percentile) to 0.78 (90th percentile), as documented in Table 3.

We validate our measure in two ways. First, if this correctly captures how constrained banks were by the payout restrictions imposed during the pandemic, one would expect the following: when payout restrictions were relaxed, banks that were ex-ante more affected, that is more reliant on share buybacks, increased their payouts relative to banks that were less affected, i.e., more reliant on dividends. In panel (a) of Figure 5, we plot the change in banks' buyback to payout ratio around the relaxation of restrictions (comparing 2021:Q1-Q2 to 2020:Q3-Q4) against banks' ex-ante reliance on share buybacks, as measured by their average buyback to payout ratio over 2017-2019. We find that the bank-level pre-pandemic buyback to payout ratio correlates strongly with the bank-level increase in share buybacks after the relaxation of restrictions. The correlation coefficient is 0.51, suggesting 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 restrictions were in place.

Second, as noted in Section 4.1, the median CCAR bank experienced an increase in its Tier 1 capital ratio after the imposition of payout restrictions, reflecting higher retained earnings. Thus, we would expect that our measure for banks' ex-ante exposure to the payout policies correlates positively with the bank-level change in Tier 1 capital ratio after the June 2020 announcement, and negatively with the bank-level change in Tier 1 capital ratio after the December 2020 announcement. The evidence presented in Appendix F confirm this hypothesis. Taken together, these results corroborate the use of the average buyback to payout ratio over 2017-2019 as measure of banks' ex-ante exposure to the payout restrictions imposed during the pandemic.



Graph reports the difference between 2021 buyback-to-payouts ratio and 2020:Q3-2020:Q4 buybacks-to-payout ratio (y-axis) against the average ratio of share buybacks to total payouts for domestic CCAR banks over the time period 2017-19 (x-axis). 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.

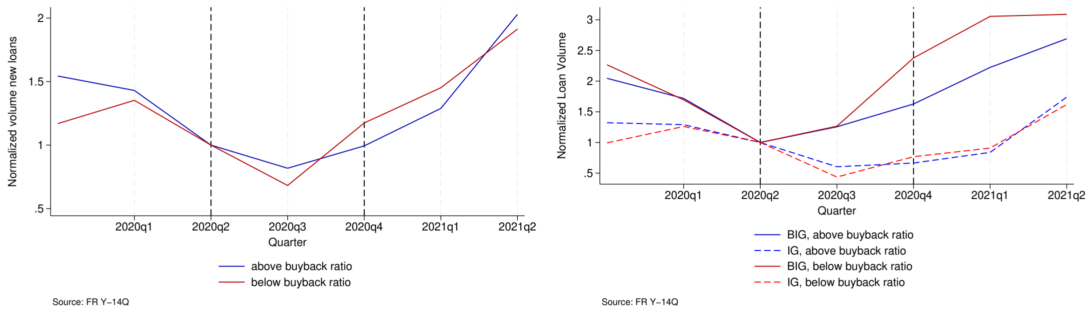
Figure 5: Ex-ante payout ratios and ex-post increase in buybacks

5.2 Empirical Evidence on Risk-Taking in Lending

Next, we present our analysis on banks' risk-taking in lending in response to the introduction and subsequent relaxation of payout restrictions. We start with some aggregate evidence on bank lending around the announcements by splitting the sample into banks with an average 2017-19 buyback-to-payout ratio above, respectively below, the median. Panel (a) of Figure 6 shows that the introduction and relaxation of payout restrictions did not have a differential impact on the total volume of new loans extended by the two group of banks.[17] Differently, Panel (b) shows that lending to risky firms at buyback-reliant banks grew less than lending to risky firms at not buyback-reliant banks while the restrictions were in place. This pattern reversed once the restrictions were removed in December 2020. Hence, the graphical evidence suggests that payout restrictions did not affect aggregate credit supply, but rather implied a reallocation of lending to borrowers with different risk profiles. 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.

Subsequently, we investigate the differential risk-taking behavior of more versus less affected banks by payout policies more formally. To this end, we estimate the triple differences-

[17] Figure G.17 reports a version of this 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 2020:Q2. 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 2020:Q2. 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 Y14Q-H1. BIG = below investment grade. IG = investment grade.

Figure 6: Lending around Regulatory Announcements

in-differences specification of equation 7 to test if banks that were ex-ante more constrained by payout restrictions shifted their lending towards riskier/safer borrowers relative to less constrained banks around the regulatory announcements.

Table 5 reports the results.[18] After the introduction of payout restrictions, banks that were more constrained, as measured by their pre-2020 propensity to use share buybacks relative to dividends, cut back on their risk-taking relative to less constrained banks. This effect reversed upon the lifting of the restrictions, when banks more reliant on share buybacks prior to the pandemic increased their risk-taking relative to other CCAR banks. Concretely, a bank with a one standard deviation higher pre-2020 propensity to use share buybacks (.093) grants 3.4% smaller loans to borrowers with a one standard deviation greater probability of default (.031) after payout restrictions are imposed (column 1). Results are fully robust to saturating the regression with bank-quarter fixed effects (column 2). This absorbs any time-varying bank-specific factors that may affect banks' lending behavior beside their ex-ante reliance on share buybacks.

One concern is that banks may grant loans and subsequently dispose of them. If that margin drives to some extent 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,

[18]We present a compact regression table here; Table G.16 contains more detailed results.

however, that our estimates remain comparable after removing disposed loans from the sample[19] suggesting that factors such as, e.g., an increase in the demand for securitization around the time of relaxation of payout restrictions do not drive our results.[20]

When the restrictions are lifted, a bank with a one standard deviation greater propensity to use share buybacks (.093) grants 8.8% larger loans to firms with a one standard deviation (.031) greater probability of default. The effect its statistically and economically significant across all specifications, as well as robust to the inclusion of bank-quarter 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 may have positively affected the demand for securitization or loan investments by non-bank entities. In that case, banks may have expanded loan origination to riskier borrowers to satisfy such demand in the securitization market and the secondary market. However, the coefficients of the triple interaction in model 3 and model 4 are economically comparable, suggesting that banks' incentive to risk-shift is the key driver of our results.

Jointly, the evidence from Table 5 and Figure 5 is consistent with the theoretical predictions of hypothesis 3.3. Our findings confirm that payout restrictions not only affect banks' payouts, but also exert an effect on banks' risk-taking. Banks that are more tightly restricted reduce their risk-taking relative to less affected banks when restrictions are introduced; the opposite is true when payout restrictions are lifted. More generally, this reveals that payout and risk-taking decisions can be complementary and that banks may risk-shift both through payout and risk-taking choices in lending.

While our findings provide support to the risk-shifting channel, they suggest that the risk management channel à la Froot et al. (1993) is not at play. This is consistent with the decline

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

[20] Another potential concern is whether our metric of banks' exposure to payout restrictions correlates with banks' ability to intermediate Paycheck Protection Program (PPP) loans, which may also affect the risk profile of the loan portfolio. Yet, the PPP was rolled on April 3, 2020, significantly predating the introduction of payout restrictions. By June 2020, most first and second round PPP loans had already been issued and the share of new PPP loans exceeding the $1 million reporting threshold in the FR Y-14Q data was below 5%, and even lower for the top 4 largest banks (Granja et al., 2022). Moreover, even for the third round in early 2021, the median and 3rd quartile of the PPP loan distribution were below $100,000 (Fairlie and Fossen, 2022). Hence, PPP loans are likely to account for a small share of our data and banks' potentially heterogeneous ability to process PPP loans is unlikely to drive our results.

	(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 5: Risk-taking around regulatory announcements

in equity prices discussed earlier. If shareholders had benefited from cheaper debt funding to finance additional equity-value enhancing risk-taking, equity values should have risen and risk-taking should have increased for the more exposed banks relative to other banks during the time frame in which the restrictions where in place. Neither is the case. This is consistent with the notion that deposit rates, which make up the bulk of banks' debt financing, are relatively sticky (Drechsler et al., 2021).

A natural question from a regulatory perspective is whether payout restrictions may have unintended consequences beside the benefits of shoring up bank capital and reducing risk-taking. For example, riskier borrowers may lose access to credit during a severe downturn. This represents an important question for future research.

Finally, Table G.17 reports the estimates of a different version of equation 7 where we substitute the dependent variable with the (weighted average) interest rate charged on new loans extended by a bank to a firm. We use the interest rate rather than the spread because the latter is not available for the subset of fixed-rate loans. We do not observe any statistically discernible effect on the interest rate after the introduction of payout restrictions in June 2020. However, once restrictions are relaxed in December 2020, banks ex-ante more reliant on share buybacks charge lower interest rates to riskier borrowers relative to banks more reliant on dividends. These results are consistent with those of Table 5 and confirm that banks for which payout restrictions are more binding increase risk-taking in lending after the relaxation of the policies.

6 Conclusion

This paper provides the first quantitative evaluation of payout restrictions as a policy tool to reduce bank risk-shifting, using the imposition and subsequent relaxation of payout restrictions on large US banks during the Covid-19 crisis as a natural experiment. Payout restrictions differ from other tools to increase bank capital in times of crisis as they directly increase bank equity through higher retained earnings (in contrast to higher capital requirements which may be met by reducing risk-weighted assets) and involve discretion (in contrast to hybrid capital instruments that are contracted ex-ante).

When the Federal Reserve introduced payout limitations on the subset of banks subject to the Comprehensive Capital Analysis and Review in June 2020, stock prices of those banks dropped while debt values increased, consistent with a shift of risk from debtholders onto shareholders. When payout restrictions were lifted in December 2020, both of these effects reverted and payouts increased substantially.

We, further, show that the introduction and removal of payout restrictions affect lending decisions at restricted banks. When payout restrictions were introduced, banks that were more affected - as measured by their ex-ante reliance on share buybacks relative to dividends - reduced their risk-taking relative to banks that were less affected, while the overall credit supply remained unaffected. Upon lifting the restrictions, riskier lending by constrained banks increased by 8.8%

for borrowers with one standard deviation higher probability of default relative to banks that were less constrained. In sum, these results indicate that payout restrictions not only reduce payouts and improve equity buffers, but also curb risk-taking incentives. Conversely, the relaxation of payout restrictions was followed by an increase in payouts and greater risk-taking at banks that were relatively more constrained. Our paper, thus, highlights the benefits of lower banking sector risk due to higher capital and reduced incentives to take on risk under payout restrictions. But it also points to a potential trade-off, as payout restrictions may cut off risky borrowers from credit during a recession.

A standard contractual solution to mitigate risk-shifting via payouts would be payout covenants in debt contracts. The literature has pointed out that frictions, such as public guarantees on bank debt and network externalities, may imply an under-provision of payout covenants in privately negotiated debt contracts (Acharya et al., 2017). Payout restrictions imposed by the regulator are one potential remedy. They effectively amount to a publicly imposed payout covenant circumventing the frictions that lead to private under-provision. In the Basel III regulatory framework, breaches of the capital conservation buffer are also sanctioned by limits to dividends and boni.[21] Exploring the optimal policy of setting payout restrictions, including banks' potential reaction if restrictions are expected in some future states, remains an avenue for future research.

[21] `https://www.esrb.europa.eu/national_policy/capital/html/index.en.html`. This extends measures from the 1991 Prompt Corrective Action Procedure that imposes payout restrictions on US banks that breach capital ratios.

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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 with bid-ask spreads for some observations where pricing data is not available.

A.2 TAQ

We use the TAQ trade repository, which captures every 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)), these ultra-high-frequency data contain 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 a 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 by 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 the 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.

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 $\phi = 1$.[22] Re-arranging yields:

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

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

The FOC is:

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

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:

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

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

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

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

B.2 Proof of Proposition B.4

Remember that debt value was given by:

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

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

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 B.3

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:

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

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

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

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

B.4 Proof of second part of Propositions 2.3 and 2.4

Remember that equity and debt value are respectively given by:

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

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:

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

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:

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

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. This proves the second part of proposition 2.3.

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:

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

This completes the proof of the second part of Proposition 2.4.

B.5 Proof of Proposition 2.5

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:

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

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

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

Case 1:

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

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

Case 2:

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

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

Case 3:

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

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

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

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

Condition 2:

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

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

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

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

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

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

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

So we now analyse when the following two conditions hold:

$$
\begin{aligned}
V3 &> V1 \\
V3 &> V2
\end{aligned}
$$

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

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

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) :

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

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

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

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 $(V3)$:

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

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

$$
\begin{aligned}
& \frac{\bar{a}c}{2}-\underline{a}^2-\frac{3\underline{a}c}{2}-\ell^2+2\ell\underline{a}+c\ell>0 \\
\Leftrightarrow \; & \frac{(\bar{a}-\underline{a})c}{2}-\underline{a}c-\underline{a}^2-\ell(\ell-c-2\underline{a})>0 \\
\Leftrightarrow \; & \frac{(\bar{a}-\underline{a})c}{2}-\underline{a}c-\underline{a}^2-\ell(\ell-c-\underline{a})+\underline{a}\ell>0
\end{aligned}
\tag{10}
$$

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 2.5.

B.6 Additional Model Results

Proposition B.3. *The expected payment from the government to debtholders rises in d.*

Proposition B.3 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.

Proposition B.4. *The response of debt value to reducing payouts is declining in ϕ.*

The intuition for this proposition is as follows: With more extensive government guarantees, 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.

C Summary Statistics

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 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.3: 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”.[23] Moreover, one Fed governor dissented from the decision, arguing to additionally ban dividends.[24] 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”[25], 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.”[26]

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 4:30 pm ET, markets expected that ”the Fed is

[23] 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

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

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

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

likely to keep a pandemic-induced halt on buybacks and caps on dividends."[27] 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".[28]

Once the relaxation of the restrictions was announced, this was viewed as an "unexpected buyback clearance" and "surprise decision".[29]

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

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

[29] 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. To this end, we subtract loan-loss provisions from net income. This robustness check ensures that the dynamics of the aggregate net payout ratio is not driven by loan-loss provisions, which underwent substantial fluctuations over the course of the Covid pandemic. The dark red bars report the aggregate net payout ratio using unadjusted net income, the light red bars report the aggregate net payout ratio computed using adjusted net income. One can see that the release of loan loss reserves in early 2021 dampens the aggregate net payout ratio. Measured as a fraction of adjusted net income, the increase in net payouts after the relaxation of payout restrictions in December 2020 is even more pronounced. That is because the release of loan loss reserves contributed substantially to banks' net income in early 2021.

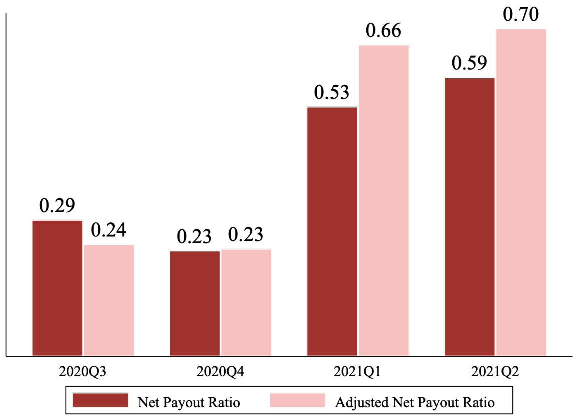


Figure reports net payout ratio for CCAR banks. Net payout ratio is defined as dividends plus net share buybacks, divided by net income. This figure is reported by dark red bars. Light red bars use adjusted net income which adjusts for the contribution of loan loss provisions to net income. Data is from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

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

Figure E.2 compares the aggregate net payout ratio of CCAR banks on the right-hand side with that 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 confirms that the relaxation of payout restrictions was the key driver behind the surge in CCAR banks' payouts in early 2021, and not macroeconomic or industry-wide factors.

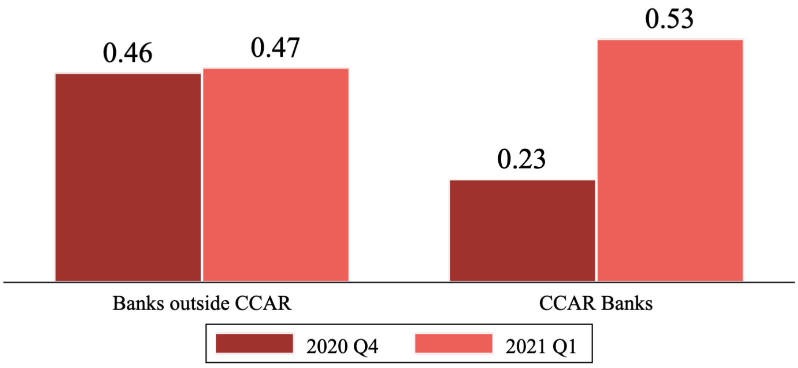
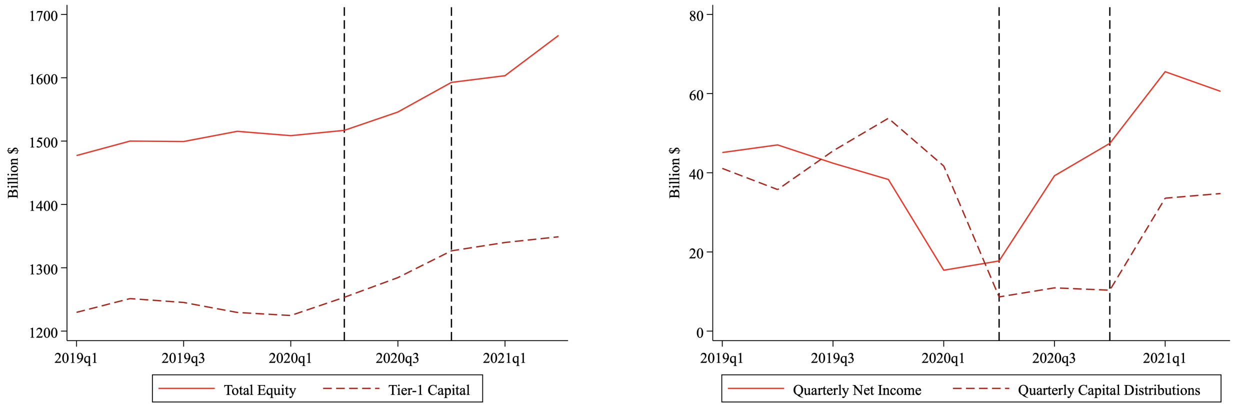


Figure reports net payout ratio for 2020 Q4 and 2021 Q1 for CCAR banks and largest 14 banks outside CCAR. Net payout ratio is defined as dividends plus net share buybacks, divided by net income. Data is from Compustat and FR Y9-C.

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 during the time period in which payout restrictions were in place, driven by an accumulation of retained earnings. This increase in the level of bank capital was not accompanied by a rise in risk-weighted assets, hereby leading to an increase of 0.62 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 the sum of total equity and total Tier-1 regulatory capital in panel (a), and the sum of quarterly net income and quarterly net payouts in panel (b) for domestic CCAR banks from 2019:Q1 to 2021:Q2. Data is from FR Y9C.

Figure E.3: Capital and Income Overview

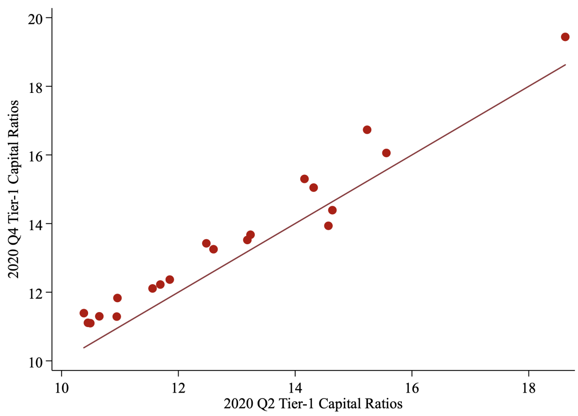


Figure reports Tier-1 capital ratio in 2020Q2 and in 2020Q4 for domestic CCAR banks along with a 45-degree line.

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. Profitability across CCAR banks and large non-CCAR banks evolves similarly over the course of 2019 until 2021. In particular, ROA does not seem to be affected by the announcements of June 2020 and December 2020. This suggests that agency cost à la Jensen and Meckling (1976) are not a major driver of the empirical patterns documented for equity prices and debt values of CCAR banks. If this type of agency costs (i.e., managers' shirking) were the main explanation, one would expect payout restrictions to lower profitability of affected banks relative to other banks since payout restrictions increase free cash flow at managers' disposal. Yet, profitability rises strongly in 2020:Q3-2020:Q4 for CCAR banks, and in parallel with non-CCAR banks, when payout restrictions were in place in the United States.

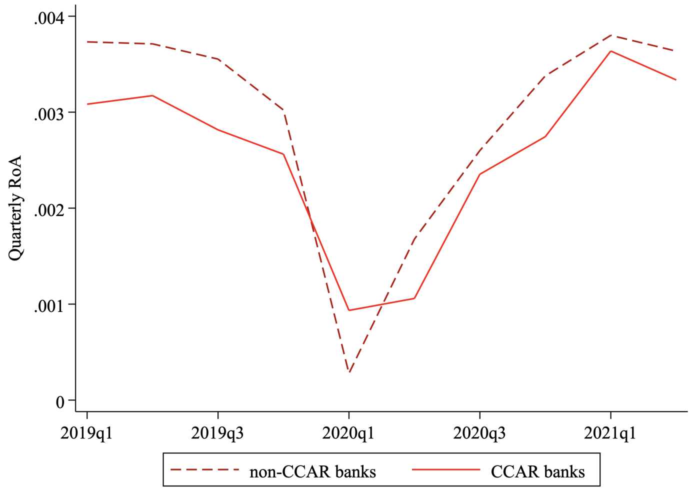


Figure reports return on assets for CCAR banks and largest non-CCAR banks. Profitability is defined as net income over total assets. Data is from FR Y9-C.

Figure E.5: Return on Assets

E.4 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.

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

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.

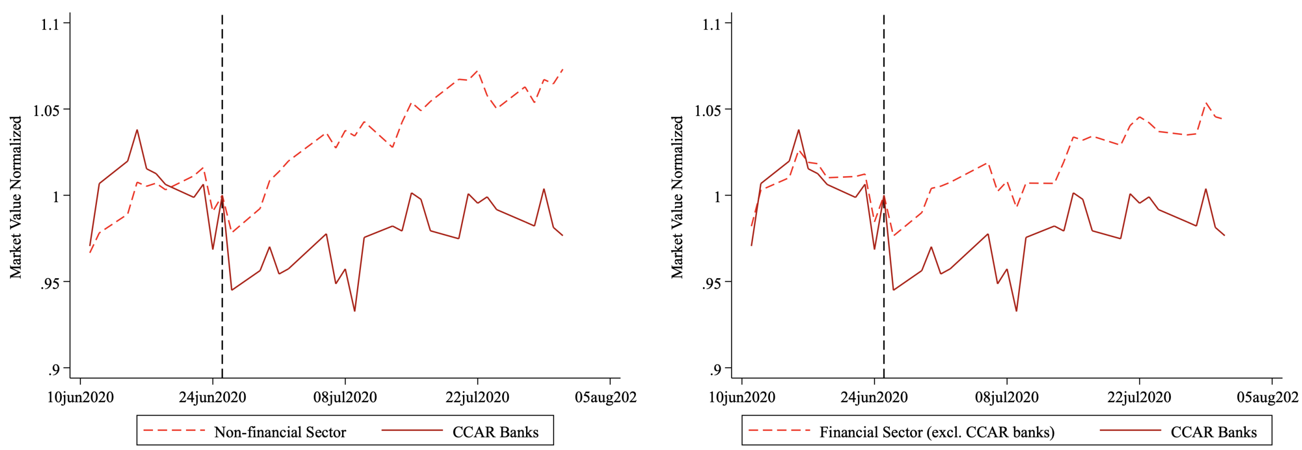
One drawback is that abnormal returns over a multi-day window could also be driven by other announcements than just the payout restrictions. The high-frequency event studies and slightly lower frequency cumulative abnormal returns regressions can therefore be viewed as complementary. As shown next, cumulative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

E.5 Longer-run Evidence

This subsection provides evidence that the effects identified on equity values 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 months after the payout restrictions are lifted.

Figure E.6 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.

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.6.



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

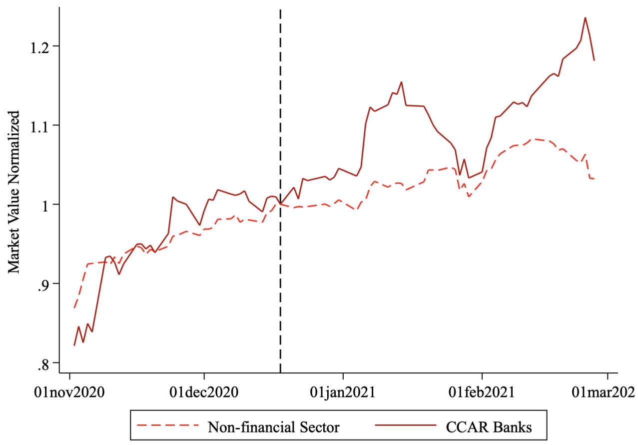
Source: CRSP and own calculations. Market values are normalized to 1 on 06/25/2020, indicated by vertical dashed line. Panel (a) compares market value of CCAR banks to the non-financial corporate sector (excluding SIC 6000-6999). Panel (b) compares market value of CCAR banks to the financial sector excluding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

Figure E.6: Market Values around 06/25/2020

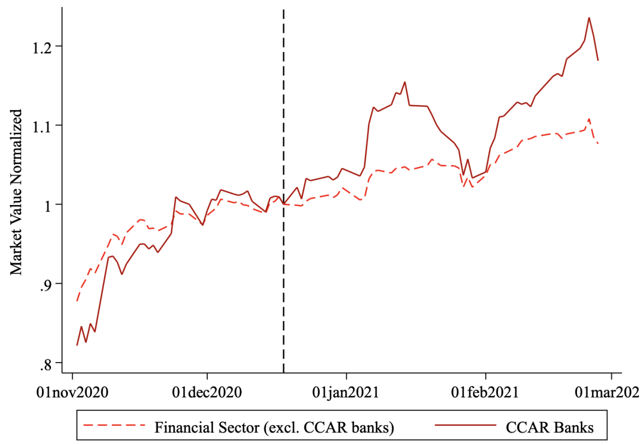
The pattern around the 12/18/2020 announcement is similar in Figure E.7. Banks perform relatively similar to other financial firms and even relative to the non-financial sector until 12/18/2020. Following the announcement of relaxation of payout restrictions, bank stocks rise differentially by 2-3 % 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).

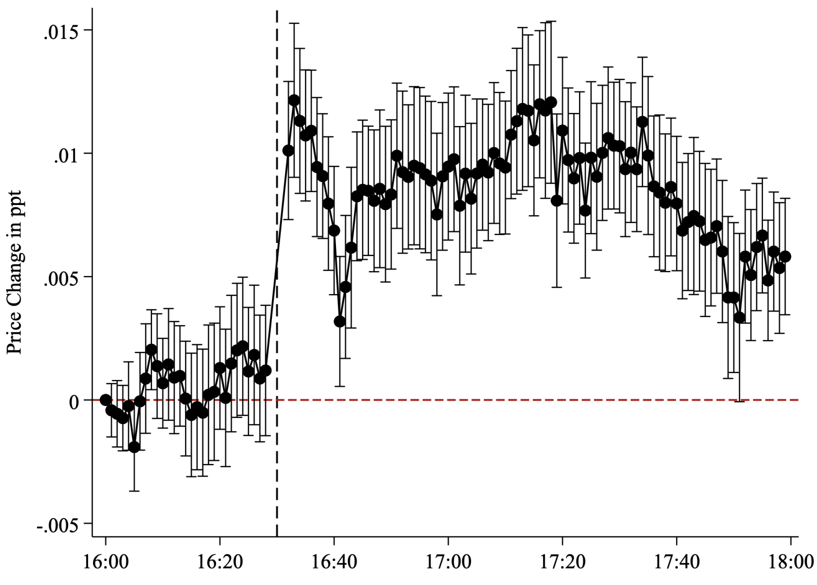
Figure E.7: Market values around 12/18/2020

E.6 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 Federal Reserve 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 4:00 pm to 6:00 pm ET time window. Figure E.8 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 the β_τ coefficients of the interaction terms between the CCAR bank indicator and minute dummies of Equation 5, along with their 95 % confidence bands, estimated in event study regressions around the 03/25/2021 announcement. Prices are normalized to 1 at 4:00 pm ET. Standard errors are double-clustered at the firm and time level. Source: TAQ data.

Figure E.8: March 2, 2021 - Event Study

E.7 Term Structure of CDS Response

Figure E.9 reports the entire term structure of the estimated CDS responses around the announcement of payout restrictions on 06/25/2020 along with the 95 % confidence bands. Limiting payouts lowers CDS spreads for CCAR-banks across all maturities. The estimated coefficients are highly significant and hover between 2 and 3 basis points.

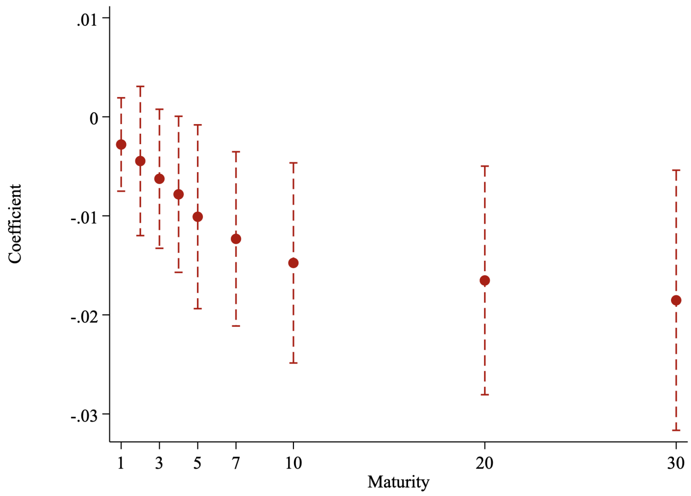


Figure reports point estimate and 95 % confidence interval for differences-in-differences coefficient in a regression of CDS spread at maturity as indicated by x-axis onto post-dummy interacted with flag for CCAR banks using a +/- 5 trading day window around 06/25/2020.

Figure E.9: Term Structure of CDS Response around 06/25/2020

Figure E.10 reports the term structure for CDS spreads for financial firms around 12/18/2020 when payout restrictions were partly 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.

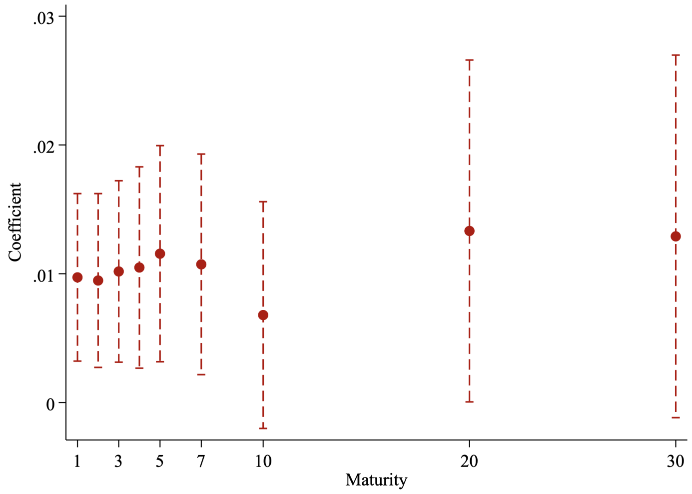


Figure reports point estimate and 95 % confidence interval for differences-in-differences coefficient in a regression of CDS spread at maturity as indicated by x-axis onto post-dummy interacted with flag for CCAR banks using a +/- 5 trading day window around 06/25/2020.

Figure E.10: Term Structure of CDS Response around 12/18/2020

E.8 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.4: 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.5: 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.6: 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.7: 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.8: 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.9: CAR after 12/18/2020 Unweighted Regression (Financial Firms Only)

E.9 Results from Fama-French 3-factor model

As an additional robustness check for cumulative abnormal returns, we employ the cumulative abnormal returns 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:

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.10: CAR after 06/25/2020 Weighted Regression (Banks only)

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	-.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.11: 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.12: 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.13: CAR after 12/18/2020 Unweighted Regression (Banks Only)

E.10 Corporate Bond Results

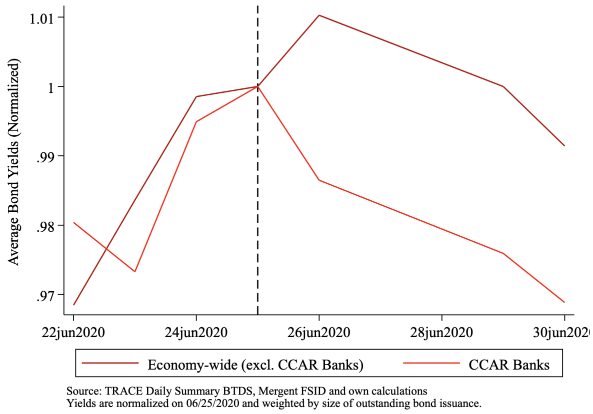
In addition to looking indirectly at the response of debt prices through CDS spreads, one can also directly estimate the response of corporate bond yields around the announcements about payout restrictions. While CDS capture pure default risk, corporate bond implied credit spreads contain both liquidity 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.11 and E.12 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.

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

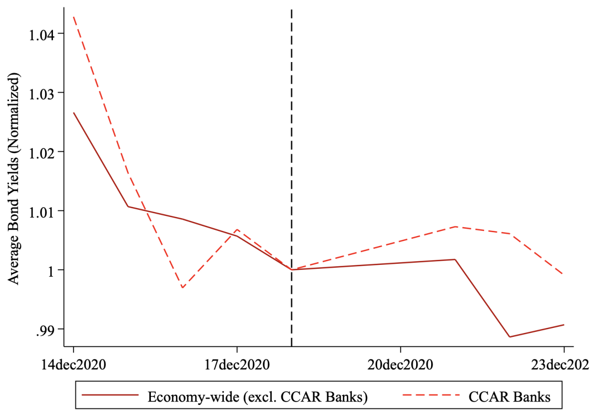
Next, we test econometrically for a differential effect:

$$Yield\ Spread_{it} = \alpha_i + \alpha_t + \beta Post_t CCAR\ Bank_i + \gamma X_{it} + \delta X_{it} CCAR\ Bank_i + \epsilon_{it} \quad (14)$$



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.11: 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.12: Corporate Bond Yields around 12/18/2020

All variable definitions are identical to the previous equations. $Yield\ Spread_{it}$ 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.14 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.14: Corporate Bonds: Daily Differences-in-Differences Estimation around 06/25/2020

Following the announcement of payout restrictions, corporate bond yields of CCAR banks decline by 8.4 basis points relative to those of the control group 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.15 shows results from estimating Equation 14 around the 12/18/2020 announcement.

	(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

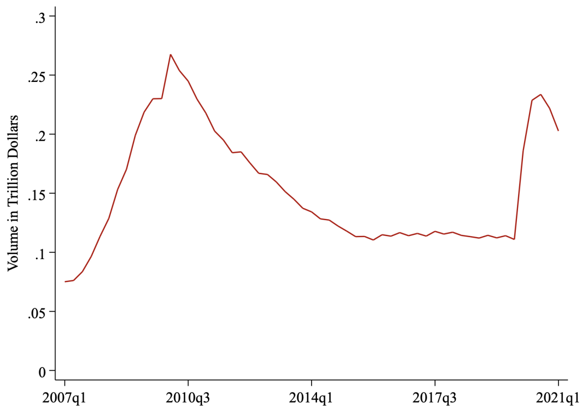
$***p < .01, **p < .05, *p < .1$

Table E.15: Corporate Bonds: Daily Differences-in-Differences Estimation around 12/18/2020

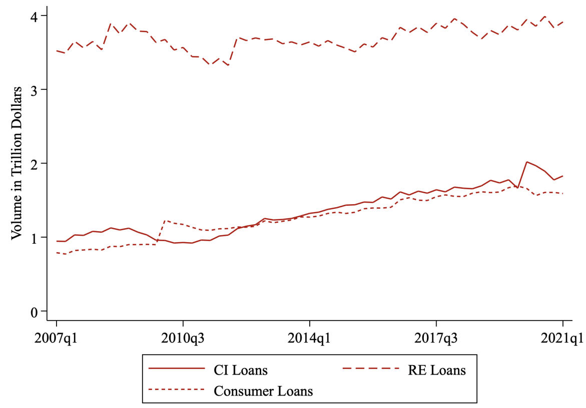
Corporate bond yields of CCAR banks rise relative to the reminder of the economy. Consistent with the earlier evidence on CDS spreads, corporate bond yields rise, implying a decline in debt value. The differential increase in corporate bond yields is about 4.9 basis points in the preferred specification, suggesting that lifting payout restrictions has made bank debt riskier.

E.11 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.13. Since the set of CCAR banks is not defined for the years prior to the Dodd-Frank Act, those figures report statistics for the 30 largest US banks by assets in each quarter.



(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.13: Bank Balance Sheet Items

Comparing the Covid-crisis to the Great Recessions, two features stand out. First, loan loss reserves almost reached the financial crisis levels in 2020. Second, this accumulation was very fast compared to the financial crisis. This seemingly prudent bank behavior might suggest that banks did not have risk-shifting incentives throughout the pandemic.

There are, however, some caveats with this argument. First, accounting rules have been changed by FASB precisely to encourage a forward-looking 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 rules where banks are required to build up loan loss reserves based on their expectations of losses over the entire life of the loan (López-Espinosa et al., 2021). These new accounting rules were implemented with the CECL (current expected credit loss) standard for estimating allowances. On January 1, 2020, most large and mid-sized US banks had adopted

CECL.[30] This new accounting standard, intended to address procyclicality, likely contributed to 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 exempted banks from reporting certain delinquent loans as troubled debt restructurings, which may have delayed the reporting of explicit losses. These two facts limit concerns about a behavioral inconsistency between the large increase in loan loss reserves observed and the identified risk-shifting motives after the relaxation of payout restrictions.

E.12 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[31], not a rule, but the implicit understanding is that banks would expose themselves to regulatory action if not adhering to the recommendation.[32]

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

[30] See https://www.federalreserve.gov/econres/notes/feds-notes/new-accounting-framework-faces-its-first-test-cecl-during-the-pandemic-20211203.html

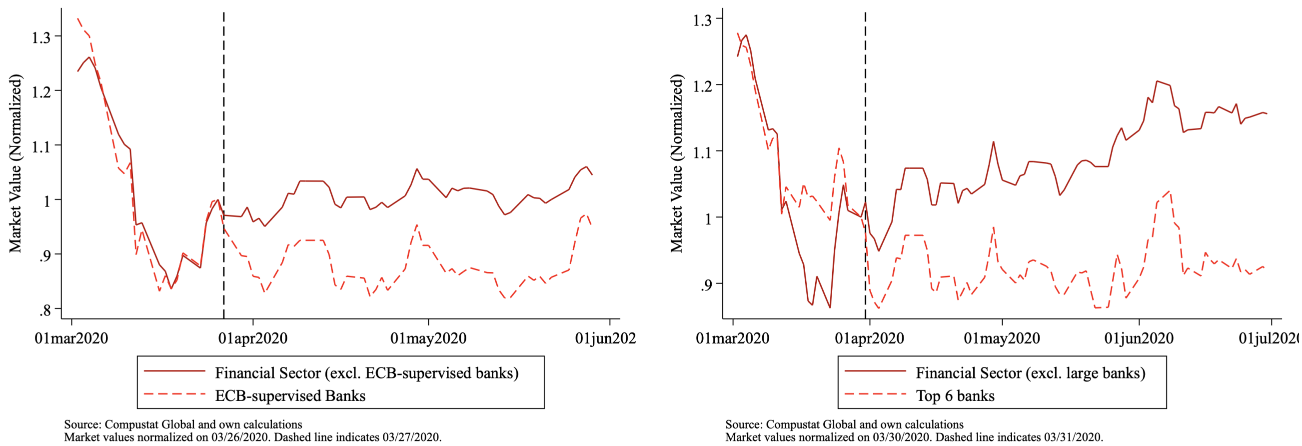
[31] https://www.bankingsupervision.europa.eu/press/pr/date/2020/html/ssm.pr200327~d4d8f81a53.en.html
https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020HB0019

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

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.[33] 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.14 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.



(a) Eurozone

(b) United Kingdom

Figure E.14: Market values of large UK banks relative to economy

Figure E.15 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.14.

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

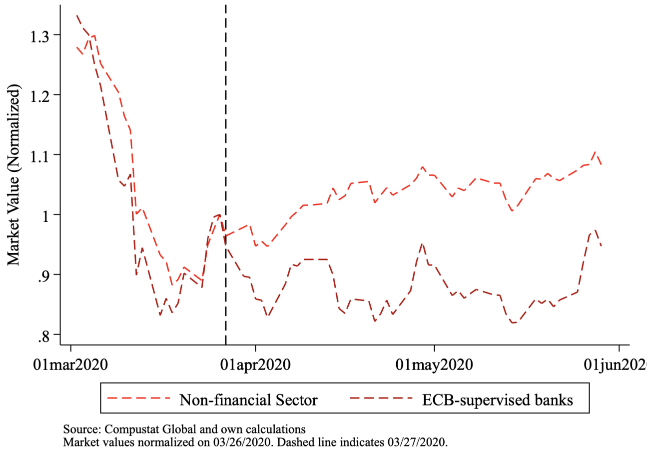
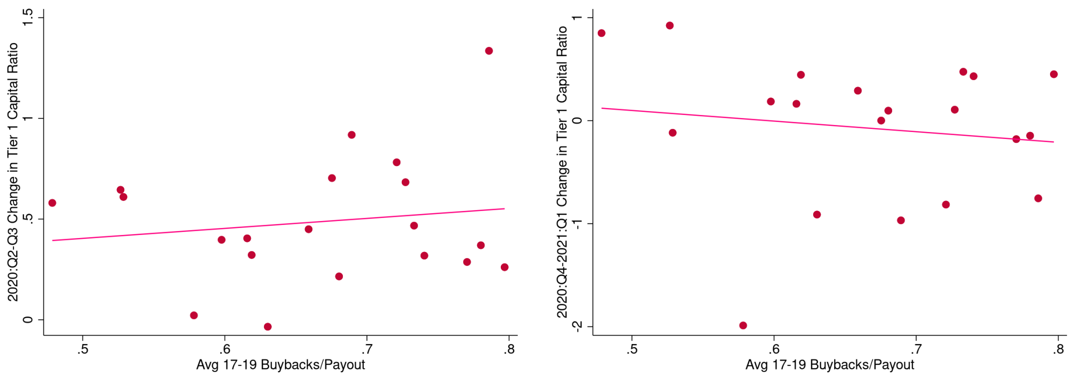


Figure reports market values for ECB-supervised banks (solid line) and non-financial firms (dashed line, excludes SIC codes 6000 - 6799). Market values are normalized to one on 03/26/2020. The vertical dashed line indicates 03/27/2020. Source: Compustat Global and own calculations.

Figure E.15: Robustness for DiD Plot

F Additional Evidence on the 2017-19 Average Buyback to Payout Ratio



(a) Ex-ante payout ratios and ex-post change in Tier 1 capital ratios - intro payout restrictions

(b) Ex-ante payout ratios and ex-post change in Tier 1 capital ratios - lifting payout restrictions

Graphs report i) the difference between the 2020:Q3 Tier 1 capital ratio and 2020:Q2 Tier 1 capital ratio (y-axis of panel (a)), and ii) the difference between the 2021:Q1 Tier 1 capital ratio and 2020:Q4 Tier 1 capital ratio (y-axis of panel (b)) against the average ratio of share buybacks to total payouts for domestic CCAR banks over the time period 2017-19 (x-axis). Each dot represents one domestic CCAR bank. Ratios are calculated using information on share buybacks, dividend payouts and Tier 1 capital ratio from the FR Y-9C and Compustat.

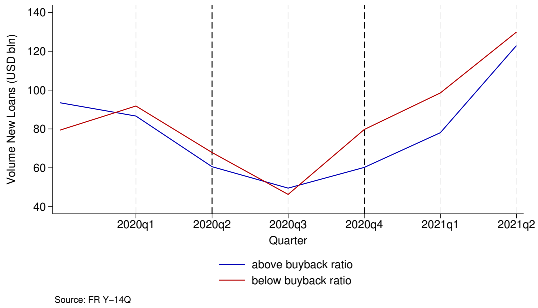
Figure F.16: Ex-ante payout ratios and ex-post change in Tier 1 capital ratios

G Additional Lending Results

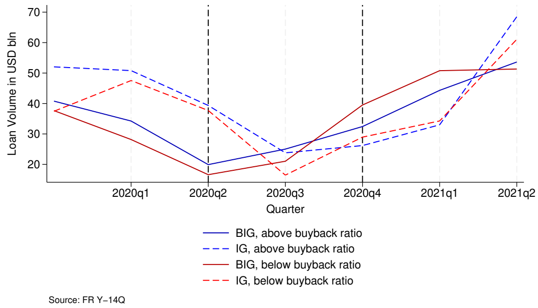
G.1 Raw Triple DiD plot

Figure 6 reports normalized plots. Figure G.17 reports the raw version of these figures without the normalization in 2020 Q2:

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



(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 G.17: Evolution of Lending

G.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		0.305	
	(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)
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 G.16: Risk-taking around regulatory announcements - Detailed Results

G.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		0.003	
	(0.01)		(0.01)	
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*		0.014*	
	(0.01)		(0.01)	
LiftPolicy (21Q1-21Q2) x Buyback/Payout (17-19)	0.019		0.019	
	(0.01)		(0.02)	
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 G.17: Risk-taking around regulatory announcements - Interest Rates