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Essays on Firm Responses to Prudential Regulation and Monetary Policy

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Princeton, NJ : Princeton University

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Essays on Firm Responses to Prudential Regulation and Monetary Policy

Thomas Kroen

A DISSERTATION
PRESENTED TO THE FACULTY
OF PRINCETON UNIVERSITY
IN CANDIDACY FOR THE DEGREE
OF DOCTOR OF PHILOSOPHY

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Economics
Adviser: Professor Atif Mian

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Abstract

This thesis consists of 3 chapters analyzing how firms respond to changes in regulation and monetary policy.

In chapter 1, I study how investor horizons affect corporate payout and investment policies using the 1982 share repurchase liberalization in the US as a natural experiment. Following the reform, firms with greater pre-reform short-termist ownership increase payouts by .85% of total assets relative to firms with a more long-term investor base. The increase in payouts is mirrored by an equally sized decline in investment. Tests exploiting newly digitized insider trading data support that the results are driven by myopic considerations, rather than reduced agency costs following the reform.

Chapter 2 studies the effects of bank payout restrictions, imposed during the COVID-crisis in 2020, on risk-shifting incentives within US banks. Using a high-frequency differences-in-differences empirical strategy, I show that when payouts are restricted for Fed-supervised banks, their equity prices fall while their debt values appreciate differentially. In sum, these results indicate that payout restrictions shift risk from debt towards equity holders while the effects revert upon relaxation of the restrictions. Moreover, removing the restrictions is followed by higher payouts and by differentially stronger growth in riskier (non-investment grade) lending, showing that payout and risk-taking choices are complements during this episode. While lending portfolios become riskier, spreads charged on loans decline, suggesting risk-shifting by bank equity holders.

Chapter 3, co-authored with Ernest Liu, Atif Mian, and Amir Sufi, addresses the question whether low interest rates contribute to the rise in market concentration. Using data on firm financials and high frequency monetary policy shocks, we find that falling interest rates disproportionately benefit industry leaders, especially when the initial interest rate is already low. A decline in the interest rate disproportionately

lowers the cost of borrowing of industry leaders relative to industry followers. Leaders take advantage of the lower cost of borrowing to raise additional debt financing, increase leverage, boost capital investment, and conduct acquisitions. The findings support that extremely low interest rates may be a culprit in explaining the rise of superstar firms in the U.S. economy.

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Thanks to Ernest and Amir, who have been amazing co-authors when working on the third chapter of this dissertation. Moreover, thanks to Jonathan, Moritz, David, and Wei for reading drafts, going over presentations in detail, providing extensive feedback, and supporting me throughout the PhD. Furthermore, I thank seminar participants at Princeton and multiple external conferences and workshops for valuable comments and suggestions that have substantially improved my work.

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To my dad, I wish we could celebrate together. To Philipp, for being such a smiling and supportive brother. And to my mom for everything she has done to enable her sons pursue their dreams.

To mom, dad and Philipp.

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Chapter 1

Payout Policy Reform and Investor Horizons

1.1 Introduction

At the onset of the 1980s, share buybacks were heavily regulated or outright banned in most major stock markets.[1] Starting with the US in 1982, several large economies have liberalized share repurchases over the last decades.[2] At the same time as the amount of share buybacks has increased and contributed to a surge in total payouts, dividends included, investment has been weak relative to measures of valuation (Gutiérrez and Philippon, 2018). This has fueled a public debate over share buyback regulation. Legislation to restrict share buybacks, such as the 2018 Reward Work Act, has been introduced to the US Congress. Despite this intense debate, there is

[1]This work was presented at 37th AFFI International Conference Doctoral Workshop, EGSC at WUSTL, Princeton Finance Lunch, Princeton Macro Lunch, QMU Economics and Finance PhD Workshop, NFA Doctoral Tutorial, German Economic Association (VfS) and FMA. I thank Arturo Leis-Pretto, George Middleton and Katherine Ross for excellent research assistance and the Julis Rabinowitz Center for Public Policy and Finance for financial support.

[2]Wang et al. (2021) provide an overview of at least 17 major stock markets than liberalized share buybacks. For example, Japan liberalized in 1994, France and Germany in 1998 and the Netherlands in 2001.

little empirical guidance in the academic literature on the effects of share buyback liberalization on firm policies.

Beyond Modigliani and Miller (1958) payout irrelevance, the theoretical corporate finance literature posits two opposing channels. On the one hand, facilitating share buybacks enables firms subject to agency costs to pay out funds and curtail funding for managers' pet projects or other inefficient uses. As first argued by Jensen (1986), payouts can mitigate agency costs and through that channel share repurchase liberalization can improve firm performance by limiting the free cash flow problem.

On the other hand, theories of corporate myopia predict that in the presence of information imperfections, where firms use payouts to signal about their investment prospects, there can be excessive, socially inefficient, signaling through payouts at the expense of investment. These trade-offs are particularly prevalent at firms that have higher ownership by short-term investors, who turn over their shares relatively quickly. Those face the strongest incentives to engage in inefficient trade-offs of short-term gains at longer-run costs. Disentangling between the myopia view and the agency cost view is empirically challenging because they have observationally equivalent implications for payouts and investment. Facilitating payouts through share buyback liberalization is predicted to lead to a surge in payouts and a reduction in investment by both sets of theories.

In this chapter, I study the effects of share buyback liberalization in the United States in 1982 on corporate policies, notably payout and investment choices. The empirical test I design discriminates between the agency theory and the myopia view of share buyback reform. Splitting US public firms by their share of short-termist institutional owners in the pre-reform period, I estimate in a differences-in-differences setting how firms' payout and investment decisions vary when previously heavily restricted share repurchases are greatly liberalized in 1982. I find that firms with greater ex-ante short-termist ownership increase payouts by .85 percent of total assets

while reducing investment by .84 - 1.1 percent of total assets. These effects are large since yearly gross investment at the average firm amounts to 8.1 percent of total assets. Moreover, the results indicate the presence of an investment-payout trade-off at firms with higher short-termist ownership.

Two lines of argument can reconcile these empirical results with theory. One is the myopia interpretation: Firms inefficiently cut back on investment to increase payouts due to short-termist pressures originating from their owners having short holding horizons. Alternatively, firms could also be efficiently sizing down. In particular, those firms with high short-termist ownership could have been over-investing in the pre-reform period, for example in managers pet projects, or hoarding large cash balances. Following the reform, those funds would be paid out to shareholders instead of being inefficiently invested in negative net present value projects.

In order to distinguish between these two arguments, I test how insider trading behavior reacts to higher short-termist ownership, the logic being as follows: If the myopia view is the dominant one, prospects for the firm worsen when short-termist ownership rises since investment will be reduced too much. Hence, insiders have an incentive to sell their shares in the firm. In contrast, if the dominant view is the efficient downsizing argument, the higher presence of short-termist owners, if anything, improves the prospects of the firm as short-termists push towards cutting inefficient over-investment. Consequently, insiders have incentives to maintain their holdings in the firm or increase them.

Using a merged dataset of newly digitized insider trading data for the pre-1986 period and existing data since 1986, which captures the universe of trades by corporate insiders, I test whether higher short-termist ownership is related to insider sales. In an estimated logit model, high short-termist ownership predicts open-market sales by corporate insiders in the post-reform period but not prior to the reform. For a formal test, I collapse the insider trading data at the firm-level and estimate a

differences-in-differences specification with open-market insider trades as dependent variable. After the 1982 share repurchase liberalization, firms with high pre-reform short-termist ownership have a significantly higher fraction of insider sales over total insider trades than firms that started from low short-termist ownership. These results are consistent with the myopia view but harder to reconcile with efficient downsizing.

Building on these firm-level results, I further ask whether industry-level general equilibrium effects partially offset the firm-level forces. Since some firms reduce their investment myopically, other firms in the same industry might increase their investment and seize an opportunity to expand. I adapt recent advances in the estimation of regional general equilibrium multipliers (Mian et al., 2019) to a corporate finance setting. Rather than comparing household-level and regional-level multipliers, I compare firm-level and industry-level multipliers. This exercise reveals the presence of sizable investment multipliers in industry-level general equilibrium. Those offset most of the firm-level negative effect on investment highlighting the importance of intra-industry re-allocation.

While the discussion so far has focused on a historical natural experiment, the results carry significant relevance as of today. Between 1/2 and 2/3 of cash distributions to shareholders at US corporations in the 21st century have taken the form of shares repurchases, with the remainder consisting of dividends. At the same time as share buybacks have overtaken dividends in their relative importance, total payouts at US companies have steadily increased over the past two decades.

Large amounts of payouts have the potential to weaken firm's balance sheet position in a crisis, if insufficient funds are retained to build up buffers. In Section 1.7 , I show that firms with higher share repurchases (relative to cash flow, net income or assets) during the 2010-decade have larger negative cumulative abnormal returns in the February 2020 stock market downturn.

The central question of the chapter whether market forces push firms towards making myopic decisions relates to a large literature on contract theory and the organization of the firm, in particular multi-tasking models such as Holmström and Milgrom (1991), Holmström and Tirole (1993), Holmström (1999) and Acemoglu et al. (2008).

The corporate finance myopia literature was started by Stein (1988), Stein (1989) and Shleifer and Vishny (1990). More recent theoretical papers on corporate short-termism include Bolton et al. (2006), who discuss the dotcom-bubble, Milbradt and Oehmke (2015), who focus on firms choosing project length and Hackbarth et al. (2018). Empirical evidence largely centers around managers and their compensation (Edmans et al. (2017), Edmans et al. (2018)) and agency costs (Crane et al., 2016). My chapter instead centers around the question whether the short-term investment horizon of the firm owners themselves relates to myopic corporate decisions.

My chapter also contributes to a large corporate finance literature on firms' payout behavior going back at least to Lintner (1956). Those papers include Miller and Rock (1985), Brennan and Thakor (1990), Allen et al. (2000), empirical evidence by Grullon and Michaely (2002), Larrain and Yogo (2008), Derrien et al. (2013), Boissel and Matray (2019), Michaely et al. (2019). In particular, my work bridges that literature with the literature on law and finance started by La Porta et al. (1998) by explicitly considering the economic effects of legal changes to share buyback regulation.

Finally, my chapter also relates to the macro-finance literature discussing weak investment and increasing payouts. These trends are discussed in Gutiérrez and Philippon (2016), Gutiérrez and Philippon (2017) and Gutiérrez and Philippon (2018), for example.[3] Different explanations have been offered. Ye et al. (2020) propose changes to market microstructure since the 1990s as an explanation whereas Kahle and Stulz (2020) observe that the aging of US public firms drives some of these patterns. What

[3]Other related papers in the literature are, for example, Greenwald et al. (2019) provide support for the hypothesis that worker-shareholder redistribution is increasingly driving stock market values.

none of these mechanisms can explain is the rapid surge in buybacks in the 1980s following repurchase liberalization. Terry (2017) provides empirical evidence[4] and an estimated model highlighting the effects of managers' pressure to meet quarterly earnings forecasts. De La O (2019) discusses the effects of share repurchases on long-term trends in capital allocation under managerial frictions but without providing microeconomic moments related to the 1982 share repurchase liberalization. Wang et al. (2021) provide an international perspective by comparing countries that liberalized share buybacks over time in a staggered differences-in-differences design. While they find that repurchase liberalization is followed by higher payouts and lower investment in a sample of 17 countries, these findings have been disputed by Baker et al. (2021) who find a null effect for investment when correcting for potential heterogeneity in treatment effects. Farre-Mensa et al. (2020), Ma (2019) and Mota (2020) show that net repurchases of equity correlate with net bond issuance in the last two decades, suggesting cross-market arbitrage and safety premia for investment grade corporate debt as candidate explanations.

My work adds to this literature by providing an explanation for the rapid surge in share repurchases after 1982 when previous restrictions on share buybacks were largely lifted in the US. Exploiting variation across firms within one country circumvents some of the identification concerns around cross-country comparisons. In particular, using a large set of micro moments, I provide evidence for a novel channel based on the role of short-termist investors in driving the surge in share repurchases while simultaneously cutting back on investment.

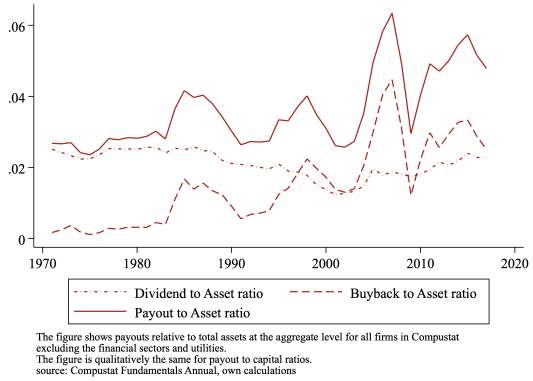
Section 2 provides aggregate evidence on the importance of share repurchases. Section 3 discusses the data and empirical approach. Results for the differences-in-differences estimation are presented in Section 4. Section 5 implements the insider

[4]Almeida et al. (2016) have a similar empirical strategy

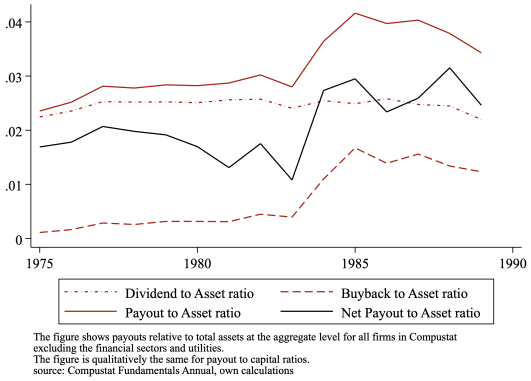
holdings test. Section 6 provides estimates on industry general equilibrium effects. Section 7 discusses the lessons and Section 8 concludes.

1.2 Aggregate Evidence

This section discusses the aggregate evidence. Most notably three facts stand out: share repurchases are the dominant form of payouts in the 21st century, the amount of repurchases is of a similar magnitude as investment, cash flow or net income and, finally, during the Covid-19 stock market downturn in February 2020, firms that had done more share buybacks prior to 2020, saw a greater negative stock price reaction. These three facts highlight the continued importance of companies' share repurchase activity in recent years before turning to the 1980s for the bulk of the empirical work.



(a) 1970-2018



(b) 1975-1989

Figure 1.1: Payout ratios of US firms

Figure 1.1 shows aggregate payouts relative to total assets for non-financial, non-utility Compustat firms. A figure similar to the left-hand one has been computed by Gutiérrez and Philippon (2016) and Gutiérrez and Philippon (2018). The rising importance of share buybacks - the purchase of its own shares by a company - as a means of distributing cash to shareholders is evident. At the same time, dividends

have remained relatively stable so that total payouts have increased considerably from slightly above 2% of total assets to up to 6% of total assets.

On the right-hand side, I add the net payouts ratio which subtracts equity issuance from gross payout while focusing on the 1975-1989 period which features 7 years before and after the 1982 share buyback liberalization. This addresses concerns that the rise in payouts to assets could be offset by an equal increase in equity issuance. However, Figure 1.1 reveals that the surge in payouts is not countered by increased issuance as net payouts and gross payout rise to a similar extent. This statement extends to the 1990-2020 period. Payouts (net of equity issuance) have substantially increased.

Table 1.1 reports 2018 aggregates for the same firms as Figure 1.1:

	Volume in billion dollars
Share Buybacks	708.92
Dividends Total	415.52
Stock Issuance	148.71
Gross Investment	813.04
Cash Flow	1643.5
Net Income	906.42

Table 1.1: 2018 Aggregates

Share buybacks make up about 63% of cash distributions to shareholders exceeding the aggregate importance of dividends. The dollar amount spent on repurchases comes close to the amount spent on gross investment and equals about 75 % total net income.

1.3 Empirical Strategy

1.3.1 Data

Data for US firms is from Compustat at yearly frequency. Ownership can be constructed from 13-f filings with the SEC which are available from 1980 onward from

Investor Type	N	Holding Period	Turnover
Banks	429	9.09	-.09
Insurance Companies	122	10.07	-.12
Investment Companies	125	7.95	-.15
Investment Advisors	688	6.44	-.15
Others(Pension Funds, Universities, Foundations)	172	9.93	-.09

Table 1.2: Summary Statistics: Institutions

Thomson Reuters. These filings are filed by institutional investors exceeding $ 100 million in assets under management. They contain detailed stock holdings at the security level (CUSIP) for the universe of these institutional investors' holdings covering about 35-45 % of total stock market ownership in the US during the 1980s.

I merge the holdings data with CRSP and update shares outstanding from CRSP - in line with the previous literature (s. Ben-David et al. (2019), for example). Some firms have shares held by all institutional investors exceeding total shares outstanding. I drop those records. Finally, I update the manager identifiers from Thomson-Reuters to deal with the original identifiers being re-assigned when an institution exits. Appendix A.1 contains more details on the sample selection criteria.

1.3.2 Summary Statistics

Table 1.2 summarizes the AUM-weighted median holding horizons across types of institutional investors as well as the turnover ratio, both computed at a quarterly frequency. There is a potential ambiguity regarding how to treat investment companies that offer several mutual funds. As noted by Schmalz (2018), "governance and voting are usually conducted at the family level". Thus, I record each investment company in the data, which contains their aggregate portfolio holdings across various funds.

Insurance companies, University endowments and pension funds tend to have the longest holding horizons with a median of 10.06 and 9.92 quarters. On the

other side of the spectrum, investment companies and investment advisors tend to have the shortest horizons with a median of 7.95 and 6.44 quarters. The turnover measures mirror this classification. Investment advisors turn over their portfolios almost twice as fast as pensions funds, universities and foundations (16 % quarterly turnover versus 9%) This provides insights into which institutional investors will most likely be classified as short-termists: investment companies and investment advisors.

Finally, Table 1.3 presents an overview of the firms which are matched between Compustat and the Thomson Reuters holdings data.

Variable	Obs	Mean	Std. Dev.
Age	18382	17.106	9.348
Total assets	18382	747.355	3796.031
Cash flow	18164	.461	.66
Return on assets	18382	.033	.122
Gross investment/ total assets	17734	.081	.065
Net investment/ total assets	17748	.026	.067
Payout ratio	17729	.019	.023

Table 1.3: Summary statistics

The average firm is about 17 years old but there is large variation in age. Firms with higher short-termist ownership tend to be older and larger. Gross investment (replacement of depreciated capital plus net investment in new capital) is about 8% of total assets for the average firm. Net additions to the capital stock make up 2.6% of total assets. Both investment figures are subject to significant variation over time. Gross payouts are about 2% of total assets for the average firm.

1.3.3 Share-buyback reform

Until 1982, share buyback regulation in the United States was governed by the 1934 Securities Exchange Act. In the wake of the Great Depression, it targeted stock price manipulation. Most notably, a share repurchase program could trigger an SEC investigation. Some companies have been charged with price manipulation (SEC vs.

Georgia Pacific 1960; Genesco (1966)) (Grullon and Michaely, 2002). Rather than an explicit ban, there was large regulatory uncertainty around share repurchases both for firms and for the brokers potentially involved, who could also be investigated under the Securities Exchange Act.

On November 26 1982, the SEC altered the landscape adopting rule 10b-18 which outlined how share repurchases on the open market could be conducted without violating the Securities and Exchange Act providing a so-called "safe harbor". It lays out the conditions under which a share repurchase program can be carried without violating SEC rules. In particular, there are restrictions on timing (no trading within the last 10-30 minutes of the trading day), volume (capped at 25% of daily trading volume) and the use of brokers (single broker on any given day). SEC chairman John Shad was quoted as follows: "Without the change, companies are inhibited from making big open-market buys" (Grullon and Michaely, 2002).

Practically, open market purchases are the primary form of share buybacks. Banyi et al. (2008) report that 84 % of all repurchase announcements and 89 % of the total value that was repurchased were accounted for by open market repurchases over the 1985-2004 period. The remaining repurchases consist of privately negotiated repurchases, fixed-price tender offers and dutch auction tender offers. Disclosure of open market repurchases was voluntary over the time period relevant to this chapter and was only mandated with the amendment of SEC rule 10b-18 in 2003 (Ben-Rephael et al., 2014).

1.3.4 Identifying short-termist owners

The next building block for the analysis consists of identifying short-termist firm owners. I define the share of short-termist owners $\mu_{i,t}$ at firm i in quarter t as:

$$\mu_{i,t} \quad = \sum_{j} s_{i,j,t} \boldsymbol{I}(\kappa_{j,-i} \leq 6) \tag{1.1}$$

j indexes institutional investors. $s_{i,j,t}$ captures the share of institution j in total ownership of a firm measured as the institution's share of total stock outstanding. $\kappa_{j,-i}$ is the median holding horizon of investor j across all their stock holdings. Firm i is excluded so that the firm-level measure $\mu_{i,t}$ is not driven by investors' holding horizons for the firm itself. The cutoff for an investor to be defined as short-termist is a median holding horizon κ below 6 quarters [5]. Empirically, $\mu_{i,t}$ is readily computed from the 13-f holdings data.

At the institution level, 82 % of investment advisors and 77 % of investment companies are classified as short-termist investors consistent with the earlier observations from Table 1.2.

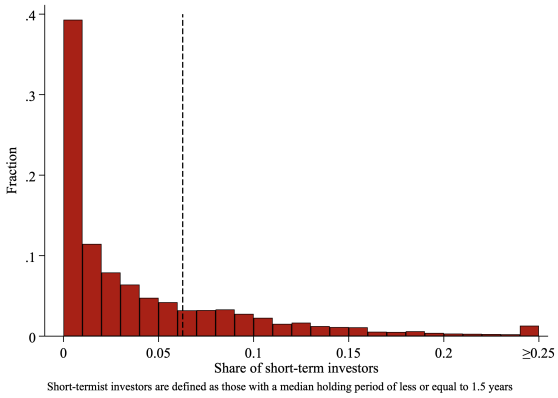


Figure 1.2: Share of short-termist investors across firms

The empirical strategy critically relies on variation in ownership by short-termist institutions across firms. Figure 1.2 plots the distribution of $\mu_{i,t}$ in the pre-reform period.

[5]Since $\kappa_{j,-i}$ excludes firm i each investor has a a marginally different κ for different firms. However, I can verify that no investor is sometimes classified as short-termist and sometimes as long-termist but instead the classification is unique for each institution.

There is substantial variation in the fraction of short-termist owners across firms. While many firms (almost 40%) have less than 1% of their shares held by short-termist investors, the distribution extends far to the right. The dashed line indicates the 75-percentile of the distribution, which corresponds to 6.27% of shares being held by short-termist investors. Moreover, the share of short-termist owners correlates positively with market capitalization. Larger firms are the ones that tend to have a greater fraction of short-termist owners.

To assess robustness of the main results with respect to the investor classification, I construct several other measures to identify short-termist investors. In a first step, the 6-quarter threshold is varied, second I compute the mean instead of median of investors' holding periods across firms. Finally, I compute the turnover ratio $T_{j,t}$ for each institution, defined as follows (consistent with Barber and Odean (2000) and Derrien et al. (2013)):

$$T_{j,t} = \sum_{i} \omega_{i,j,t} \Big(\frac{\text{Holdings Value}_{i,j,t} - \text{Holdings Value}_{i,j,t-1}}{\text{Holdings Value}_{i,j,t-1}} \Big) \tag{1.2}$$

Turnover is the weighted sum across all holdings of a given institution at a given point in time of the changes in the value of their holdings where the weights capture the portfolio share of those holdings at $t-1$ in the institution's total AUM. The measure is set to zero when net purchases occur to avoid double-counting transactions.

In Appendix A.4.1, the correlation between these several measures is reported. All the correlations are positive and large. The fact that the turnover ratio is highly correlated with the other measures is particularly comforting because the turnover ratio uses slightly different information on changes in holdings value compared to the mean and median measures, which all rely on similar measures of investors' holding horizons.

For the core of the empirical analysis, I work with yearly Compustat data. Hence, I aggregate the holdings data, in particular the share of short-termist owners $\mu_{i,t}$, at the yearly level before merging the two data sets. From now on, t refers to a year rather than a quarter.

The empirical strategy relies on identifying firms with higher and lower short-termist ownership to construct a treatment and control group. Since short-termists do not hold stocks for long, this raises the question whom short-termists trade with. Empirically, the share of short-termist owners across firms is persistent over time, suggesting that short-termists trade to a large extent with other short-termists. Figure 1.3 shows a binned scatter plot of the persistence of $\mu_{i,t}$ against its first lag.

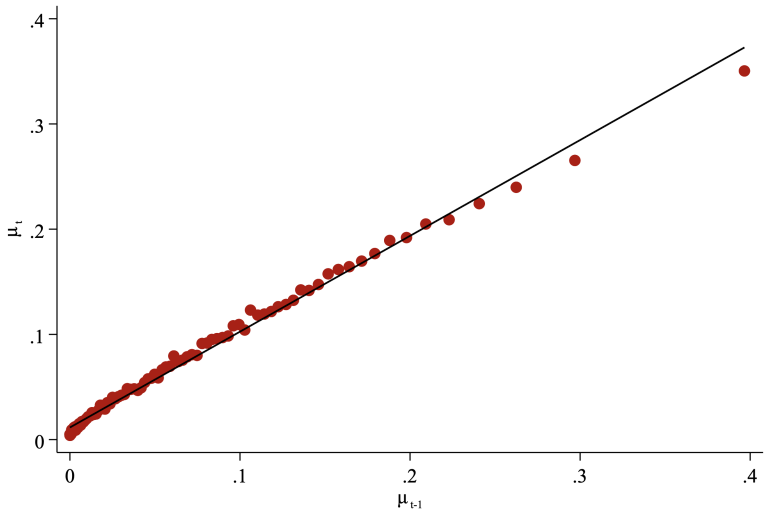


Figure 1.3: Autocorrelation of μ

Figures A.3.1 and A.3.2 in the Appendix show the same plot for the second and for the fifth lag, respectively. The positive autocorrelation is evident.

Partially, the high autocorrelation of short-termist ownership follows from its mirror image: long-termist ownership. Firms that have large long-termist ownership have few owners that continuously adjust their holdings. Consequently, as long as there is no differential pattern in the household sector's stock turnover across firms, firms

with large long-termist ownership do not experience quick inflows of short-termist owners since there is little ownership turnover.

1.3.5 Why cater to short-termist owners ?

While short-termist investors hold a sizable fraction of shares in many public companies, they very rarely hold a majority of shares. How can they influence corporate decision-making? There are at least four pieces of evidence relating to shareholder activism, negotiations with management, price impact of large investors and survey evidence.

The 1980s are a period of rising shareholder activism including the emergence of hedge funds, many of which rely on activist strategies. Prominent examples in the data include Icahn Enterprises and Soros Fund Management. Among the tools at the disposal of activist shareholders are shareholder proposals filed at the annual shareholder convention, direct negotiations with management as well as proxy fights.

Carleton et al. (1998) provide a case study on the role of those private negotiations for the Teachers Insurance and Annuity Association, which I classify as a short-termist investor given their median holding period. Based on the protocols of the insurer's discussions with management, they show that the insurer obtains an agreement with management on governance issues raised during those meetings in more than 90 % of cases. Moreover, in the majority of cases, they do so without initiating a vote on a shareholder proposal.

Furthermore, recent research on demand-based asset pricing by Koijen and Yogo (2019) highlights the price impact of institutional investors, who trade against themselves when buying or purchasing stocks if demand is elastic. Demand elasticities at the 90th percentile of the distribution of institutional investors imply that a 10% demand shock leads to .8 - 1.5 % price increase depending on the type of institution. In

turn, ex-post price impact provides institutional shareholders with an ex-ante mechanism to influence corporate governance.

Finally, survey evidence by Graham et al. (2005) finds that the majority of over 400 interviewed executives would sacrifice positive net-present-value investment as to manage earnings. Cutting back on valuable investment is preferred to discretionary accounting choices by those managers.

1.3.6 Estimation

Having captured the heterogeneity in short-termist ownership across firms, I now turn to the empirical estimation. The first question I want to answer is: Does SEC rule 10b-18 affect firms' payout behavior? In a second step, the question is whether other firm-level outcomes are also affected. The empirical methodology to answer both of these questions will be similar.

The econometric framework is a differences-in-differences design where I compare firms with high short-termist ownership prior to the reform to firms with low short-termist ownership in the pre-reform period:

$$y_{it} = \alpha_i + \alpha_{t,ind} + \beta Post_t Treat_i + \gamma Post_t LT\ share_i + \delta_1 X_{it} + \delta_2 X_{it} Treat_i + \epsilon_{it} \quad (1.3)$$

The pre-period is defined as 1978-82 while the post-period covers 1983-87. Firms are split along the pre-reform 75 percentile of the previously constructed short-termist ownership variable $\mu_{i,t}$. Practically, treated firms are those whose short-termist ownership exceeds 6.27%. The key coefficient of interest is β, which captures the differences-in-differences effect. Firm fixed effects α_i and time-industry fixed effects $\alpha_{t,ind}$ are added to the regression. The industry-level used are 4-digit SIC industries. Finally,

X_{it} are a set of firm-level controls. Throughout, firm level controls are lagged by one year.

To account for the potential correlation of short-termist institutional ownership with ownership by long-termist institutions, I further include an interaction term of the pre-reform share of long-termist institutional owners $LT\ share_i$, measured continuously, with the post-reform dummy. This ensures that the β coefficient measures the impact of having more pre-reform short-termist owners for a given share of long-termist ownership.

The key outcomes of interest in the first stage are payout variables. Notably, I use the net buyback to assets ratio defined as buybacks minus issuances divided by total assets, the dividends to assets ratio and the sum of these two, which is the net payout ratio. The net payout ratio measures all payouts to shareholders, that is dividends and repurchases, net of issuance relative to total assets.

In a second step, the same specification is estimated to analyze whether the reform has a differential impact on the investment dimension. For ease of comparison with the first stage, gross investment and net investment, which captures net additions to the capital stock, are again normalized by total assets. In all specifications, standard errors are clustered at the firm-level.

In addition to the discrete differences-in-differences estimation, a version of Equation 1.3 with a continuous treatment variable is estimated:

$$y_{it} = \alpha_i + \alpha_{t,ind} + \beta Post_t\, TreatC_i + \gamma Post_t LT\ share_i + \delta_1 X_{it} + \delta_2 X_{it}\, TreatC_i + \epsilon_{it} \quad (1.4)$$

In Equation 1.4, the discrete treatment dummy $Treat_i$ has been replaced with its continuous analogue $TreatC_i$, which similarly measures the pre-reform share of short-termist institutional investors. The median firm has 2.8% of pre-reform short-termist

owners but the distribution has a fat right tail. The 90th percentile corresponds to 12.4% of short-termist owners and the mean firm has 4.7% of short-termist owners.

The key identifying assumption for Equations 1.3 and 1.4 is that outcomes trend in parallel prior to the policy change. Beyond a graphical inspection, this can be tested formally using an event-study specification:

$$y_{it} = \alpha_i + \alpha_{t,ind} + \sum_{\substack{\tau=1978 \\ \tau \neq 1982}}^{1987} \beta_\tau \mathbf{1}_{\tau=t} Treat_i + \sum_{\substack{\tau=1978 \\ \tau \neq 1982}}^{1987} \gamma_\tau \mathbf{1}_{\tau=t} LTshare_i + \delta_1 X_{it} + \delta_2 X_{it} Treat_i + \epsilon_{it} \tag{1.5}$$

The variable definitions remain unchanged. However, we can now trace out the sequence of coefficients β_τ and test for the absence of pre-event trends. For the event-study specification, the 1982 coefficient is normalized to zero.

Conceptually, the null hypothesis embraces Modigliani-Miller: Payout policy does not respond to the availability of share repurchases and reforms to payout policies do not have an effect on investment behavior. The alternative that reforms to payout policy affect investment behavior includes but is not limited to a setting where short-termist frictions arising from firm ownership break the Modigliani-Miller result.

Before delving into the empirical results, I check the balance of covariates across treated firms with high short-termist ownership and their untreated counterparts with relatively low short-termist ownership in Table 1.4.

Treated firms are larger, have higher return on equity, a larger total share of institutional owners and are older. In the regressions, size (measured as employment) and return on equity will be included as controls. The age heterogeneity across both groups is absorbed by the combination of firm and time fixed effects. Controlling for total institutional ownership is particularly crucial because the main sorting variable,

	Control		Treated	
	mean	sd	mean	sd
Total Assets	437.70	4190.77	1184.15	2765.53
RoE	0.07	0.24	0.09	0.16
Cash Flow	0.52	0.68	0.59	0.51
Leverage	0.25	0.19	0.23	0.15
Inst. Holding Share	0.10	0.11	0.34	0.16
Employment	5.31	29.45	20.45	40.00
Age	13.60	8.26	19.62	9.47
Observations	6192		2778	

Table shows balance of covariates across control and treated firms in the pre-reform period (1978-82). RoE is measured as net income over equity. Cash Flow is ebitda over capital. Leverage is debt over assets.

Table 1.4: Balance of Covariates

the pre-reform share of short-termist owners, could simply proxy for institutional ownership. However, by including the total pre-reform share o of long-termist owners, I ensure that the differences-in-differences coefficient picks up the differential impact of short-termist ownership for given long-termist ownership.

1.4 Empirical Results

1.4.1 Effects on payouts

The first question is whether short-termism affects firm's payout behavior. Then, in the second stage - if payout behavior is affected - we can ask whether other decisions at the firm level are affected as well. Precisely, I test whether the liberalization of share repurchases in November 1982 has a differentially stronger impact on firms that have higher short-term oriented ownership.

Discrete DiD estimation

Table 1.5 reports results from the raw discrete differences-in-differences estimation from equation 1.3 without fixed effects. All ratios are multiplied by 100 so that a net payout ratio of 1 corresponds to net payouts being 1% of total assets.

	$\frac{NetBuybacks}{Assets}$	$\frac{Dividends}{Assets}$	$\frac{NetPayouts}{Assets}$	$\frac{NetBuybacks}{Assets}$	$\frac{Dividends}{Assets}$	$\frac{NetPayouts}{Assets}$
Treated x Post	0.82***	0.02	0.84***	0.82***	-0.00	0.82***
	(0.21)	(0.05)	(0.22)	(0.21)	(0.05)	(0.22)
Treated	-0.68***	0.01	-0.67***	-0.74***	0.02	-0.73***
	(0.17)	(0.06)	(0.20)	(0.20)	(0.06)	(0.23)
LT share x Post	1.46**	0.03	1.49**	1.24*	-0.05	1.19*
	(0.66)	(0.20)	(0.71)	(0.66)	(0.19)	(0.71)
LT share	4.29***	4.22***	8.51***	3.42***	3.92***	7.34***
	(0.50)	(0.24)	(0.60)	(0.50)	(0.24)	(0.60)
Post	-0.62***	-0.21***	-0.83***	-0.31**	-0.07**	-0.38**
	(0.15)	(0.03)	(0.16)	(0.15)	(0.03)	(0.16)
N	17820	17820	17820	17820	17820	17820
R^2	.0107	.159	.0319	.02	.193	.0489
Controls				x	x	x

This table shows how payouts evolve after buyback liberalization in Nov 1982. Treatment is defined as being above the 75 percentile of short-termist ownership prior to the reform. The post-period covers 1983-87. The pre-period covers 1978-82 Standard errors are clustered at the firm level. Controls are lagged employment and lagged RoE. $***p < .01, **p < .05, *p < .1$

Table 1.5: Differences-in-differences estimation

Firms with high short-termist ownership increase their net payout ratios following the reform by about .82 percent of total assets. The median firm in the sample has a payout-to-asset ratio of .88% so this corresponds to nearly a doubling of its net payout-to-asset ratio. Breaking down this increase in payouts reveals that the entire increase stems from an increase in net buybacks, see column 1, while the response of dividends in column 2 is both statistically and economically insignificant. Columns 4-6 show that the results are robust to the inclusion of firm controls, notably lagged size and RoE.

The increase in payout being driven by the share buyback margin supports the interpretation of the effect stemming from repurchase liberalization. It also argues against the substitution hypothesis stating that dividends and buybacks are simply

substitutes for one another. According to the substitution hypothesis, any increase in repurchases or reduced issuance should be matched by a decline in dividends as both payout methods are substitutes. The results in Table 1.5 do not support this hypothesis.

The average firm in the sample has 11.6 % of pre-reform long-termist ownership. In column 6, this implies a, statistically weak, increase of net payouts to assets by .13 percentage points. While more long-termist ownership is therefore also associated with an increase in payouts, quantitatively, the effect from higher short-termist ownership dominates any effects from long-termist ownership.

In the next step, the same regressions are repeated including firm and year-industry fixed effects. Firm fixed effects remove time-invariant differences across firms which addresses concerns such as short-termists simply owning firms with higher average payout ratios driving the results. Year-industry fixed effects remove variation stemming from other macroeconomic or industry-wide shocks.[6] Table 1.6 reports results from the fully saturated regressions:

While the results in Table 1.5 exploited both within and across-firm variation, the inclusion of firm fixed effects effectively only leaves within-firm variation. The net payout ratio increases by .85% of total assets at firms with high short-termist ownership. This is large both relative to firms' average payout ratios and relative to their investment activity. Again, the key margin driving this increase is the net payout margin while the response of dividends is quantitatively an order of magnitude smaller and statistically only barely significant. This is consistent with the availability of share buybacks since November 1982 affecting firm-level payout behavior. Once I only exploit within-firm variation, long-termist ownership is not associated with changes in payout behavior on the buyback margin.

[6]Results are similar when using year fixed effects only (available upon request). Year-industry fixed effects are used as to make these regressions consistent with the investment regressions to follow, where year-industry fixed effects account for differential investment opportunities across industries.

	$\frac{NetBuybacks}{Assets}$	$\frac{Dividends}{Assets}$	$\frac{NetPayouts}{Assets}$	$\frac{NetBuybacks}{Assets}$	$\frac{Dividends}{Assets}$	$\frac{NetPayouts}{Assets}$
Post	-0.01	-0.07***	-0.08			
	(0.15)	(0.02)	(0.15)			
Treated x Post	0.81***	0.07*	0.88***	0.80***	0.05	0.85***
	(0.23)	(0.04)	(0.23)	(0.27)	(0.04)	(0.28)
LT share x Post	-0.27	-0.46***	-0.73	0.28	-0.39**	-0.11
	(0.69)	(0.15)	(0.72)	(0.82)	(0.16)	(0.85)
N	17056	17056	17056	17052	17052	17052
R^2	.326	.873	.395	.449	.898	.505
Firm FE	x	x	x	x	x	x
Year-industry FE				x	x	x
Firm Controls	x	x	x	x	x	x

This table shows how payouts evolve after buyback liberalization in Nov 1982, controlling for lagged size and RoA. Treatment is defined as being above the 75 percentile of short-termist ownership prior to the reform. The post-period covers 1983-87. The pre-period covers 1978-82. All regressions include firm and year-industry fixed effects. Standard errors are clustered at the firm level. $***p < .01, **p < .05, *p < .1$

Table 1.6: Full Differences-in-Differences Estimation

To further test the identifying assumption of parallel trends, I proceed to estimating event studies. All variable and fixed effects definitions carry over. However, I now include yearly interactions of an indicator for that particular year with the treatment variable. This allows to zoom in on the timing and test the identifying assumption.

The event-study plots to follow report the respective series of estimated β-coefficients with their 95 % confidence bands. Figure 1.4 strongly confirms the differences-in-differences results and provides further support for the empirical design.

The figure clearly shows that net payout ratios increase strongly differentially precisely after the reform in November 1982. Prior to the reform, all estimated coefficients are insignificant and very close to zero. Figure A.3.3 contains the corresponding event studies for dividends and net buybacks. They confirm that the increase in net payouts is driven by net share repurchases. To make the coefficients for the dividends assets ratio visible, the scale has been adjusted by a factor of 10. Overall, dividends hardly change between the treatment and control group as evidenced by

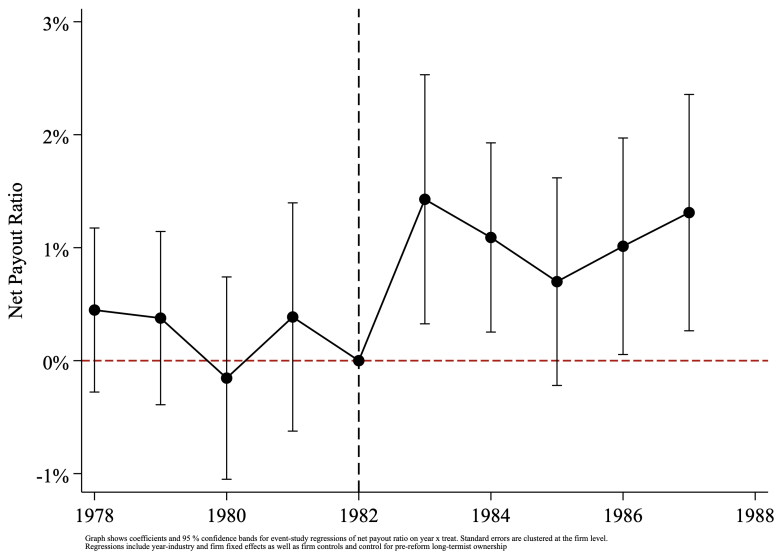


Figure 1.4: Net payout ratio over time

the post-reform response of dividends never being significant in these event-study specifications as well as being economically negligible.

Continuous Differences-in-Differences Estimation

	$\frac{NetBuybacks}{Assets}$	$\frac{Dividends}{Assets}$	$\frac{NetPayouts}{Assets}$	$\frac{NetBuybacks}{Assets}$	$\frac{Dividends}{Assets}$	$\frac{NetPayouts}{Assets}$
Post	-0.10	-0.09***	-0.19			
	(0.15)	(0.02)	(0.16)			
TreatedC x Post	7.03***	1.03***	8.06***	5.84**	0.85**	6.69***
	(2.06)	(0.34)	(2.11)	(2.32)	(0.38)	(2.36)
LT share x Post	-0.30	-0.54***	-0.84	0.50	-0.48***	0.02
	(0.68)	(0.16)	(0.71)	(0.81)	(0.18)	(0.84)
N	16866	16866	16866	16862	16862	16862
R^2	.326	.873	.396	.448	.898	.505
Firm FE	x	x	x	x	x	x
Year-industry FE				x	x	x
Firm Controls	x	x	x	x	x	x

This table shows how payouts evolve after buyback liberalization in Nov 1982, controlling for lagged size and RoA. Treatment is defined continuously as the pre-reform share of short-termist institutional ownership. The post-period covers 1983-87. The pre-period covers 1978-82. All regressions include firm and year-industry fixed effects. Standard errors are clustered at the firm level.
$***p < .01, **p < .05, *p < .1$

Table 1.7: Full DiD Estimation with Continuous Treatment

Table 1.7 reports results from estimating Equation 1.4. Results are consistent with those from the regressions with a discretely defined treatment variable. The response of the net payout ratio with respect to ownership by long-termist institutions does not change after the reform. However, short-termist ownership is strongly associated with an increase in the net payout ratio. Holding constant long-termist ownership, a firm with 10 percentage points more pre-reform short-termist institutional owners than a within-industry counterpart increases its net payout ratio by .67% of total assets. In contrast, heterogeneity in long-termist ownership has no statistically or economically significant effect on payouts. Finally, the main driver of the increase in net payouts is the net buyback to assets ratio. However, the response of dividends is also significant in these regressions, albeit much smaller.

1.4.2 Effects on investment

Results in the previous section clearly indicate that firms with higher short-termist ownership substantially raise their payout ratios by about .85% of total assets. Those additional funds being paid out to shareholders must originate from reductions on other margins. In particular, this section investigates investment outcomes. The key measures of investment are gross and net investment relative to total assets. Thus, the estimates can easily be compared to those from the previous section. While gross investment ($\Delta k_{it} + \delta k_{it-1}$) captures the entire investment activity by the firm, net investment subtracts replacement of depreciated capital so that it only measures net additions to the capital stock (Δk_{it}).

Discrete DiD estimation

The empirical set-up is the same as in equation (1.3). Formally, I test whether firms with a higher short-termist ownership reduce their investment (measured relative to total assets) differentially after the reform.

	$\frac{GrossInv}{Assets}$	$\frac{GrossInv}{Assets}$	$\frac{GrossInv}{Assets}$	$\frac{NetInv}{Assets}$	$\frac{NetInv}{Assets}$	$\frac{NetInv}{Assets}$
Treated x Post	-0.69***	-0.51**	-0.84***	-0.95***	-0.74**	-1.10***
	(0.25)	(0.24)	(0.24)	(0.31)	(0.30)	(0.30)
LT share x Post	-0.57	-1.01	-0.45	-0.78	-2.08**	-0.97
	(0.85)	(0.78)	(0.82)	(1.05)	(0.97)	(1.03)
N	14231	14323	14226	14231	14323	14226
R^2	.415	.607	.704	.312	.361	.523
Firm Controls		x	x		x	x
Firm FE		x	x		x	x
Year-industry FE	x		x	x		x

This table shows how investment evolves after buyback liberalization in Nov 1982. Treatment is defined as being above the 75 percentile of short-termist ownership prior to the reform. The post-period covers 1983-87. The pre-period is 1978-1982. Standard errors are clustered at the firm level. Firm controls are lagged size and RoE. $***p < .01, **p < .05, *p < .1$

Table 1.8: DiD: investment rate

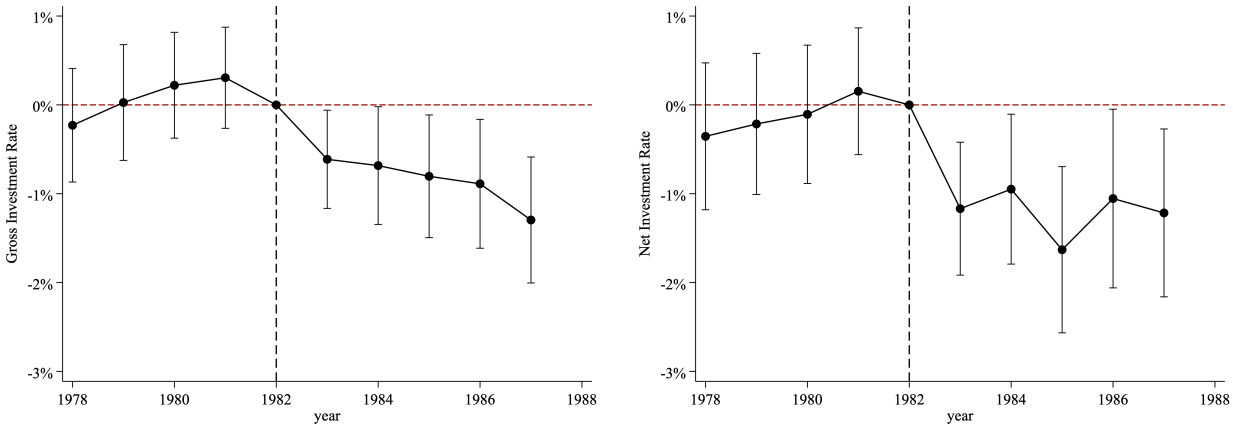
Effects on gross and net investment rates are quantitatively comparable in Table 1.8. Gross investment falls by about .84% of total assets in the most saturated regression. For net investment - investment beyond the replacement of depreciated capital - the effect is slightly larger with a fall of 1.1% of total assets.

In the sample, the average gross investment rate is 8.1% of total assets, the average net investment rate is 2.6% of total assets. Thus, the estimated fall in investment at firms with higher short-termist ownership is quantitatively large. Frequently, net investment rates are negative when firms do not replace all of their depreciated capital. To facilitate interpretation of the estimated β coefficients in the investment regressions, we can relate them to the standard deviation of investment rates. A one percentage point fall in gross and net investment rates corresponds to about 15% of one standard deviation.[7]

Relying on an event-study specification, the underlying parallel trends assumption can be tested formally and the timing can be investigated more precisely. The inclusion of year-industry fixed effects is particularly important here to remove not only

[7]The standard deviations of gross investment and net investment rates are 6.5% and 6.7% respectively.

time trends but also heterogeneity in investment trends and investment opportunities across sectors.



(a) Gross investment rate (b) Net investment rate

Figure 1.5: Investment rate event studies

Figure 1.5 shows that gross and net investment rates are approximately display a sharp and statistically significant drop in the first post-reform year 1983. The drop persists over time. If anything, point estimates in 1987 are slightly larger than the initial post-reform estimate. It is striking how the investment event studies are close to being mirror images of the event-studies for net payouts. Thus, there is evidence for the basic trade-off emphasized in the theoretical myopia literature: Firms with greater short-termist ownership reduce investment activities but increase payouts after share repurchase liberalization, which increases payout flexibility.

To make the results easier to compare to the macroeconomic literature, I also estimate a version of Equation 1.3 where I normalize investment by the firm's capital stock instead of its assets. Since the capital stock is only one component of total assets, the average gross investment and net investment to capital ratio is about three times as large when compared to the assets normalization.

Consistent with this feature, the estimated coefficients in Table A.4.2 are about three times larger than those in Table 1.8 but the estimated effect on investment is

still negative and highly significant. Firms reduce their investment activity by 2.2 to 3.4 percentage points of their total capital stock, depending on whether we consider gross or net investment.

Continuous DiD estimation

I further check the robustness of the investment results in Table 1.9, which reports results from estimating Equation 1.4 with a continuously defined treatment variable. Results are very similar in that both gross and net investment rates decline significantly following the reform. To evaluate the quantitative magnitude, it is useful to compare these estimates to the ones from Table 1.7. The estimates for the increase in net payouts for firms with high pre-reform short-termist ownership and for the corresponding decline in investment are very similar, supporting the hypothesis of a tradeoff between investment and payouts. On net, every one percentage point reduction in the investment to assets ratio is mirrored by a one percentage point increase in the net payout ratio.

	$\frac{GrossInv}{Assets}$	$\frac{GrossInv}{Assets}$	$\frac{GrossInv}{Assets}$	$\frac{NetInv}{Assets}$	$\frac{NetInv}{Assets}$	$\frac{NetInv}{Assets}$
TreatedC x Post	-5.90**	-4.45**	-6.50***	-7.24***	-5.94**	-7.51***
	(2.34)	(2.23)	(2.29)	(2.78)	(2.74)	(2.84)
LT share x Post	-0.72	-0.97	-0.54	-1.22	-1.95*	-1.14
	(0.84)	(0.80)	(0.84)	(1.04)	(0.99)	(1.06)
N	14077	14172	14072	14077	14172	14072
R^2	.426	.608	.705	.341	.362	.524
Firm Controls	x	x	x	x	x	x
Firm FE		x	x		x	x
Year-industry FE	x		x	x		x

This table shows how investment evolves after buyback liberalization in Nov 1982. Treatment is defined continuously as the pre-reform share of short-termist ownership. The post-period covers 1983-87. The pre-period is 1978-1982. Standard errors are clustered at the firm level. Firm controls are lagged size and RoE. $***p < .01, **p < .05, *p < .1$

Table 1.9: Continuous DiD: investment rate

1.4.3 Robustness

Before analyzing different explanations for the results, this section reports estimates for different measures of investor horizons. The main measure used so far classified investors as having a short investment horizon if their median investment horizon across their portfolio was no more than 6 quarters. Here, I report results for varying that 6 quarter cutoff and for using turnover as main measure of investment horizon. To facilitate comparison, throughout I report estimates from the continuous differences-in-differences regressions.

Alternative Measures of Investor Horizons

Before reporting those regression estimates, I first provide an overview of the variation across a range of different measures of investment horizons. Each of these measures generates a distinct, yet highly correlated, measure of the share of short-horizon institutional investors at a firm. The first set of measures vary the cutoff for investors to be classified as short-horizon. In addition to the six quarter cutoff from the previous sections, Table 1.10 further reports results for 4,5,7, and 8 quarters. In the last row, Table 1.10 further reports the turnover based measure. For each definition, I report the share of short-termist investors, measured continuously, at a firm for different definitions of the treatment variable.

Variable	Obs	Mean	Std. Dev.	P50
4 Quarters	26362	.018	.026	.008
5 Quarters	26361	.031	.038	.016
6 Quarters	26621	.05	.061	.028
7 Quarters	26357	.067	.071	.041
8 Quarters	26344	.09	.09	.057
Turnover Measure	26101	.062	.059	.043

Table 1.10: Measures of Investment Horizon

As the cutoff below which investors are classified as short-termist increases, the share of short-termist investors at firms is increasing on average. When short-termist

investors are defined as those with a median holding period not exceeding 4 quarters, the average firm has 1.8 % of share owned by short-termist institutions. For an 8 quarter cutoff, this rises to 9 % on average. This reflects that the latter definition covers more institutions than the former, more narrow one.

Finally, the turnover based measure exhibits an average of 6.2 % of short-termist institutional investors among a firm's total shareholder base. Investors are defined as short-termist if their turnover is below the median turnover across institutions in the pre-reform period.

Holding Period Measures

Next, I report results for re-estimating the continuous difference-in-differences regressions with the different treatment definitions. For simplicity, this section will only report results from the fully saturated regressions with firm controls, firm and year-industry fixed effects for net payout ratios and for the net investment rate. Table 1.11 contains results for the net payout ratio when using 4,5,7, and 8 quarters as the maximum median investment horizon for investors to be classified as short-termist.

	4 Quarters	5 Quarters	7 Quarters	8 Quarters
Treated x Post	9.24**	8.15**	7.73***	7.20***
	(4.26)	(3.44)	(1.98)	(1.74)
LT share x Post	0.82	0.41	-1.18	-2.22**
	(0.80)	(0.85)	(0.93)	(1.07)
N	16853	16853	16853	16853
R^2	.505	.506	.506	.506
Firm FE	x	x	x	x
Year-industry FE	x	x	x	x
Firm Controls	x	x	x	x

This table shows how payouts evolve after buyback liberalization in Nov 1982, controlling for lagged size and RoE. Treatment is defined continuously as the pre-reform share of short-termist institutional ownership for different cutoffs. The post-period covers 1983-87. The pre-period covers 1978-82. All regressions include firm and year-industry fixed effects. Standard errors are clustered at the firm level. $***p < .01, **p < .05, *p < .1$

Table 1.11: Net Payout Regressions for different Investor Definitions

Across all specifications, a higher share of pre-reform short-termist investors is associated with a statistically significant increase in the net payout rate. Moreover, the effect of the share of long-termist investors is economically substantially smaller and insignificant, except for the rightmost column. Quantitatively, the marginal effect of having the same pre-reform share of short-termist investors is declining as I increase the cutoff. One interpretation is the following. When defining short-termist investors as those with a median holding horizon of 4 quarters or less, I capture the most short-termist institutions. Conversely, as I raise the cutoff, the average short-termist institution has a slightly longer holding horizon. As the short-termist pressure eases, I indeed find that a broader definition implies a smaller estimated coefficient consistent with the interpretation that institutions with very short holding horizons exert the greatest pressure onto firms to increase payouts.

Table 1.12 repeats this exercise for the net investment rate.

	4 Quarters	5 Quarters	7 Quarters	8 Quarters
Treated x Post	-12.03**	-12.85***	-7.94***	-7.49***
	(4.88)	(3.82)	(2.27)	(1.96)
LT share x Post	-2.05**	-1.27	-0.15	0.96
	(0.95)	(1.00)	(1.15)	(1.27)
N	17656	17656	17656	17656
R^2	.508	.509	.509	.509
Firm FE	x	x	x	x
Year-industry FE	x	x	x	x
Firm Controls	x	x	x	x

This table shows how the net investment rate evolves after buyback liberalization in Nov 1982, controlling for lagged size and RoE. Treatment is defined continuously as the pre-reform share of short-termist institutional ownership for different cutoffs. The post-period covers 1983-87. The pre-period covers 1978-82. All regressions include firm and year-industry fixed effects. Standard errors are clustered at the firm level. $***p < .01, **p < .05, *p < .1$

Table 1.12: Investment Regressions for different Investor Definitions

For each continuously defined treatment variable, a higher share of short-termist investors prior to the reform correlates strongly with a decline in the net investment rate. The coefficients are slightly larger than the increase in payouts from Table 1.11 but statistically, equally cannot be rejected for any. Hence, defining short-termist

institutions as institutions with median holding horizons no longer than 4,5,7, or 8 quarters yields comparable results to the definition in earlier sections where the cutoff was 6 quarters.

The full regression tables with all main specifications for payout outcomes are reported in Tables A.3.1, A.3.3, A.3.5, and A.3.7. For investment, full regressions tables for each distinct treatment variable are listed under A.3.2, A.3.4, A.3.6, and A.3.8. The main empirical results are robust to either treatment definition.

First, net payout increase significantly following share repurchase liberalization with the increase being driven primarily by the share repurchase margin. The dividend response is quantitatively close to an order of magnitude smaller in all specifications and not always statistically significant.

Second, investment declines significantly by a comparable magnitude as payouts increase.

Turnover Measure

Based on the turnover definition from Equation 1.2, I classify investors as having a short-termist if their quarterly turnover lies above the median turnover. Using that binary classification of investor horizon, I reconstruct a measure of short-termist investors at the firm-level analogous to Equation 1.1 and then re-estimate the continuous difference-in-differences specification using that new measure. Tables 1.13 and 1.14 report results for payout and for investment outcomes:

The average share of short-termist investors per firm is .062. Hence, a firm with the average treatment, that is a 6.2 % share of short-termist investors prior to the reform, experiences an increase in net payouts of .71% of total assets and an investment decline of -.87% of total assets.

The turnover-based measure exploits different variation within institutions as compared to the previous measures. While the previous measure based on the median

	$\frac{NetBuybacks}{Assets}$	$\frac{Dividends}{Assets}$	$\frac{NetPayouts}{Assets}$	$\frac{NetBuybacks}{Assets}$	$\frac{Dividends}{Assets}$	$\frac{NetPayouts}{Assets}$
Post	-0.21	-0.09***	-0.31**			
	(0.15)	(0.02)	(0.15)			
TreatedC x Post	13.22***	1.40***	14.63***	10.08***	1.34***	11.42***
	(2.55)	(0.44)	(2.60)	(2.84)	(0.50)	(2.87)
LT share x Post	-3.52***	-0.82***	-4.34***	-1.90*	-0.79***	-2.69**
	(1.00)	(0.23)	(1.05)	(1.14)	(0.26)	(1.17)
N	16729	16729	16729	16726	16726	16726
R^2	.322	.872	.392	.447	.898	.504
Firm FE	x	x	x	x	x	x
Year-industry FE				x	x	x
Firm Controls	x	x	x	x	x	x

This table shows how payouts evolve after buyback liberalization in Nov 1982, controlling for lagged size and RoA. Treatment is defined continuously as the pre-reform share of short-termist institutional ownership. The post-period covers 1983-87. The pre-period covers 1978-82. All regressions include firm and year-industry fixed effects. Standard errors are clustered at the firm level. $***p < .01, **p < .05, *p < .1$

Table 1.13: Continuous DiD: payouts

	$\frac{GrossInv}{Assets}$	$\frac{GrossInv}{Assets}$	$\frac{GrossInv}{Assets}$	$\frac{NetInv}{Assets}$	$\frac{NetInv}{Assets}$	$\frac{NetInv}{Assets}$
TreatedC x Post	-7.90***	-8.41***	-11.46***	-11.18***	-10.61***	-13.98***
	(2.84)	(2.74)	(2.76)	(3.44)	(3.49)	(3.58)
LT share x Post	0.39	1.14	2.02*	0.67	0.78	2.22
	(1.16)	(1.13)	(1.16)	(1.43)	(1.42)	(1.50)
N	16160	16157	16155	16160	16157	16155
R^2	.414	.62	.709	.318	.37	.52
Firm Controls	x	x	x	x	x	x
Firm FE		x	x		x	x
Year-industry FE	x		x	x		x

This table shows how investment evolves after buyback liberalization in Nov 1982. Treatment is defined continuously as the pre-reform share of short-termist ownership. The post-period covers 1983-87. The pre-period is 1978-1982. Standard errors are clustered at the firm level. Firm controls are lagged size and RoE. $***p < .01, **p < .05, *p < .1$

Table 1.14: Continuous DiD: investment rate

of holding horizons broadly captures the distribution of holdings horizons across investments within an institution, the turnover-based measure could be driven by substantial trading in relatively few positions. Despite these conceptual differences, the quantitative results are still very similar highlighting the robustness to different constructions of my measure of short-termist investors.

1.5 Alternative Explanations

Results so far paint a clear picture: Firms with higher short-termist ownership increase payouts at the expense of investment following share buyback liberalization. Interpreting these results is not straightforward, though, because they are consistent with at least two broad interpretations. First, it could be that firms with higher short-termist ownership were inefficiently over-investing until 1982. After the 1982 share buyback reform, they paid out those funds that were previously invested. This would imply that share buyback reform provides firms a means of efficiently sizing down. For the remainder, I will refer to this mechanism as "efficient downsizing mechanism".

The second set of of mechanisms that could be at work could originate from short-termist capital market pressures, consistent with the myopia literature. Given the greater flexibility of share repurchases relative to dividends, firms with greater short-termist ownership use a buyback-driven increase in payouts in an attempt to signal higher intrinsic value. Those signaling considerations come at the expense of positive net present value investment. This second mechanism will be referred to as "myopia mechanism."

This section provides first a formal test to discriminate between the two hypotheses using insider holdings data. Then, several other potential explanations are discussed.

1.5.1 Insider Holdings Test

To disentangle more precisely between the "efficient-downsizing" and the "myopia" hypotheses, this section proposes a test based on insider holdings data. The idea underlying the test is as follows: Following share buyback reform, firms with high short-termist ownership substitute from investment to payouts. If this follows the "efficient downsizing" argument, prospects for the firm have not worsened. Thus,

incentives for insiders to hold stock in their firms are not affected or would even improve. On the other hand, the "myopia" argument stipulates that the change in firms' behavior is ultimately inefficient. In that case, insiders have an incentive to sell their shares and reduce their portfolio's exposure to the firm. Thus, the trading behavior of insiders at firms with high short-termist ownership can provide information that allows to separate the two hypotheses. The underlying assumption for insider trades to reveal any information beyond market prices is that insiders have some information about the firm that is not immediately observable by all market participants and can also not be inferred by all market participants. Since insider trades are published only with delay and total insiders holdings are quantitatively very small at about .1% of total market value (Jeng et al., 2003), the public cannot readily infer how insiders traded in the 1980s from publicly available data or from aggregate market movements.

Insider trading regulation in the US in the early 1980s is dominated by the Securities and Exchange Act of 1934 (Meulbroek, 1992) and case law decisions. Most importantly, "an insider must disclose material inside information or refrain from trading" (Meulbroek, 1992). The opportunity to file a trading plan in advance of any insider trade was added later by the SEC through Rule 10b5-1, released in 2000. For more detail on Rule 10b5-1, see Jagolinzer (2009). While insiders can be charged for exploiting information advantages relative to the public and despite tightening regulation, insider trading remains "a crime that is notoriously difficult to prove"[8] as noted by observers. Insider trading is also prevalent at all times of the sample period from 1978 to 1987.

For insider trading data, I use two data sources. Starting in 1986, Thomson Reuters Insiders Data covers the universe of stock transactions by corporate insiders.[9] These filings are mandatory for corporate insiders defined as "officers and directors,

[8] `https://www.ft.com/content/e71158c8-41e5-11ea-bdb5-169ba7be433d`

[9] Derivative Transactions are not available before 1996.

and any beneficial owners of more than ten percent of a class of the company's equity securities" by the SEC [10]. In order to obtain data for the period around the 1982 share buyback reform, I digitize insider tradings data for the 1978-1985 period from the SEC's Official Summary of Security Transactions and Holdings. These transactions are referred to as insider transactions because they involve corporate insiders who might have material non-public information about the firm, not because they are selling or buying shares directly from their firm.

Both sets of data capture the information from SEC Forms 3, 4 and 5, which record executed trades by firm insiders. Merging both of these datasets therefore provides a full account of insider trading at US public firms from 1978 until 1987, covering the same time period as the previous empirical analysis.

The insider trading data contains the following information: name of insider, firm, amount of holdings, transaction date, type of transaction (sale or purchase) and amount of shares transacted. Combining post-transactions holdings and the amount of shares transacted, I can infer the pre-transaction amount of holdings. While Thomson Reuters does some checking for mistakes in the records, the data still contains mistakes such as more shares being purchased than are held post-transaction. Those are removed from the data. For more details on the digitizing procedure and data construction, see Appendix A.2. Critically, I remove transactions by large institutional shareholders to avoid a mechanical correlation between the μ-measure and any measures of insider trading, which would otherwise bias downward the regression coefficients in equation 1.7. Summary statistics at the trade-level for those firms that are matched to Compustat are provided in Table 1.15:

Notice that many firms are not matched to Compustat, because the analysis focuses on non-financial Compustat whereas the bulk of insider transactions take place in the financial sector.

[10] `https://www.sec.gov/fast-answers/answersform345htm.html`

Variable	Obs	Mean	Std. Dev.
Sale Flag	47097	.443	.497
Number of Shares Bought	26134	11747.85	364437.1
Purchase Price	14546	16.761	21.959
Number of Shares Sold	20298	9607.043	84793.58
Sale Price	15394	25.679	47.095

Table 1.15: Summary Statistics: Insider Trades

"Sale flag" is a binary indicator for whether an insider transaction is a sale ($Sale = 1$) or a purchase ($Sale = 0$). As we can see, 44.3 % of transactions are sales. Next I break down the numbers of shares transacted, The average transaction involves more than 10,000 shares in either trading direction but there is large skewness in the distribution. For a small fraction of trades, only the sale-flag is reported so that the number of observations with numbers of shares bought or sold is lower than the total number of observations. For more than half of the transactions, transaction prices are also observed.

Logit Estimation

In a first step, I test the predictive power of short-termist ownership onto insider transactions. Using the binary classification of transactions as sales or purchases, a logit model is estimated, separately for the pre-reform (1978-1981) and for the post-reform (1983-1987) period. These regressions show whether the predictive power of short-termist ownership for insider trades has changed around 1982. The data is three-dimensional consisting of trades by insider j of firm i at time t.

$$P(Sale_{ijt} = 1) = \frac{1}{1 + \exp(-[\beta \mu_{i,t-1} + \gamma X_{i,t-1}])} \tag{1.6}$$

Controls are RoE, size and share of long-termist institutional ownership. $\mu_{i,t-1}$ is lagged ownership by short-termist institutions. All right-hand side variables are lagged by one year. Equation 1.6 tests whether short-termist ownership predicts insider sales. Table 1.16 reports the marginal effects from the logit estimation, with the pre-reform period in the first two columns and post-reform estimates in the last two columns. The underlying logit coefficients are reported in Table A.4.3. One would worry that large short-termist institutional investors would also qualify as insiders so there would be a mechnical relationship between the right-hand side measures of short-termist ownership and insider transactions. This is the reason for dropping records of insider transactions by institutional investors in the insider trading data. Having done that, there is no a-priori correlation between explanatory variables and outcomes.

	78-81	78-81	83-87	83-87
Sale Flag				
μ_{t-1}	-0.2206***	-0.1222	0.2857***	0.3933***
	(0.0757)	(0.0905)	(0.0356)	(0.0424)
RoE		-0.3616***		-0.1113***
		(0.0532)		(0.0235)
Size		-0.0001		-0.0006***
		(0.0001)		(0.0001)
LT Inst. Holdings		-0.0403		0.0161
		(0.0430)		(0.0244)
N	11675	11147	32845	30575
Pseudo R2	5.3e-04	.0046	.0014	.0043

Logit Regression marginal effects for predicting insider sales. Standard errors are Huber-White heteroskedasticity robust.
$***p < .01, **p < .05, *p < .1$

Table 1.16: Logit Marginal Effects

Prior to the reform, short-termist ownership, as measured by $\mu_{i,t-1}$, has either no or negative predictive power for insider transactions as evidenced in the first two columns. In the post-reform period, the reverse is true. High ownership by short-termist institutional investors predicts high sales by insiders in the subsequent year. Furthermore, long-termist ownership does not predict insider sales in either period

while insiders are more likely to sell small and poorly performing (low lagged RoE) firms.

Moving from 0% to 10% of short-termist owners raises the likelihood of an insider sale by 3.9 percentage point for the following year. The effect is quantitatively large when compared to the other control variables. These results suggest that share buy-back reform and the effects on corporate decisions analyzed earlier also affect trading incentives for corporate insiders after 1982. Since this analysis was only a predictive test, the next subsection provides a more formal test for the pattern highlighted in Table 1.16.

Difference-in-Differences Estimation

To make the firm-level analysis comparable to the earlier sections, I aggregate the insider data at the firm level. For 2103 unique firms, this yields a measure of the propensity by insiders to sell (or purchase) shares on the open market and of the transaction amounts of corporate insiders.

In this step, I estimate regression 1.7 at the firm level. This provides a stronger test than the logit model because I now explicitly test whether those firms most affected by the reform display different insider trading behavior after SEC rule 10b-18 is passed.

$$\frac{Ins.\ Sales_{it}}{Ins.\ Trades_{it}} = \alpha_i + \alpha_{t,ind} + \beta Post_t Treat_i + \gamma Post_t LT_i + \delta_1 X_{it} + \delta_2 X_{it} Treat_i + \epsilon_{it} \quad (1.7)$$

The differences-in-differences design is the same as in equation 1.3 and all variable definitions carry over, including the set of control variables X_{it} (RoE and size measured as employment). The coefficient of interest is β. It tests whether insider sales on the open market make up a greater fraction of transactions in the post-reform

years at firms that have high pre-reform short-termist ownership. Table 1.17 reports results both from an unweighted and from a size-weighted estimation of equation 1.7:

	Unweighted	Weighted
Post x Treated	0.0847**	0.3770**
	(0.0428)	(0.1593)
N	6702	6700
R^2	.655	.759
Firm FE	x	x
Time-industry FE	x	x
Controls	x	x

Table 1.17: Linear Regression

The fraction of insider sales among all insider trades rises significantly both in the unweighted and in the weighted regression. For the average firms, the fraction rises by 8.5 percentage points. The increases are more concentrated among larger firms so weighting by size reveals an increase by 37.7 percentage points after the reform.

Taken together, these results show that insiders at firms, which have more short-termist ownership prior to the reform, exhibit more insider sales following the reform. These results are consistent with the surge in payouts and the cuts in investment after the reform having a negative impact on those firms so insiders opt for selling stakes in their company. On the other hand, if paying out potential free cash flows and reducing investment was efficient, one would expect $\beta \leq 0$ in equation 1.7, which was statistically rejected.

1.5.2 Profitability

In this subsection, I test how profitability, defined as gross profit over assets, changes after the reform. I re-estimate the differences-in-differences design with profitability as dependent variable. Table 1.18 reports results. In the fully saturated specification, profitability falls by 7 percent measured as a fraction of total assets for firms that have a high share of short-termist ownership prior to the reform. Columns (1) - (3) indicate

a statistically significant decline in profitability, which turns insignificant, however, in the fully saturated model of column (4). This results is consistent with the finding from the previous subsection: Insiders sell more after the reform because prospects for firms with a short-termist investor base are worsening, as evidenced by the decline in profitability. Thus, the profitability results are also consistent with the inefficient myopia explanation but difficult to reconcile with operational improvements within the firm.

	(1)	(2)	(3)	(4)
Treated x Post	-26.38***	-15.28**	-15.41**	-7.16
	(7.96)	(6.44)	(6.49)	(6.59)
LT share x Post	7.34	3.53	4.88*	2.70
	(4.86)	(2.59)	(2.61)	(2.90)
N	15574	15574	15574	15574
R^2	.0349	.78	.787	.837
Firm Controls	x	x	x	x
Firm FE		x	x	x
Year FE			x	
Year-industry FE				x

Table 1.18: Profitability Results

1.5.3 Other candidate explanations

Agency-theoretic explanations of corporate payout behavior emphasizes the managers might engage in empire-building or inefficient acquisitions if companies have large free cash flows (Jensen, 1986). If the rise in share repurchases is primarily about paying out excess cash balances, one should observe treated firms holding larger amounts of cash relative to untreated firms. However, in the data, I observe the opposite. The average cash balance (relative to assets) at treated firms is 2.8 % whereas it is 4.1 % for the control group. Hence, clearly, those firms that increase payouts following the reform do not have larger ex-ante cash holdings.

The "efficient downsizing mechanism" also suggests that treated firms should have lower investment opportunities in the post period. Having lower investment opportunities relative to the control group, would imply lower investment according to standard q-theory. Empirically, Tobin's Q is similar across both groups.

Finally, there is a large literature on how changes to dividend taxation affect firm behavior. The old public finance view (Poterba and Summers, 1985) suggests that lower payout taxes increase investment as the after-tax marginal product of investment increases. Since share repurchases are taxed at a lower rate for most shareholders[11], the liberalization of share repurchases effectively lowers the tax rate on distributions. According to the old view in public finance, this should boost investment. There is not evidence for that. Investment slows in the aggregate and those firms that repurchase the most, hence make the most use of the lower tax rate, actually reduce their investment.

The "new view" in public finance (Auerbach (1979), Bradford (1981)) stipulates that marginal investment is financed out of retained earnings or debt rather than through new equity issues. A lower payout tax has no effect on investment since the increase in the after-tax return on investment is exactly offset by the opportunity cost of investment (see Yagan (2015) for a more detailed discussion). This view cannot explain the results either.

1.6 Industry-level general equilibrium

The entire analysis so far focused on the firm-level dimension. What happens at the industry-level when some firms reduce their investment while increasing their payouts? Can firms with more long-termist ownership step in and potentially fill in parts of the

[11]They are taxed at the capital gains tax rate while dividends are taxed at the owner's income tax rate. The latter exceeds the capital gains tax rate by about 30 percentage points in the higher tax brackets implying that share repurchases are the more tax-efficient way to pay out earnings - at least for shareholders in the higher income tax brackets.

investment gap or does the entire industry reduce investment? These questions are inherently about intra-industry reallocation and therefore about industry-level general equilibrium effects. Methodologically, I address these questions using recent advances in the estimation of general equilibrium multipliers (Sarto (2018) and Mian et al. (2019)). The interest in this nascent literature is not primarily on recovering macro elasticities from regional data (see Beraja et al. (2019) and Chodorow-Reich (2020) for examples) but rather how to recover regional elasticities that are potentially affected by regional general equilibrium effects from data on microeconomic observations such as households. Here, I apply a similar methodology in a corporate finance setting to uncover intra-industry general equilibrium effects. The definition of industry are 4-digit SIC codes of which there are 357 unique codes in the data for the relevant 1980-87 time period.

The procedure of Mian et al. (2019) relies on a two-step methodology. In a first step, which corresponds to the estimation of equation 1.3, the firm-level effect is estimated. The industry-year fixed effects absorb any industry-level general equilibrium effects such as wage patterns, industry-level price indices or industry-level shocks. Hence, equation 1.3 identifies the partial equilibrium effect within an industry holding all other forces constant. Notice that the year-industry fixed effects also absorb all economy-wide general equilibrium effects. To open up the black box of industry-level general equilibrium effects, which could potentially mitigate the impact of lower firm-level investment at firms with high short-termist ownership, I estimate the industry-level analogue of equation 1.3. However, given the relatively low frequency of the data, there are too few quarterly observations aggregated at the economy-wide level to estimate the economy-wide general equilibrium multiplier.

To uncover the industry general equilibrium effects, I estimate the industry-level version of 1.3 where all variables are aggregated at the industry level. Thus, $y_{s,t}$ is

the mean of outcome y in industry s in year t. The same definition holds for the construction of the treatment and of the control variables at the industry level.

$$y_{s,t} = \alpha_s + \alpha_t + \beta_2 Treat_s Post_t + \gamma LTshare_s Post_t + \delta_1 X_{s,t} + \delta_2 X_{s,t} Treat_s + \epsilon_{s,t} \quad (1.8)$$

The general empirical strategy is unchanged. Only the level of the variation is now different. Equation 1.8 uses within-industry variation to identify β_2 . Most crucially, the difference between β_2 and β, which was obtained from estimating equation 1.3, reveals the size of within-industry general equilibrium effects. This is the key result from Mian et al. (2019). If β and β_2 are identical, the industry-level effect corresponds to the firm-level effect. Hence, there is no difference between the industry-level outcomes and firm-level outcomes. No forces at the industry-level mitigate or amplify the firm-level outcomes. Importantly, this would not imply the absence of higher-order general equilibrium effects at the economy level. The time fixed effects absorb any shocks at the economy-wide level such as productivity shocks or business cycle shocks, which affect all firms.

If β_2 were to exceed β, there would be within-industry amplification. Conversely, increasing payouts at some firms - those with higher short-termist ownership - could trigger general re-allocation away from that industry and we would observe $\beta_2 < \beta$.

Table 1.19 reports the industry-level results for the three main outcomes of interest: net payouts, gross and net investment. As before, I express the ratios as percentages of total assets:

These results are very interesting both on the payout and on the investment dimension. In industries with more treated firms net payouts are 1.4 percentage points higher (measured relative to total assets). This industry-level effect is slightly larger than the firm-level outcome in Table 1.6 although the difference is not statistically

	Net Payouts / Assets	Gross Investment / Assets	Net Investment / Assets
Treated x Post	1.41***	0.14	-0.59
	(0.47)	(0.45)	(0.54)
N	3307	3339	3342
R^2	.468	.582	.388
Controls	x	x	x
Year FE	x	x	x
Industry FE	x	x	x

This table shows how net payouts and investment evolve at the industry-level. The pre-period is 1978-82. The post-period covers 1983-87. Treatment is defined as the average share of treated firms within an industry. $***p < .01, **p < .05, *p < .1$

Table 1.19: Industry-level GE effects

significant. Hence, there is little general equilibrium impact on the payout margin. The industry-level effects of the reform on payouts are largely driven by the firm-level response, which was estimated at about .85 percentage points (relative to total assets). But. there is evidence for slight amplification at the industry-level.

On the investment margin, however, results are substantially different. Neither for net nor gross investment is the coefficient statistically significant. Moreover, the point estimate for gross investment actually turns positive, while the firm-level results in Table 1.8 reported a negative firm-level response. While the industry-level estimates are less precise due to the lower number of observations at the industry-level, the difference between β_2 and β is clearly positive at the 4-digit industry-level. This implies significant within-industry re-allocation of investment. While firms with higher short-termist ownership reduce investment, there is substantial re-allocation of investment. As a result, I cannot reject the null hypothesis that short-termist ownership has no post-reform effect on investment. At the same time as firms with higher short-termist ownership cut back on investment, their counterparts with more long-term ownership expanded their investment activity.

1.7 Lessons and Relevance today

In this section, I discuss the relevance of the lessons from the 1982 share repurchase liberalization for the 21st century. My results contribute towards two important debates: the drivers of the secular investment decline and the build-up of financial stability risks in the corporate sector in the aftermath of the financial crisis.

1.7.1 Low Investment Literature

As noted in Section 1.2, the aggregate importance of share buybacks as a means of distributing capital to shareholders has steadily increased since 1982. In addition, a widely-observed fact is that investment has weakened over time in the United States (Farhi and Gourio (2018), Gutiérrez and Philippon (2016), Liu et al. (2022)). In the first part of the empirical analysis, this chapter uncovers a strong investment-payout tradeoff at firms with high short-termist ownership. My results therefore highlight a novel potential explanation for the decline in investment: short-termist investors and capital market pressures.

These findings provide a local estimate for the differential impact of share buyback liberalization onto firm policies around 1982, depending on a firm's investor base. While extrapolation of these estimates to 2021 should be done cautiously because of changes in financial markets and the overall economy, the share of short-termist institutional investors, as well as the share of institutions overall, in the aggregate stock market has steadily increased over the past 40 years. For instance, investment advisors are the institution type for which I found the quickest turnover ratio and the shortest average holding period. Consistent with the interpretation of a growing role for short-termist institutions, Koijen and Yogo (2019) report that investment advisors are the fastest growing group of institutions as measured by their share in the total market, which quadruples from 5 % in 1980-84 to 20 % of the total stock market in

2015-17. Hence, rising capital market pressures from short-termist investors could explain parts of the long-run secular decline in investment.

International evidence by Wang et al. (2021) suggests that share repurchase liberalization in a sample of 17 countries, excluding the US, is followed by higher payouts and lower investment. Their staggered differences-in-differences design is, however, vulnerable to concerns about heterogeneity in treatment effects Baker et al. (2021). In fact, Baker et al. (2021) find a null effect on investment after correcting for potentially heterogeneous treatment effects. Figures A.5.1, A.5.2 and A.5.3 provide evidence on aggregate trends for public firms in Germany, France and the Netherlands, respectively. For all three countries, we observe an increase in net payouts after share repurchase liberalization and a decline in investment, trends broadly consistent with the US experience over the last 4 decades, highlighting that rising payouts and weak investment are two macroeconomic trends of international scope.

1.7.2 Share Buybacks and weak Balance Sheets

The large disbursements to shareholders raise the question whether companies weaken their balance sheets. To understand this and provide further evidence for the timeliness of the results in 1982, I compute payout ratios for US firms for 2010-2019 and test whether they correlate with cumulative abnormal returns in the 2020 COVID-induced stock market crash. This methodology was pioneered by Campbell et al. (1997) (for a recent application, see Acemoglu et al. (2016), for example). I focus on the stock market downturn from February 19 to February 28 2020, triggered by news about the escalating COVID pandemic as the event period. News about the spread of COVID-19 in Italy and other European countries as well as concerns about the impact of COVID-19 on the domestic economy led to a sell-off in US equity markets totaling in a more than 10 % drop within 10 days in the second half of February 2020.

While the sell-off continued after a brief rebound well into March 2020, I focus on the initial downturn to have a well-defined event-period.

To obtain a benchmark for returns, I use data from January 1, 2019 up to January 19, 2020 - 1 month before the event time - consistent with the prior literature. For that time frame, I estimate the following model for returns R_{it} of firm i on trading day t:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \epsilon_{it} \tag{1.9}$$

R_{mt} denotes the market return on day t for which I use the S&P 500 index. The abnormal returns AR_{it} on the event days in February 2020 are then defined as the returns of a stock in excess of the predicted return given the estimated coefficients $\hat{\alpha}_i$ and $\hat{\beta}_i$:

$$AR_{it} = R_{it} - \hat{\alpha}_i - \hat{\beta}_i R_{mt} \tag{1.10}$$

Notice that while I use the same index t for time in equations 1.9 and 1.10, the former regression is estimated on the pre-event time window while the abnormal returns are computed for the event times. Cumulative abnormal returns CAR_{it} are given by the sum of abnormal returns AR_{it} over the event time window:

$$CAR_i = \sum_{t=0}^{T} AR_{it} \tag{1.11}$$

Using these estimated cumulative abnormal returns, I estimate whether firms' repurchase activity in the decade leading up to 2020 is related to cumulative abnormal

returns during the Covid-19 stock market drop. I respectively normalize the total buyback volume of each firm by total assets, net income and cash flow. Using these measures, I run a cross-sectional regression of cumulative abnormal returns on a measure of buyback activity BB_i:

$$CAR_i = \alpha + \beta BB_i + \epsilon_i \tag{1.12}$$

This regression allows to test the hypothesis whether buyback activity prior to the Covid-19 crisis predicts abnormal stock returns at the onset of the crisis. Table 1.20 summarizes the results for the different normalizations.

	(1)	(2)	(3)
$\frac{\text{Buybacks}}{\text{Cash Flow}}$	-0.0220**		
	(0.0110)		
$\frac{\text{Buybacks}}{\text{Net Income}}$		-0.0135***	
		(0.0046)	
$\frac{\text{Buybacks}}{\text{Assets}}$			-0.2362**
			(0.1160)
N	2558	2560	2584
R^2	.0013	.0018	.0011

Results are from a regression of CAR from Feb19 to Feb28 on average buyback ratio over previous decade.
$***p < .01, **p < .05, *p < .1$

Table 1.20: Cumulative Abnormal Returns during Covid-19

Regardless of normalizations, all three regressions find a significantly negative relationship between prior buyback activity and abnormal returns. Firms that repurchased relatively more shares experienced lower cumulative abnormal returns in February 2020 when the Covid-19 crisis reached the stock market supporting the notion that large amounts of share buybacks might leave companies vulnerable to negative shocks. The standard deviation of buyback to asset ratios is around 4 percentage points. A one standard deviation increase in that ratio implies a 1 % lower cumulative abnormal return. Hence, firms with higher normalized amounts of repurchases over the 2010s face a considerable negative stock price reaction at the onset of the Covid-19 crisis.

Overall, these results highlight how the analysis of share buyback liberalization in the 1980s carries relevance for current developments regarding corporate payout policies.

1.8 Conclusion

This chapter uses a natural experiment - share repurchase liberalization in the United States in 1982 - to study frictions in firms' payout decisions. I find evidence that companies with higher short-termist ownership increase their payouts substantially following the reform. This comes at the expense of lower investment expenditures. The same firms that raise their payouts by about .85% percent of total assets, representing a large and unprecedented increase in payouts, reduce their investment by a quantitatively comparable amount. In sum, these results highlight the presence of an investment-payout trade-off that is exacerbated by the presence of short-termist firm owners.

To better understand these results and separate between an efficient-downsizing and a myopic interpretation, a test using newly digitized insider trading data is conducted. Under the assumption that corporate insiders have a non-zero degree of information advantage over the average market participant, these tests provide additional information beyond analyzing market values. Concretely, higher short-termist ownership predicts insider sales and firms with higher pre-reform short-termist ownership have more insider sales after the reform. This is consistent with a myopia interpretation where firms with higher short-termist ownership inefficiently increase payouts in an attempt to signal better prospects to the market,.

Finally, I show that the payout effects persist at the industry-level. However, there is a sizable general equilibrium multiplier that undoes much of the firm-level investment effect. This result highlights the importance of intra-industry re-allocation.

Incorporating these empirical results within a structural corporate finance model remains an avenue for future research.

Chapter 2

Payout Restrictions and Bank Risk-Shifting

2.1 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.[1] This empirical pattern has given rise to concerns about risk-shifting and excessive risk-taking. By paying out safe cash flows, managers and shareholders might shift the risk of the remaining assets from shareholders onto debtholders. Hence, the question looms on how to align incentives across the different claim holders of the firm and restrictions on corporate payouts have been proposed to limit risk-shifting motives. In this chapter, I focus on payout restrictions in the financial sector.

In June 2020, for the first time, the Federal Reserve issued stringent payout restrictions on the largest banks in the United States. Going forward, their dividends

[1]This chapter has been presented at Princeton, Federal Reserve Board, Boston Fed, Georgia Tech, PIMCO, Warwick Economics PhD Conference, Inter-Finance PhD Workshop, 10th Workshop Banks and Financial Markets, and EGSC at WUSTL.

and share buybacks were substantially restricted, without a pre-determined end date. Similar measures were imposed in many other jurisdictions during the Covid crisis, including in the Eurozone, UK, Canada and Switzerland.

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

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

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

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

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

To test these predictions empirically, I exploit the imposition of explicit payout restrictions for the subsample of 33 bank holding companies subject to the Federal Reserve's Comprehensive Capital Analysis and Review (CCAR), henceforth CCAR

banks, on June 25, 2020 as well as the subsequent relaxation of these restrictions on December 18, 2020 as natural experiments. This chapter provides the first detailed account for how these policies affected US banks over the course of 2020.

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

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

Theoretically, this equity response is consistent with two sets of explanations. First, the Fed imposing payout restrictions could communicate bad news about banks' assets to the market. This argument reflects a potential negative news effect. Alternatively, risk-shifting could be at work where payout restrictions prevent banks from paying out funds and transferring the risk of the remaining assets onto debt holders.

In that case, shareholders have to assume more risk following the payout restrictions, leading to lower equity values. To distinguish between the negative news and risk-shifting stories, I use data on unsecured debt prices, both CDS spreads and corporate bond yields, to estimate event studies comparing the CCAR banks to a control group of financial firms. Focusing on unsecured debt ensures that I remove valuation effects coming from the value of the collateral backing the debt or, in the case of convertible bonds, the value of equity.

If payout restrictions mostly communicate bad news about assets, not only do equity values fall but debt is predicted to become riskier as well. Hence, the imposition of payout restrictions should lower bond prices while raising bond yields and CDS spreads. In contrast, risk-shifting implies a divergence of equity and debt prices when payout restrictions change. Curbing payouts benefits debtholders in the presence of risk-shifting as there is a larger equity cushion to support risk and previous risk-shifting is reversed. Thus, debt prices help solve the identification challenge between the news and risk-shifting channel. In event-study regressions, I find that daily CDS spreads fall differentially for the CCAR banks relative to other financial firms when payout restrictions are imposed on 06/25/2020 and, conversely, rise differentially after they are relaxed on 12/18/2020. Using corporate bond yields as the dependent variable for these event-study specifications 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, I analyze whether payout restrictions interact with risk-taking decisions at banks. Using data on newly issued syndicated loans, which capture the extensive margin of new lending, I show empirically that the CCAR banks increase their non-investment grade lending by 32 % relative to investment-grade lending when the payout restrictions are removed. This is evidence for banks taking on riskier loans. At the same time, the average interest rate spread charged by CCAR banks declines

differentially for riskier loans. Jointly, these two results suggest greater risk-taking that is not being compensated via higher credit spreads. Payout and risk-taking decisions therefore act as complements. When payout restrictions are relaxed, risk-taking simultaneously increases.

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

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

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

shifting where long-term debtholders benefit disproportionately from having payout restrictions in place and lose significantly from having the restrictions relaxed.

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

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

(De Nicolò et al. (2010), Jiménez et al. (2014), Delis et al. (2017)), though I consider a prudential regulatory tool: payout restrictions.

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

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

The rest of the chapter is structured as follows: Section 2 outlines a conceptual framework with a single bank, that makes payout and risk-taking decisions, and

outlines how payout restrictions affect debt and equity pricing as well as risk-taking. Section 3 discusses the empirical strategy including the institutional setting, data and econometric approach. Section 4 shows results for debt and equity values around the Fed announcements about payout restrictions, Section 5 contains the analysis on risk-taking decisions and Section 6 concludes.

2.2 Conceptual Framework

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

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

2.2.1 Environment

The model operates in partial equilibrium with a single bank that lives for two periods, $t = 0, 1$ and is run by risk-neutral shareholders. Without loss of generality, I assume the discount rate $r = 0$. The bank has non-stochastic cash assets c and stochastic non-cash assets $a \sim U(\underline{a}, \bar{a})$ where $\bar{a} > \underline{a} > 0$. It has liabilities in place, ℓ, which

cannot be renegotiated at $t = 0$. I assume that there is non-trivial ex-ante default risk: $\ell \in [c + \underline{a}, c + \bar{a}]$. Finally, the bank equity holders derive franchise value $V > 0$ if the bank does not default in period $t = 1$. Figure 2.1 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 2.1: 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[2]. For tractability, I assume $d \in [0, c]$.

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

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

2.2.2 Equity and Debt Values

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

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

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

$$\max_{d} d + \mathbf{E}[a - \hat{a} \mid a > \hat{a}]Pr(a \geq \hat{a}) + Pr(a \geq \hat{a})V \tag{2.1}$$

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

$$DV = Pr(a \geq \hat{a})\ell + Pr(a < \hat{a})(\phi \mathbf{E}[\hat{a} - a \mid a < \hat{a}] + \mathbf{E}[a + c - d \mid a < \hat{a}]) \tag{2.2}$$

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

$$TV = d + \mathbf{E}[a + c - d] + Pr(a \geq \hat{a}(d))V + Pr(a < \hat{a}(d))\phi \mathbf{E}[\hat{a} - a \mid a < \hat{a}] \tag{2.3}$$

2.2.3 Properties

Proposition 2.2.1 *(From Acharya et al. (2017)) There exists a threshold* $V^* = \ell - \frac{c}{2} - \underline{a}$ *so that:*

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

The intuition for the proof comes from the convexity of shareholders' payoffs. As a result, the first-order condition will not return the maximum and instead we end up with a corner solution. The corner depends on whether we are above or below a threshold. V^* is increasing in ℓ, which one can interpret as leverage. Since the CCAR banks are among the most levered banks in the United States, one can interpret proposition 2.2.1 as that the CCAR banks would choose high payouts in the absence of regulatory intervention, a pattern I will document in the empirical section. This

also implies that restricting payouts lowers shareholder value when the constraint on payouts binds.

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

Proposition 2.2.2 *Debtholder value is decreasing in d and debt value is maximized at $d = 0$.*

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

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

Lemma 2.2.3 *Debtholders and shareholders strictly disagree on payout policies for parameter values such that $V < V^* = \ell - \frac{c}{2} - \underline{a}$. Equity value is increasing in payouts and debt value is declining in payouts in that region.*

Lemma 2.2.3 directly follows from the two previous propositions. The lemma is critical since it enables us to think about payout restrictions imposed by an exogenous regulator.

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

One limitation of the result in Lemma 2.2.3 is that it abstracts from dynamic considerations. The model assumes that all debt is in place. In a dynamic setting, banks might issue debt after the payout restrictions have been imposed and the prediction that debt values appreciate through the payout restrictions implies lower costs of debt rollover, which would benefit shareholders. The presence of long-term debt and of government guarantees, ϕ, on bank liabilities, which attenuates the response of debt to the payout restrictions, mitigate the empirical importance of this reduction in rollover costs channel.

Proposition 2.2.4 *The response of debt value to reducing payouts is declining in ϕ.*

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

Proposition 2.2.5 *The expected payment from the government to debtholders rises in d.*

Proposition 2.2.5 illustrates how payout restrictions would affect the expected transfer from the government to banks' debtholders. For $\phi > 0$, those are increasing

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

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

Proposition 2.2.6 *A decline of the upper bound of the asset distribution, $\bar{a}$, lowers both equity and debt values. Formally:* $\frac{dEV}{d\bar{a}} \geq 0$, $\frac{dDV}{d\bar{a}} \geq 0$

Proposition 2.2.6 derives empirical predictions for comparative statics in the asset payoff. In particular, it characterizes how debt and equity values change with respect to $\bar{a}$. A rise in $\bar{a}$ can be interpreted as good news about bank assets whereas a decline would by synonymous of bad news. Bad news about assets makes default more likely and also implies lower expected payoffs to shareholders upon survival. Jointly, these two forces imply that equity values fall upon bad news about assets. Debt values also decline because default risk increases and debtholders are assumed imperfectly insured against default, $\phi < 1$. Proposition 2.2.6 is important because when regulators impose payout restrictions, those could be a signal of bad news about bank assets, that is a decline in $\bar{a}$. However, the debt response is the opposite compared to the case where payout restrictions lead to a reversal of risk-shifting as analyzed in Lemma 2.2.3.

All proofs are in Appendix B.2.

2.2.4 Risk-taking Choice

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

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

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

$$\max_d \{\max_d EV(d, \textit{safe}), \max_d EV(d, \textit{risky})\} \tag{2.4}$$

where $EV(d, \textit{safe})$ denotes equity value as per Equation 2.1 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 2.2.7 *There exist bounds $\underline{\ell}, \bar{\ell}$ and $\underline{V}, \bar{V}$ such that for liability values, ℓ, that satisfy $\underline{\ell} = \max\{\frac{\bar{a}+\underline{a}}{2}, \underline{a} + c\} < \ell < \bar{\ell} < \frac{\bar{a}+\underline{a}}{2} + c$ with $c > \frac{\bar{a}-\underline{a}}{4}$ and for franchise values V that satisfy $\underline{V} < V < \bar{V}$, there is complementarity as follows:*
The bank selects $U(\underline{a} - \epsilon, \overline{a} + \epsilon)$ and $d = c$ if unrestricted. If $d = 0$ is imposed, it selects $U(\underline{a}, \overline{a})$.
The bounds $\underline{V}$ and $\bar{V}$ are defined in the appendix.

Proposition 2.2.7 highlights that for banks that are sufficiently, but not excessively levered, there is a complementarity between payout and risk-taking choices. When

payouts are left unrestricted, these banks would pick high payouts and higher risk. But if forced to refrain from payouts, that is if $d = 0$ was imposed on them, they would also cut back on the risk-taking margin. This result highlights how payout restrictions can affect the bank's policies along other dimensions than payout policy only. By shifting risk from debtholders back onto shareholders a binding payout restriction incentivizes shareholders to take on less risk.

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

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

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

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

2.2.5 Model and Data

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

In practice, payout restrictions can operate via two channels. First, they can partly reverse risk-shifting incentives and second, they might be imposed when regulators have private information that bank assets' are worse than anticipated. If risk-shifting is the dominant channel, I derived in Lemma 2.2.3 that equity values should decline after payout restrictions are imposed whereas debt values should increase. In contrast, both equity and debt values are predicted to fall when bad news about assets are released, see proposition 2.2.6. Hence, the change in debt value is informative for discriminating between these two competing explanations. In addition, the equity response is important for two reasons. First, if equity values change after announcements about payout restrictions, this suggests that the restrictions were not fully anticipated. Second, if equity values decline when payout restrictions are announced, this would support that the potential benefit of the payout restrictions for equityholders through lower costs of debt rollover is not the dominant force.

Finally, how can Proposition 2.2.7 be interpreted when bringing the model to the data?

The CCAR banks were levered at the onset of the Covid crisis but to a significantly lesser extent than at the onset of the financial crisis. Moreover, we observe empirically that banks do not operate strictly at their regulatory constraints, such as capital ratios, but keep buffers relative to the constraint. Consequently, I interpret the CCAR banks as being moderately but not extremely levered through the lens of the model,

which is consistent with the parameter restrictions necessary for Proposition 2.2.7. The empirical results are consistent with this interpretation.

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

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

2.3 Empirical Strategy

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

2.3.1 Data

For US stock-market data, I use daily CRSP as well as TAQ. TAQ has daily tick-by-tick data for the major American stock exchanges (NYSE, NASDAQ, AMEX), reported with millisecond timestamps. When proceeding with the estimation, I ag-

gregate that data by the minute, using the average stock price for each firm within a given minute. This time aggregation will allow for the inclusion of time fixed effects for each minute to absorb time-varying factors in the empirical analysis, except for ultra-high frequency variation. I use TAQ data over 2-hour time windows (4pm to 6pm Eastern) on 06/25/2020, 12/18/2020 and 03/25/2021. For ease of comparison, I normalize the pricen to one for all stocks at 4.00 pm Eastern.

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

Next, data on debt pricing from TRACE for secondary market corporate bond transactions and Markit for credit default swap (CDS) pricing are critical. TRACE contains daily summaries of bond trades for corporate bonds at the CUSIP level, which I supplement with data on the size of the issuance from Mergent FISD. Data construction is described in Appendix B.1.4.

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

Data on balance sheet variables comes from the Federal Reserve's Y9C data and Compustat. The Y9C data provides great detail on bank balance sheets at the bank

holding company (BHC) level, which is used to construct time series of payouts, profitability, net income, loan loss provisions, assets and liabilities.

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

Further details on the data construction are outlined in Appendix B.1.

2.3.2 Institutional Setting

Following the financial crisis after the Lehman Brothers collapse in 2008, US regulators added a wide range of new financial regulations, the most important ones were imposed through the Dodd-Frank Act from 2010. Section 165 of the law lays out several new regulations pertaining to large bank holding companies[4] including stress tests and the Comprehensive Capital Analysis and Review (CCAR), which requires banks to submit their capital distribution plans at the bank holding company (BHC) level to the Fed for approval.

Comprehensive Capital Analysis and Review (CCAR)

All BHCs with consolidated assets exceeding $100 billion are subject to the CCAR exercise. As part of the CCAR, the Fed reviews banks' proposed distributions of dividends and share buybacks and needs to authorize these plans. Approval is subject to capital distribution plans being consistent with maintaining sufficient capitalization

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

in times of economic or financial stress. In normal times, the CCAR is conducted once per year. During the Covid pandemic, two rounds of testing were imposed in 2020. In the analysis to follow, I remove foreign banking organizations (FBOs) since regulation and payout restrictions in their home countries, where the parent organizations are based, are critical for them as opposed to the restrictions imposed by the Fed. Throughout, I will refer to this sample of 22 domestic BHCs subject to the CCAR as "CCAR banks".

06/25/2020

On June 25, 2020 at 4.30 pm EDT, the Fed released a statement announcing that share buybacks would not be permitted for the third quarter and dividends would be capped by the minimum of second quarter dividends and average earnings over the past four quarters. "As a result, a bank cannot increase its dividend and can [only] pay dividends if it has earned sufficient income."[5]

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

12/18/2020

On 12/18/2020 at 4.30 pm EDT, the Fed announced that it would remove the ban on repurchases for large US banks, which had been imposed in June 2020. Analyst

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

comments suggest that the lifting of repurchase restrictions partly came as a surprise.[6] Much less stringent restrictions remained in place. Specifically, the sum of quarterly dividend and share buyback payouts could not exceed average quarterly earnings from the past four quarters.

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

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

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

2.3.3 Summary Statistics

Table 2.1 reports summary statistics for 2019 for the sample of domestic CCAR banks and the largest domestic bank holding companies outside the CCAR. Throughout, CCAR banks will refer to those domestic banks participating in the CCAR in 2020.

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

Further summary statistics are reported in Appendix B.3: Tables B.3.5 and B.3.6 contain summary statistics for CDS spreads around the announcements on

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

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

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

Table 2.1: 2019 Summary statistics for banks

06/25/2020 and 12/18/2020 respectively. Table B.3.7 contains summary statistics for corporate bonds and the syndicated loan data is summarized in Table B.3.8.

2.3.4 Estimation

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

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

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

Equity Response

To estimate the equity response to the imposition and stepwise removal of payout restrictions onto US banks, I rely on the TAQ high-frequency equity market data. All Fed announcements are released at 4.30 pm Eastern. Using the aggregated minute-by-minute stock level data, I estimate high-frequency differences-in-differences event studies according to Equation 2.5:

$$P_{it} = \alpha_i + \alpha_t + \sum_{\substack{\tau=16:00 \\ \tau \neq 16:30}}^{18:00} \beta_\tau \mathbf{1}_{t=\tau} \, CCAR \; Bank_i + \epsilon_{it} \tag{2.5}$$

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

Including non-financial stocks in the control group is due to the lower liquidity of after-hours stock market trading, which implies that many of the smaller non-CCAR

banks are very infrequently traded over the time window. To mitigate concerns about the choice of control group, Sections 2.4.4 and 2.4.4 will provide evidence on daily equity market data with a tighter control group.

Equation 2.5 is a direct test of the equity implications of Lemma 2.2.3, which states that imposing binding payout restrictions should lower equity values whereas relaxing those restrictions should raise equity values. Moreover, Equation 2.5 also allows to test whether the restrictions were partly unanticipated. In an efficient stock market, the impact of the restrictions would be fully priced in if they were ex-ante anticipated.

Debt Response

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

$$Spread_{it} = \alpha_i + \alpha_{t,r} + \sum_{\substack{\tau=-5 \\ \tau \neq 0}}^{5} \gamma_\tau \mathbf{1}_{t=\tau} CCARBank_i + \delta_2 \, X_{it} + \epsilon_{it} \tag{2.6}$$

CDS spreads for firm i on day t are regressed on a time-rating fixed effect, firm fixed effects and contract-level controls. The main coefficients of interest are the series of coefficients γ_τ on the interaction of a time dummy for each day with the treatment CCAR-bank dummy $CCAR\ Bank_i$. non-CCAR firms are other financial firms for this specification, tightening the identification. Standard errors are again double-clustered by time and firm. In the results section, I will estimate Equation 2.6 for all available frequencies of CDS spreads.

An alternative approach to test for the effect on debt values consists of using data on corporate bond yields. Results for this will be shown as well. Both CDS spreads and bond yields allow to separate between the risk-shifting hypothesis derived in Proposition 2.2.2 and the bad news hypothesis derived in Lemma 2.2.3. If the imposition of payout restrictions conveys bad news about banks' assets, their default risk should increase and hence debt values should fall implying a rise in CDS spreads and corporate bond yields. Conversely, the risk-shifting hypothesis predicts a decline in CDS spreads and corporate bond yields as risk is shifted from existing bondholders onto equityholders, making default on debt less likely.

Lending Effects

Building on the insights how risk-shifting incentives shift debt and equity pricing, I further proceed to test whether payout restrictions affect banks' risk-taking decisions. This tests if the theoretical possibility of a complementarity between payout and risk-taking decisions derived in Proposition 2.2.7 has practical relevance. The theoretical rationale is that once payout restrictions are lifted, bank equityholders face incentives to pay out funds and take on riskier projects at the same time. The downside of such risky investments is then transferred onto debtholders and the government since shareholders have reduced the size of the equity stake through payouts. Shareholders nevertheless capture the upside from risky investments due to the call-option feature of equity compensation.

To test this channel empirically, I aggregate the Thomson Reuters One syndicated loan data for each bank-month pair into the above and below investment-grade new loan portfolio. The dummy $nonIG_{ib}$ equals one for each bank's non-investment grade loan portfolio. Hence, for each bank-month pair, I have two observations: the amount of new investment-grade loan issuances and the amount of new below investment-grade loan issuances in the syndicated loan market. Using the sample of these bank-

month-loan type pairs from August 2020 to March 2021, I then estimate whether there is a differential impact from lifting the payout restrictions in December 2020 onto riskier lending. The $Post_t$ dummy equals one for the post-December 2020 months. This motivates a differences-in-differences empirical strategy as outlined in Equation 2.7:

$$log(Loans_{ibt}) = \alpha_b + \alpha_t + \beta_1 Post_t nonIG_{ib} + \beta_2 nonIG_{ib} + \beta_3 Post_t + \gamma X_{ibt} + \epsilon_{ibt} \tag{2.7}$$

α_b is a bank fixed effect and α_t is a time fixed effect. The main coefficient of interest in this differences-in-differences specification is β_1, the coefficient on the interaction term of the non-investment-grade dummy with the post-policy change dummy.

2.4 Empirical Results for Payouts, Equity and Debt Prices

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

2.4.1 Overview of CCAR banks

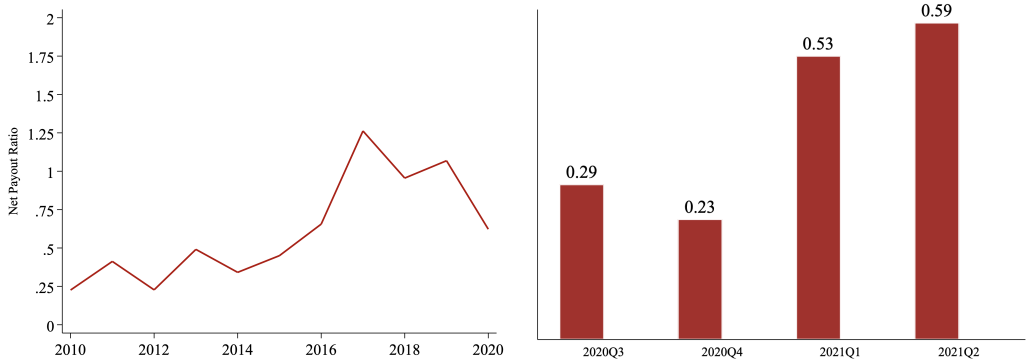
Here, I provide an overview over payout decisions by CCAR banks as well as leverage. In particular, I show that changes to payout restrictions directly affect payouts before proceeding to the analysis of the effect on debt and equity values.

Direct Effects on Payouts

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

$$Net\ Payout\ Ratio_{it} = \frac{Div_{it} + BB_{it} - Iss_{it}}{Net\ Income_{it}} \tag{2.8}$$

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



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

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

Figure 2.2: CCAR Bank Net Payout Ratio

Figure 2.2 reports the time series of net payout ratios for CCAR banks since 2010 in the left-hand panel. Prior to the Covid crisis, net payout ratios hovered around 1, indicating the CCAR banks were on average paying out all of their net income.

In 2020, there is a sharp reduction in net payouts. the right-hand panel zooms into the evolution of the net payout ratio from 2020Q3 - 2021 Q2. It confirms that net payout ratios are low, at .29 and .23 for the two quarters when payout restrictions are in place in the United States. Likewise, when the restriction are being relaxed again at the end of 2020, we observe a strong increase in net payout ratios in the first two quarters of 2021. This is consistent with the payout restriction being binding and their relaxation therefore causing a rise in payouts.

Figure B.4.5 confirms that this observation is robust to correcting net income for the impact of loan loss provisioning. Since many banks released previous loan loss provisions in 2021, net payout ratios are even higher in 2021 when net income, net of loan loss provisioning, is taken as the denominator of the net payout ratio.

I also show in Figure B.4.6 that the net payout ratio rises for CCAR banks after the relaxation of payout restrictions in December 2020 but not for the largest 14 banks outside the CCAR. This further suggests that the increase in payouts by CCAR banks in early 2021 is driven by the changes to payout restrictions and not by other macroeconomic or industry-specific factors.

Changes in Leverage

If payout restrictions effectively limit banks in their ability to pay out earnings, retained earnings must be increasing and thus equity increases implying a decline in leverage. Figure 2.3 shows the time series of leverage, defined as Tier 1 capital over total assets used for leverage calculations, for CCAR banks in the left-hand panel and for banks outside the CCAR in the right-hand panel.

Prior to the Covid-crisis, leverage of large US banks hovers around 10.5 dollars of assets for each dollar of Tier-1 capital. Leverage increases sharply at the onset of the Covid-crisis, especially over the first half of 2020. One reason is the large influx of deposits in the early days of the Covid crisis. When payout restrictions are imposed



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

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

Figure 2.3: Bank Leverage Time Series

in June 2020, leverage falls for the CCAR banks in panel a) but not for the large banks outside the CCAR in panel b). This provides some first evidence that the restrictions have bite.

In the aftermath of the relaxation of payout restrictions in December 2020, one can see that leverage rises again for the CCAR banks. This highlights how the increase in payouts observed in Figure 2.2 leads to lower a capital base among large banks. Yet, for the banks outside the CCAR in the left-hand panel, leverage remained flat since June 2020 and slightly fell in 2021. Figure B.4.7 reproduces the same plot for some individual banks.

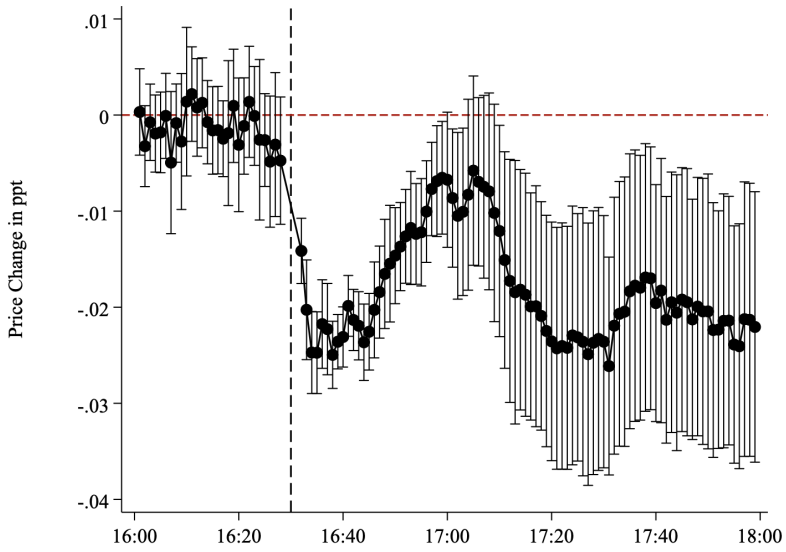
2.4.2 06/25/2020 - Imposing Payout Restrictions

The first empirical test exploits the June 25, 2020 announcement of payout restrictions. At 4.30pm ET, the Fed announces that payouts by large US banks, those taking part in the CCAR, will be restricted going forward for an unspecified length of time. How this announcement affected debt and equity prices of banks is an empirical question. On the one hand, the announcement could reflect bad news about banks. Alternatively, the payout restrictions could shift risk from debt onto equityholders

since it is becoming more costly to pursue risk-shifting strategies for equityholders. In either case, equity values should be falling. But in the first case, debt values should fall as well if banks are in worth health than previously known whereas risk-shifting implies an appreciation of debt values.

Equity Values

Figure 2.4 displays results for high-frequency event studies on equity prices. The vertical dashed line indicates the announcement time at 4.30 pm ET:



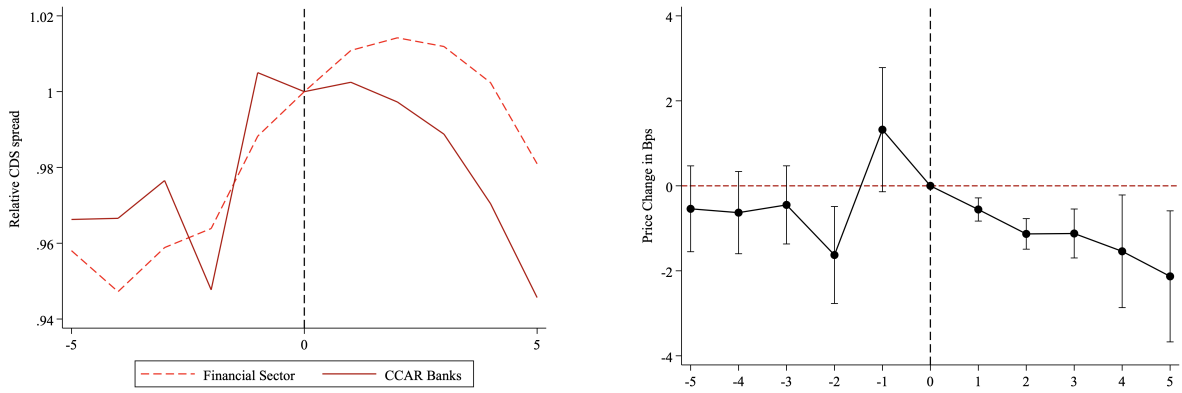
Graph reports coefficients and 95 % confidence bands for event study regressions on 06/25/2020 of normalized stock price onto minutely Time x CCAR bank interaction terms (Equation 2.5). Prices are normalized to 1 at 4.00 ET. Standard errors are double-clustered at the firm and time level. Source: TAQ data

Figure 2.4: High-frequency Event Studies 06/25/2020 4.00 - 6.00 pm ET

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

debt rollover are dominated by risk-shifting or negative news. The debt response will now help to discriminate between those two explanations.

Debt Values



(a) Raw Data (b) Event-study

Panel a) reports raw data for CDS spreads around announcement day on 06/25/2020. Solid red line plots mean CDS spread for CCAR banks normalized to 1 on 06/25/2020. Dashed red line reports mean CDS spread for other financial firms, normalized to 1 on 06/25/2020. Panel b) reports estimated coefficients and 95 % standard errors from estimating Equation 2.6. CDS are measured in basis points. Standard errors are clustered at the firm-level.

Figure 2.5: Results for 5-year CDS Spreads

Panel a) of Figure 2.5 reports the raw data for CDS spreads, separated into CCAR banks and other financial firms. To facilitate comparison of the two time series, I normalize both time series to 1 on the announcement date, 06/25/2020, which corresponds to day 0 in the plot. Following the announcement, a persistent gap emerges between the two time series. CDS spreads for CCAR banks fall relative to other financial firms in the market. To remove time-invariant heterogeneity across CDS issuers and account for time-varying factors via time fixed effects, I formally estimate Equation 2.6 and report the event-study coefficients with their 95 % confidence bands in Panel b).

There is little evidence for a pre-trend in CDS spreads. Following the announcement, however, the event study confirms the observation from panel a). CDS spreads

fall significantly and differentially for CCAR banks relative to the control group of financial firms. Quantitatively, the effect is about 2 basis points after 5 trading days.

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

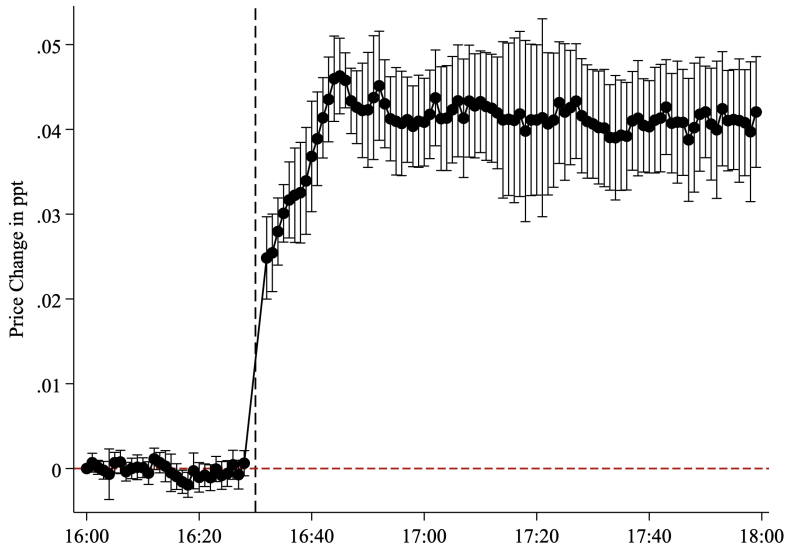
2.4.3 12/18/2020 - Lifting Payout Restrictions

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

Equity Values

Figure 2.6 reports the equity response for CCAR banks relative to the remainder of public firms on 12/18/2020 between 4.00 and 6.00 pm ET:

Within minutes of the announcement that payout restrictions are being loosened, equity values rise differentially by about 4 percent for the average CCAR bank. The effect is both statistically and economically highly significant, showing that the lifting of the payout restrictions was partly unexpected and therefore not ex-ante priced.



Graph reports coefficients and 95 % confidence bands for event study regressions on 12/18/2020 of normalized stock price onto minutely Time x CCAR bank interaction terms (Equation 2.5). Prices are normalized to 1 at 4.00 ET. Standard errors are double-clustered at the firm and time level. Source: TAQ data

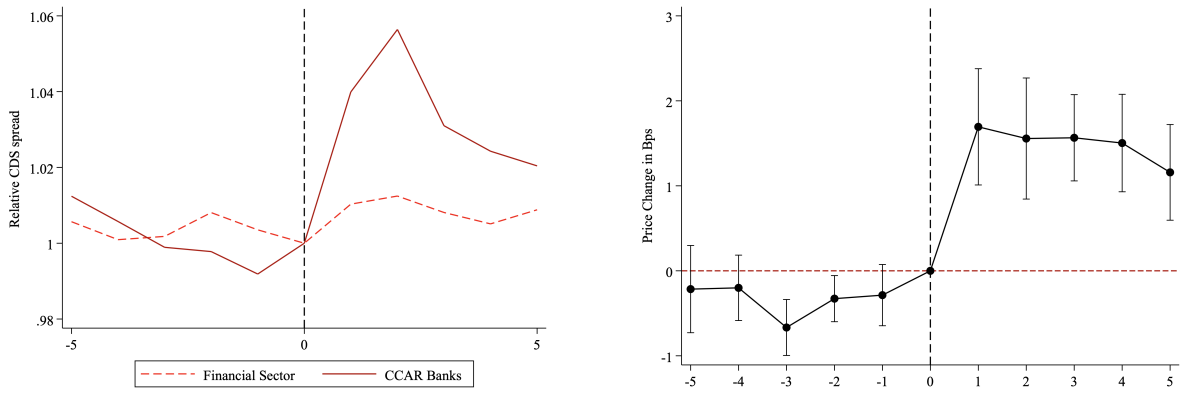
Figure 2.6: High-frequency Event Studies 12/18/2020 4.00 - 6.00 pm ET

Moreover, from Figure 2.6, we can corroborate the identifying assumption for the event studies that there is no pre-trend.

Debt Values

Again, the debt response should a priori be informative whether the relaxation of payout restrictions is a signal about banks being in better than expected financial health or whether risk-shifting is occurring. Panel a) of Figure 2.7 plots CDS spreads by CCAR banks versus the remainder of the financial sector around the December 18 announcement. For the figure, I normalize all CDS spreads to 1 on December 18 to facilitate comparison.

While spreads trend relatively parallel until December 18, 2020, spreads sharply diverge after the announcement. The spreads of CCAR banks rise differentially more when the payout restrictions are being lifted. This is suggestive of risk shifting back from equity onto debtholders, leading to a rise in default risk. The event study results reported in panel b) confirm this. CDS spreads rise differentially for the CCAR banks



(a) Raw Data (b) Event-Study

Panel a) reports raw data for CDS spreads around announcement day on 12/18/2020. Solid red line plots mean CDS spread for CCAR banks normalized to 1 on 12/18/2020. Dashed red line reports mean CDS spread for other financial firms, normalized to 1 on 12/18/2020. Panel b) reports estimated coefficients and 95 % standard errors from estimating Equation 2.6. CDS are measured in basis points. Days are trading days. Standard errors are clustered at the firm-level.

Figure 2.7: Results for 5-year CDS Spreads

after banks have been allowed to pay out more funds. Consistent with risk-shifting, CDS spreads increase by more than 1 basis point. Since the average CDS spread for CCAR banks hovers around 106 basis points prior to the announcement, this corresponds to at least a .94% increase.

Figure B.4.9 again reports the entire term structure of CDS spreads. The rise in CDS spreads affects all listed maturities.

2.4.4 Further Results on Equity and Debt Values

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

Abnormal Returns after 06/25/2020

One potential concern about the high-frequency event studies for stock prices is that liquidity in the after-hours market around the announcements at 4.30 pm ET is lower and this reduced liquidity could undermine the informativeness of the event studies, particularly since the control group also includes non-financial firms. To address these

concerns, I estimate daily event studies for abnormal returns as outlined by Campbell et al. (2012) and commonly used in the asset pricing literature (Jayachandran (2006), Coval and Stafford (2007), Edmans et al. (2012), Acemoglu et al. (2016)).

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

$$R_{it} = \alpha_i + \beta_i + R_{m,t} + \epsilon_{it} \tag{2.9}$$

$R_{m,t}$ denotes the market return on day t. Following the literature, I estimate this model stock by stock over a 250 trading day time window that ends 30 days before the respective event-window used to analyze the impact of the Fed's payout restrictions. Next, I infer abnormal returns for the event window as the difference between actual returns and those predicted by Equation 2.9:

$$AR_{it} = R_{it} - (\hat{\alpha}_i + \hat{\beta}_i R_{m,t}) \tag{2.10}$$

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

$$CAR_{it} \quad = \sum_{\tilde{t}=1}^{10} AR_{i,\tilde{t}} \tag{2.11}$$

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

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

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

Table 2.2 reports results from a size-weighted regression of cumulative abnormal returns at the bank-level onto an indicator for the CCAR banks for each of the ten trading days after the announcement of payout restrictions on 06/25/2020. We can see that the differentially lower abnormal returns for CCAR banks persist relative to a control group that only consists of smaller banks. Thus, the decline in equity values persists relative to a control group that is now much tighter than in the high-frequency event studies.

Table B.4.1 repeats the same exercise but without weighting regressions by size. The results are very similar. Tables B.4.2 and B.4.3 provide further robustness checks

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

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

Table 2.2: CAR after 06/25/2020 Weighted Regression (Banks only)

by estimating a weighted and unweighted regression with a broader control group of all financial firms (SIC codes 6000-6999, excluding 6726). Results are still quantitatively similar and highly statistically significant. Overall, all of these results suggest that the announcement effects of payout restrictions documented in the high-frequency event-studies persist over time. This supports that the payout restrictions are economically important.

Abnormal Returns after 12/18/2020

I repeat the same methodology for cumulative abnormal returns following the announcement about relaxing the payout restrictions on 12/18/2020. Table 2.3 contains the results for the same size-weighted regressions comparing CCAR banks to the control group of smaller banks.

Results confirm that the announcement effect persists into January when the payout restrictions are being relaxed in December 2020. This effectively highlights that

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

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

Table 2.3: CAR after 12/18/2020 Weighted Regression (Banks Only)

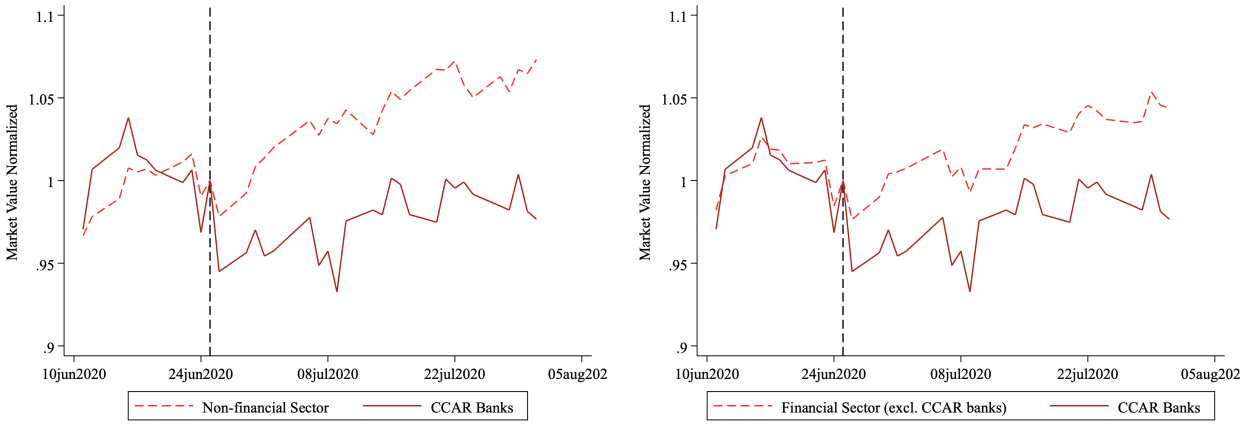
the high-frequency response identified from the tick-by-tick data has economic relevance over a longer time window and affects economic incentives. Tables B.4.4, B.4.5 and B.4.6 show that results are robust to running equal-weighted regressions with banks only in the control group and to running both weighted and unweighted regressions that compare the CCAR banks to all other financial firms. Market-capitalization weighted regressions, however, have the advantage of being representative of the overall market and thus confirm that the responses observed in the unweighted regressions are not driven only by the smaller banks.

Longer-run Evidence

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

outperform other financial stocks for the months after the payout restrictions are lifted.

Figure 2.8 reports the total market value of CCAR banks (normalized to 1 on 06/25/2020) relative to the total market value of non-financial public firms on the left-hand side and relative to financial firms, excluding the CCAR banks, on the right-hand side.



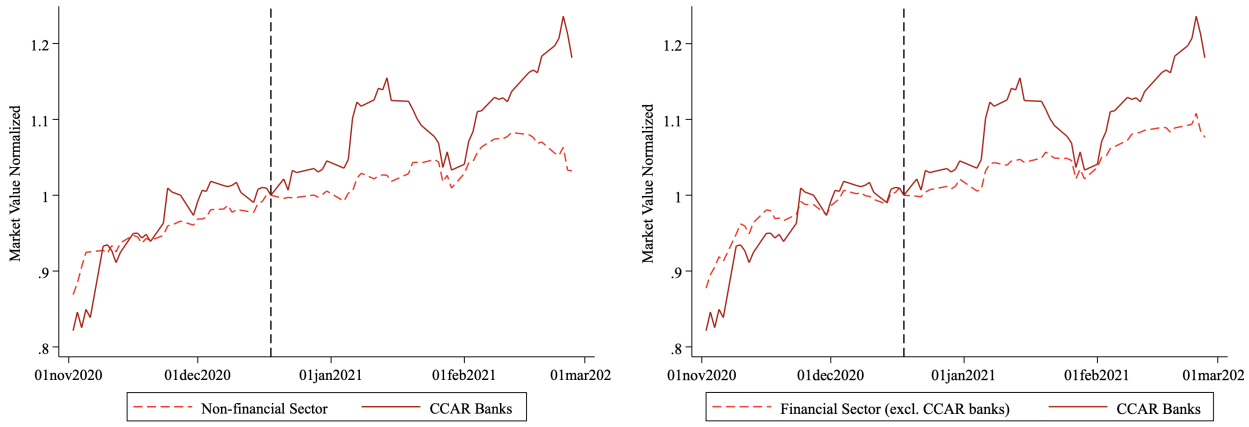
(a) CCAR Banks vs. Non-Financials (b) CCAR Banks vs. Other Financials

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

Figure 2.8: Market Values around 06/25/2020

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

The pattern around the 12/18/2020 announcement is similar in Figure 2.9. Banks perform relatively similar to other financial firms and even relative to the non-financial sector until 12/18/2020. Following the announcement of relaxation of payout restrictions, bank stocks rise differentially by 2-3 % upon impact. The magnitude culminates in a 10% difference after about 3 weeks.



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

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

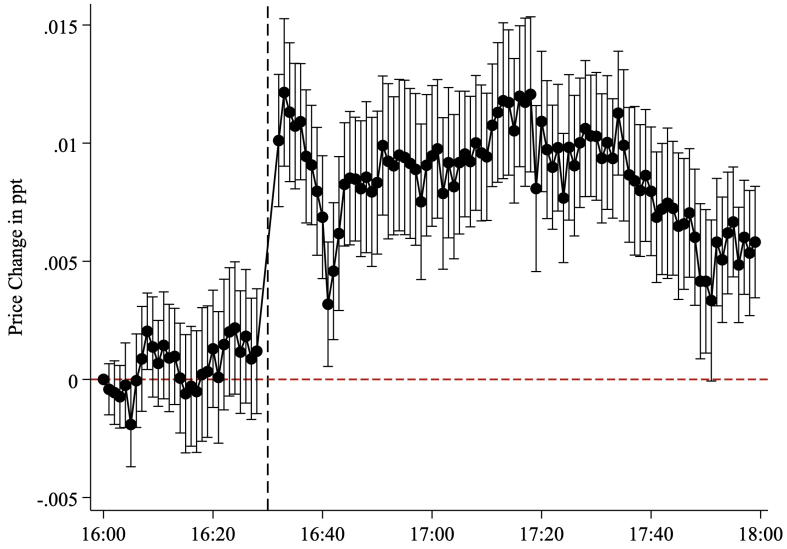
Figure 2.9: Market values around 12/18/2020

Removal of Last Restrictions on 03/25/2021

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

Since very few banks paid out more than their net income pre-Covid, the changes in March 2021 should be expected to have a smaller effect as the constraint was already not binding in most states of the world. I repeat the estimation of Equation 2.5 for 03/25/2021 over the same 4pm to 6pm ET time window. Figure 2.10 reports the results:

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



Graph reports coefficients and 95 % confidence bands for event study regressions on 12/18/2020 of normalized stock price onto minutely Time x CCAR bank interaction terms (Equation 2.5). Prices are normalized to 1 at 4.00 ET. Standard errors are double-clustered at the firm and time level. Source: TAQ data.

Figure 2.10: High-frequency stock market response 03/25/2021

Bond Price Response

In addition to looking indirectly at the response of debt prices through CDS spreads, one can also directly estimate the response of corporate bond yields around the announcements about payout restrictions. Figure 2.11 plots average corporate bond yields for the CCAR banks and the remainder of the economy around the announcement of payout restrictions. For the figures, yields are normalized to one on 06/25/2020.

While corporate bond yields trend relatively in parallel until the announcement, they diverge afterwards. In particular, the yields for CCAR banks fall differentially relative to the remainder of firms. Next, I test econometrically for a differential effect.

$$Yield_{it} = \alpha_i + \alpha_t + \beta_1 Post_t + \beta_2 CCAR\ Bank_i + \beta_3 Post_t CCAR\ Bank_i + \epsilon_{it} \quad (2.12)$$

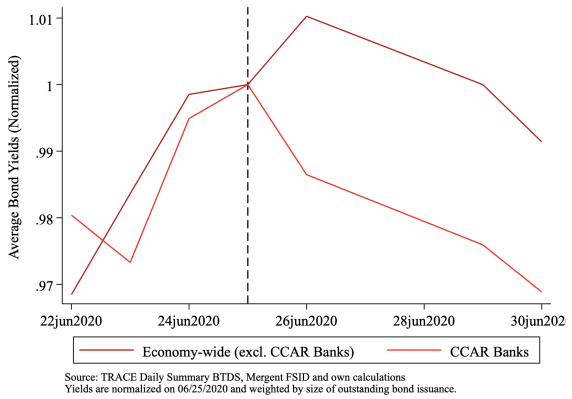


Figure 2.11: Corporate Bond Yields around 06/25/2020

All variable definitions are identical to previous equations. $Yield_{it}$ is the daily yield reported in the TRACE daily summary and the main coefficient of interest is β_3, which tests whether bond yields for CCAR banks evolve differentially once the payout restrictions have been imposed. Table 2.4 reports the corresponding results:

	(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 2.4: Corporate Bonds: Daily Differences-in-Differences Estimation around 06/25/2020

Following the announcement of payout restrictions, corporate bond yields for CCAR banks fall differentially by 8.4 basis points in the full specification. This is consistent with the results for CDS spreads that were also declining around the announcement of payout restrictions. Whereas CDS spreads provide indirect evidence

for increasing debt prices, the results on corporate bond yields directly confirm that debt prices are increasing in the secondary market when payouts to shareholders are being limited.

The bond price response on December 18, 2020 is equally consistent with the previous explanations. In Figure B.4.1, bond yields in the secondary market rise differentially for CCAR banks after payout restrictions are relaxed. Table 2.5 shows results from estimating Equation 2.2 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

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

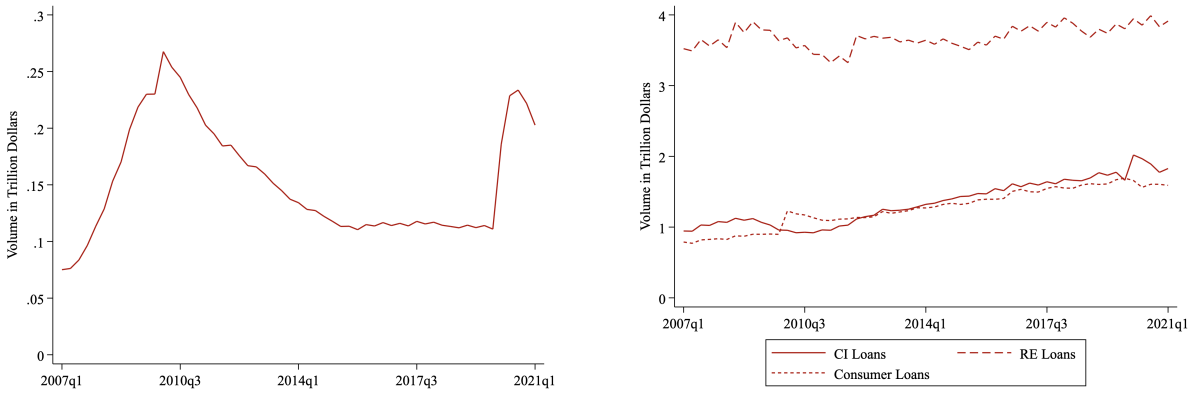
Table 2.5: Corporate Bonds: Daily Differences-in-Differences Estimation around 12/18/2020

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

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 2.12. Since the set of CCAR

banks is not defined for the years prior to the Dodd-Frank Act, those figures report numbers for the 30 largest US banks by assets in each quarter to have a well-defined sample over time.



(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 2.12: Bank Balance Sheet Items

Comparing the Covid-crisis to the Great Recessions, two features stand out. First, loan loss reserves almost reached financial crisis levels in 2020 and, second, this accumulation was very fast as compared to the financial crisis. This might suggest that banks might have other considerations than risk-shifting. There are, however, some caveats with this argument. First, the total volume of the loan book of the same banks was substantially larger than in 2008 (right panel of Figure 2.12). Hence, if risks in early 2020 were as high or higher as during the financial crisis, loan loss reserves should have exceeded their 2008 levels. Second, accounting rules have been changed by the FASB precisely to encourage earlier build-up of loan loss reserves. Incurred credit loss (ICL) accounting rules that mandated banks to build up provisions for credit losses that were about to be incurred have been replaced with expected credit loss (ECL) accounting where banks are to build up loan loss reserves given their expectations of losses over the entire life of the loan (López-Espinosa et al., 2021). These measures, intended to address procyclicality, likely explain parts of the

build-up of loan loss reserves in the early times of the Covid-pandemic. Finally, Section 4013 of the CARES Act exempts bank from reporting certain delinquent loans as troubled debt restructurings, which leads to an under-reporting of explicit losses.

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

Profitability

Figure B.4.4 reports quarterly return on assets as a measure of profitability. Profitability across CCAR banks and large non-CCAR banks evolves in parallel over the course of 2019 until 2021. This suggests that agency cost theoretic explanations a la Jensen and Meckling (1976) are not a major driver of the empirical patterns documented. If agency costs were the main explanation, one would expect the payout restrictions to lower profitability of restricted banks since payout restrictions increase free cash flow at managers' disposal. Yet, profitability rises strongly for CCAR banks, and in parallel with non-CCAR banks, over the period where the payout restrictions are in place in the United States.

Evidence from other Jurisdictions

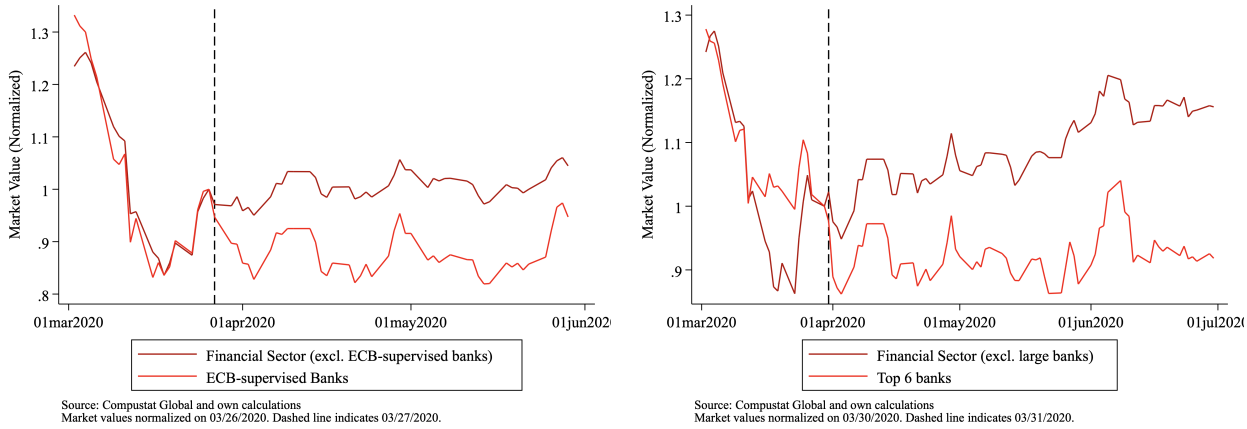
The United States is by no means the only jurisdiction that imposed payout restrictions on its banks during the Covid-crisis. In fact, these policy measures, despite country-specific institutional settings, were ubiquitous around the world, including in the Eurozone, UK, Switzerland and Canada. The main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

Eurozone banks are subject to common banking supervision. Here, I consider banks from six large countries - Germany, France, Spain, Italy, Belgium, and the

Netherlands. Data construction follows the procedure outlined in appendix B.1.3. 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[7], not a rule, but the implicit understanding is that banks would expose themselves to regulatory action if not adhering to the recommendation.[8]

On March 31 2020, the largest UK lenders voluntarily suspended payouts under pressure from the national regulator, the Prudential Regulation Authority (PRA). While the PRA did not explicitly ban payouts, it was widely understood that there was large-scale pressure and moral suasion to have banks commit to the payout suspension under the threat that the PRA would otherwise engage in regulatory action.[9] 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 2.13 reports how equity values evolve around the respective announcement data in the Eurozone (Panel a) and in the UK (Panel b).



(a) Eurozone (b) United Kingdom

Figure 2.13: Market values of large UK banks relative to economy

[7] https://www.bankingsupervision.europa.eu/press/pr/date/2020/html/ssm.pr200327~d4d8f81a53.en.html

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

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

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 percent and persists months into the future, again confirming that payout restrictions reduce equity prices.

2.5 Empirical Results for Risk-taking Decisions

In this section, I investigate whether payout restrictions also affect risk-taking decisions at banks. This follows the Jensen and Meckling (1976) risk-shifting logic, which was highlighted in Proposition 2.2.7. As payout restrictions are removed, bank shareholders can, on the one hand, pay out more and, on the other hand, exploit the call-option feature of risky projects. Risky projects that would optimally be turned down with the payout restrictions in place, because shareholders would bear too much risk, become optimal to take on when enough of the downside risk is transferred to debtholders and the government.

2.5.1 Syndicated Loans

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

To analyze risk-taking, I use monthly loan-level data from Thomson One. Figure 2.14 reports monthly newly issued syndicated for the CCAR banks, split by

investment-grade and below-investment grade lending and normalized to 1 in December 2020, the month in which the payout restrictions are lifted:

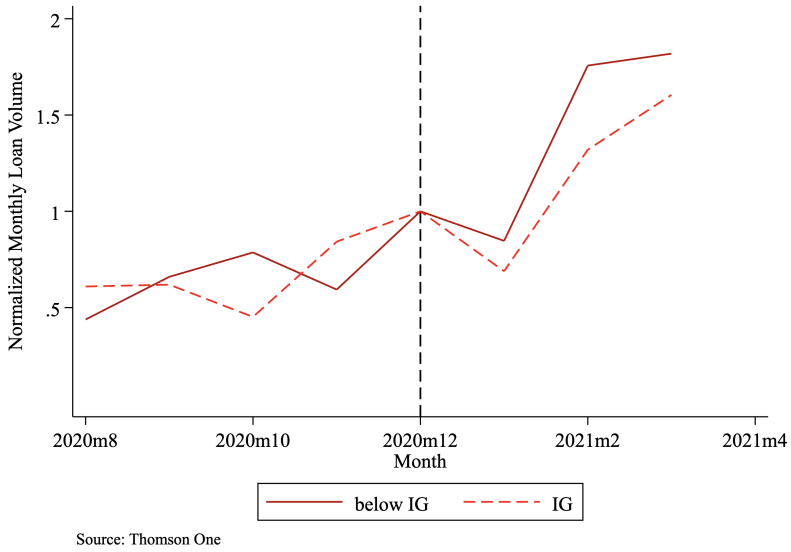


Figure 2.14: Lending by CCAR Banks

While risky lending (below investment-grade) and safe lending (above investment-grade) trend in parallel over the second half of 2020, they diverge in 2021, once the payout restrictions are being relaxed. Risky lending surges for the CCAR banks. Interestingly, this does start in January 2021 but the increase is much more pronounced in February and March, consistent with the removal of restrictions being partly unexpected and new syndicated loans taking time to negotiate. Godlewski (2010) finds that, in his sample of the syndicated loan market, the average duration of the negotiation process is 55 days, which is consistent with the pattern observed in Figure 2.14.

To supplement Figure 2.14, Figure B.4.3 reports the empirical CDF of the ratio of risky syndicated loan originations to total syndicated loan originations for CCAR banks. The empirical CDF shifts to the right after payout restrictions are partly lifted, indicating that more banks choose a riskier mix of lending.

Furthermore, Figure B.4.2 shows that there is no differential change between riskier and safer lending for lenders outside the CCAR around the December 2020 event. This result further strengthens the interpretation that the removal of payout restrictions is driving the divergence in Figure 2.14 and not another aggregate shock that would affect all lenders or the demand side.

To test the channel formally, I estimate Equation 2.7:

	(1)	(2)	(3)	(4)	(5)
Post	0.09	0.20*			
	(0.12)	(0.10)			
nonIG	0.10	0.29*	0.10	0.29*	0.29*
	(0.19)	(0.16)	(0.19)	(0.16)	(0.16)
Post x nonIG	0.44***	0.34***	0.44***	0.34***	0.33**
	(0.12)	(0.11)	(0.12)	(0.12)	(0.13)
N	432	432	432	432	410
R^2	0.03	0.68	0.06	0.72	0.80
Bank FE		x		x	
Time FE			x	x	
Bank-Time FE					x

$***p < .01, **p < .05, *p < .1$. Table reports coefficients from a regression of (log) newly issued loans at the bank-month-loan portfolio level onto differences-in-differences terms for a post-December 2020 dummy interacted with a dummy for the non-investment grade loan portfolio. Standard errors are clustered at the bank-level.

Table 2.6: Lending by Loan Type for CCAR banks

The main coefficient of interest is the interaction term of the post-restriction dummy and the non-investment-grade dummy. In the most saturated specifications of columns (4) and (5), the coefficient indicates 33-34 % differentially higher growth of non-investment grade loans relative to investment grade loans following the relaxation of the payout restrictions.

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

2.5.2 Interest Rate Margin

The surge in riskier lending on its own is difficult to interpret economically: Are banks taking on riskier loans, for which they are compensated by higher interest rates? Or

are they becoming riskier overall? Data on interest rate spreads is informative here. For 80.3 % of loans, Thomson One reports the spread (in basis points) over a reference rate, most commonly LIBOR. Figure 2.15 plots the distribution of spreads for the sample of CCAR banks:

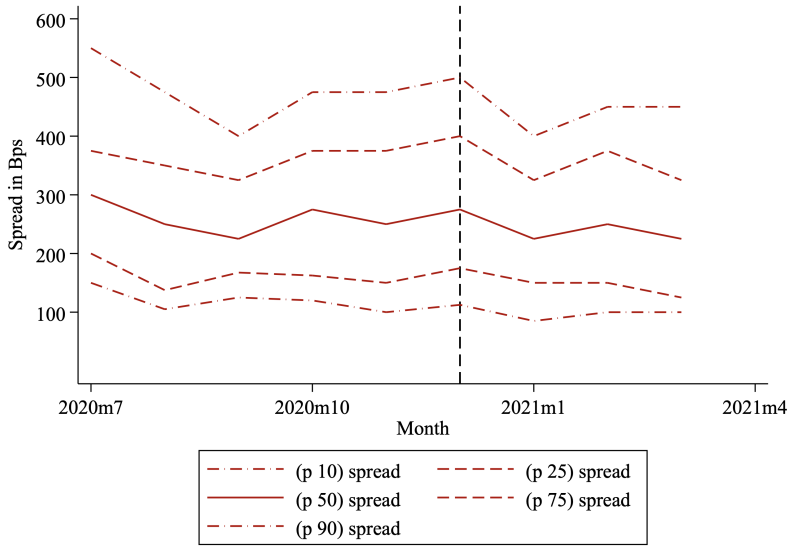


Figure reports 10th, 25th, 50th, 75th and 90th percentile of credit spreads collapsed by month on the Thomson One syndicated loan data. Spreads are reported in basispoints.

Figure 2.15: Distribution of Loan Spreads

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

In the next step, I formally test whether interest rate spreads at the CCAR banks are changing after the payout restrictions have been largely lifted. I collapse the average spread by bank i and month t to estimate the following relationship.

$$Spread_{ibt} = \alpha_b + \alpha_t + \beta_1 Post_t nonIG_{ib} + \beta_2 nonIG_{ib} + \beta_3 Post_t + \epsilon_{ibt} \quad (2.13)$$

The definition for the right-hand side variables are the same as for the previous regressions in Equation 2.7. The main coefficient of interest is β_1. Table 2.7 displays the estimation results:

	(1)	(2)	(3)	(4)	(5)	(6)
Post	-21.80***	-21.72***	-7.36*	-7.26		
	(5.01)	(5.13)	(3.88)	(4.50)		
nonIG			213.53***	209.82***	209.41***	209.75***
			(11.31)	(11.21)	(11.17)	(11.02)
Post x nonIG			-20.31**	-19.72**	-18.69**	-20.29**
			(7.88)	(8.04)	(8.35)	(8.51)
Constant	235.64***	235.61***	119.70***	121.53***	118.78***	117.00***
	(7.56)	(1.96)	(2.45)	(5.50)	(5.52)	(5.11)
N	414	414	414	414	414	376
Bank FE		x		x	x	
Time FE					x	
Bank-Time FE						x
R^2	.0082	.13	.78	.84	.85	.91

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

Table reports regression results from regressing loan spreads, measured in basispoints, onto interaction of post-dummy (which equals 1 in 2021) and dummy for below investment-grade loans. Columns 1 and 2 only run the single difference specification. Columns 3 to 6 run different versions of the differences-in-differences empirical design. Data is collapsed by bank and month. Standard errors are double-clustered at the bank and time level.

Table 2.7: Evolution of Loan Spreads

The first two columns confirm the graphical evidence of Figure 2.15. Those two columns only test whether spreads fall following the relaxation of payout restrictions. Quantitatively, spreads decline by about 20 basis points in 2021. Since these regressions only exploit time variation, the results could be plagued by other industry-wide shocks that affect spreads.

The differences-in-differences specifications estimated in columns 3-6 address those concerns. In particular, they allow for the implicit inclusion of time fixed-effects that absorb macroeconomic time-varying factors. In the tightest identification in column

6 with bank-time fixed effects, spreads decline differentially by 20 basis points more for non-investment grade loans relative to investment grade loans.

Together with the results on the quantity margin of lending, the results in this section indicate that banks increase risky lending when payout restrictions are lifted, consistent with risk-shifting explanations. Moreover, the higher risk is not reflected in higher interest rate spreads, implying that banks - and in particular bank creditors - bear more downside risk.

2.6 Macroprudential Policy and Expected Government Savings

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

2.6.1 Capital Requirements versus Payout Restrictions

Whereas banks can either adjust the numerator (capital) or the denominator (risk-weighted assets) to meet tighter capital requirements, payout restrictions directly affect the amount of capital at a bank. This difference is critical since recent empirical evidence by Gropp et al. (2019) shows that banks adjust risk-weighted assets to meet higher capital requirements rather than raising more equity capital - a mechanism theoretically highlighted by Admati et al. (2018). Figure 2.16 shows that Tier-1 capital increased by more than $ 50 billion after the restrictions are imposed at the

end of 2020 Q2. This increase in Tier-1 capital is driven by the accumulation of retained earnings.

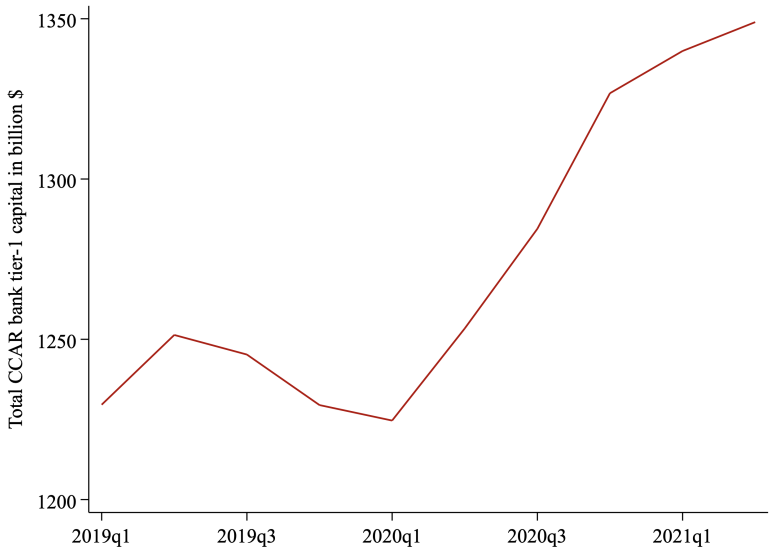


Figure reports total Tier-1 capital of domestic CCAR banks in billion US dollars. Data is from FR-Y9C.

Figure 2.16: Total CCAR Bank Tier-1 Capital

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

2.6.2 Quantifying Expected Government Savings

When the government imposes payout restrictions that make the banking system safer, this generates indirect gains for the government due to the extensive insurance the government provides directly, through deposit insurance, and indirectly, through

implicit bailout expectations, on banking sector liabilities. However, the change in those government guarantees is not directly observed. The inference on government guarantees will assume a break-even analysis: How big a change in government guarantees, ΔGG, is needed so that, jointly with the change in debt values (ΔDV), it offsets the change in equity values (ΔEV)? Formally, I aim to solve for ΔGG such that:

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

Framework

I make three assumptions:

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

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

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

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

$$\Delta DV = \underbrace{(1-\phi^{ST})\frac{\Delta EV}{DV}DV^{ST,partlyinsured}}_{\Delta DV^{ST,partlyinsured}} + \underbrace{(1-\phi^{LT})\frac{\Delta EV}{DV}DV^{LT}}_{\Delta DV^{LT}} \quad (2.14)$$

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

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

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

The empirical details are in Appendix B.4.9.

Results

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

June 25, 2020 Substituting everything, I obtain:

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

December 18 Results Substituting everything, I obtain:

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

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

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

2.7 Conclusion

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

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

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

Payout restrictions imposed by the respective regulator, a widespread practice across jurisdictions during the Covid-crisis, are one potential remedy. Effectively, payout restrictions amount to a publicly imposed payout covenant circumventing both of the problems that lead to private under-provision. Under the Basel III regu-

latory framework, breaches of the capital conservation buffer are also to be sanctioned by limits to dividends and boni.[10] This extends measures from the 1991 Prompt Corrective Action Procedure that imposes payout restrictions on US banks that breach capital ratios. While I find that the government savings from imposing widespread payout restrictions in 2020 are modest in the US, mostly because banks remain well-capitalized throughout, I show that payout restrictions can nonetheless be powerful in mitigating risk-shifting incentives. Exploring the optimal policy of setting payout restrictions remains an avenue for future research.

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

Chapter 3

Falling Rates and Rising Superstars

3.1 Introduction

The large rise in market concentration in the United States has spurred a wide inquiry into its causes and consequences.[1] The stakes are especially high given recent research suggesting a link between the rise in market concentration and the slowdown in productivity growth (e.g., Akcigit and Ates (2019), Olmstead-Rumsey (2020), Asriyan et al. (2021), Liu et al. (2022)). This study presents empirical evidence connecting the secular decline in interest rates to the rise of superstar firms that dominate markets. We find that a decline in interest rates benefits industry leaders relative to industry followers in financial and real terms, and that the relative benefit becomes stronger, or snowballs, as the level of the interest rate approaches zero.

There is a dearth of research on the possible connections between the rate of interest and market competition. This is surprising given the centrality of both the interest rate and the nature of competition for the overall economy. There are sound

[1]This chapter is joined work with Ernest Liu, Atif Mian and Amir Sufi. It has been presented at Northwestern Kellogg and Berkeley Haas.

theoretical reasons to expect a link between interest rates and market competition. For example, suppose that industry followers borrow at a constant spread δ over the interest rate r paid by industry leaders. [2] In this case, a declining r would give a natural advantage to industry leaders. The reason is that borrowing capacity of a dollar of pledgeable cash-flow stream growing at the rate g is proportional to $\frac{1}{r-g}$ for industry leaders and $\frac{1}{r+\delta-g}$ for industry followers. The difference between them is convex as r falls, and in fact goes to infinity as r gets close to g. As we show below, the spread δ that industry followers pay relative to industry leaders has actually become larger as interest rates have fallen, which only strengthens this effect. More generally, theoretical models with financial frictions often imply that low interest rates benefit industry leaders relative to followers (e.g., Chatterjee and Eyigungor (2020), Asriyan et al. (2021)).

A second independent channel translating low interest rates into an advantage for industry leaders is the differential strategic effect of lower rates shown in Liu et al. (2022). As they show, even when there are no financial frictions, a decline in interest rates, and especially a decline to near-zero interest rates, are harmful for competition. The reason is that a decline in the interest rate has an asymmetric strategic effect on industry leaders versus followers: a fall in the interest rate increases the strategic incentive for industry leaders to "escape competition, but discourages industry followers as they now anticipate even tougher competition ahead. Moreover, this strategic effect becomes dominant as the interest rate moves closer to zero.

This paper formally investigates the empirical relationship between economy wide interest rates and the rise of superstar firms in the United States using the merged CRSP-Compustat data set from 1962 to 2019. We begin by analyzing the stock market reaction to an interest rate decline for industry leaders versus industry followers,

[2]This is related to the large body of research showing that large firms borrow at a lower interest rate relative to small firms. For example, Chodorow-Reich et al. (2021) find that small firms (SMEs) obtain shorter maturity credit lines than large firms, post more collateral, have higher utilization rates, and pay higher spreads.

where we define the top 5 percent of firms by value in an industry as leaders and the rest as followers. We construct a leader portfolio that goes long industry leaders and shorts industry followers, and we examine the portfolio's performance in response to changes in the ten year U.S. Treasury rate (r).

We find that the leader portfolio exhibits higher returns in response to a decline in r, and, more importantly, this response becomes stronger, or snowballs, when the initial r is low. We control for the the price to earnings ratio as a measure of implied duration, showing that the snowballing effect is not mechanically driven by industry leaders having higher duration. This suggests that lower r impacts relative firm valuations not only through changing the discount rate but also through possible endogenous changes in expected future cash flows that favor the current industry leader - a finding consistent with the strategic competition channel above.

Interest rate changes are endogenous to changes in the overall economy, and there is an obvious concern that omitted variables may be responsible for the results. For example, the interest rate decline is naturally correlated with negative news about future demand; if industry leaders have a larger option value on future demand, then the spurious correlation between the interest rate movement and expected demand will lead us to underestimate the true differential impact of the interest rate decline on industry leaders.

We address the possible endogeneity of interest rate movements by using plausibly exogenous high frequency monetary policy shocks that capture changes in the expected Federal Funds Rate within a 60-minute time window around FOMC meeting announcements (as in Gorodnichenko and Weber (2016)). Consistent with the logic that the simple OLS may underestimate the true impact of the interest rate on the leader portfolio, the estimated magnitude is larger when using high frequency monetary policy shocks. Since the impact is stronger at low levels of r, for expositional purposes we always report the predicted magnitude of our estimates at an interest

rate of $r = 2\%$. We find that a 10 basis point reduction in r when $r = 2\%$ translates into a 0.53 percentage point larger increase in the market valuation of industry leaders relative to industry followers.

We investigate the possible reasons and mechanisms that lead to lower rates boosting the relative valuation of industry leaders. We find that a fall in r exhibits a stronger pass-through to the borrowing costs of industry leaders relative to industry followers, and this effect snowballs at lower r. In terms of magnitudes, a 10 basis point decline in r leads to a 14 basis point relative decline in the borrowing cost of industry leaders relative to followers at $r = 2\%$. When the initial r is very close to the zero lower bound, a 10 basis point decline in r leads to a 24 basis point relative decline.

Industry leaders take advantage of the lower cost of debt financing. There is a large relative increase in debt issued by industry leaders relative to industry followers, and the book leverage ratio of leaders also increases. The effects of a decline in r on these two financial outcomes also exhibit the snowballing effect: the effect of a decline in r is larger when the initial interest rate is lower. When the economy is close to the zero lower bound, a 10 basis point decline in r leads to a 5.2 percent relative increase in debt issued, and a 1 percentage point relative rise in the leverage ratio for industry leaders. Some of the additional debt raised is used to buy back shares, which also contributes to the rise in leverage we observe.

The final set of results concern the relative real effects of lower interest rates on industry leaders versus followers. These results largely follow the stock market and financial effects described above. We find that a decline in r leads to a relative increase in capital expenditures, cash acquisitions, and property, plants, and equipment (PPE) for industry leaders relative to followers. These real effects, like the valuation and financial effects, also snowball at lower levels of the initial interest rate. The results on investment provide empirical support to the prediction in Liu et al. (2022)

that industry leaders respond more aggressively to a decline in the interest rate in order to go for the kill to ensure their claim on the more valuable future cash flows. Interestingly, one of the strongest results is on cash acquisitions, which suggests that industry leaders may be more likely to target their rivals when interest rates fall from very low levels.

Overall, our results have important implications for the broad literature on persistently low interest rates (or r^*) and their implications for the macroeconomy, including the literature on "secular stagnation" (e.g., Summers (2014)). Most of the work in this literature has focused on possible causes for the low interest rate, with explanations ranging from demographics, inequality, and low productivity growth. Our work suggests that there is a potentially important feedback effect from low r back to the real economy through market structure and industry competition.

Empirical evidence presented in this paper suggests that falling rates, especially as rates get close to zero, disproportionately benefit "superstar" firms. The growth of superstar firms and the accompanying decline in competition has been well-recognized in the literature. Our results provide support to the idea that these trends are partly driven by declining interest rates, especially as rates decline to a level close to zero. Therefore, while low interest rates are generally thought to be expansionary, very low interest rates might also have a contractionary impact on the economy via the rise in market concentration, a point made theoretically in Liu et al. (2022).[3] This study establishes an important link in this chain, showing that lower interest rates do in fact lead to a relative rise in valuation, debt financing, and investment of industry leaders relative to followers, and a relative decline in leaders' cost of borrowing. The snowballing results show that these effects are especially strong in very low interest rate environments.

[3]See also the recent study by Asriyan et al. (2021) that argues that lower interest rates can crowd-out investment by more productive entrepreneurs.

The findings of this study are related to the large body of research exploring the rise in market concentration in the United States since the 1980s (e.g., Grullon et al. (2019), Philippon (2019), Syverson (2019), De Loecker et al. (2020)). Scholars have proposed that the rise in concentration may be a reason behind weak investment and low productivity growth (e.g., Gutiérrez and Philippon (2016), Gutiérrez and Philippon (2017), Crouzet and Eberly (2019), Liu et al. (2022)). A closely related area focuses on the rise of superstar firms, and the implications of superstar firms for the labor share and productivity patterns (e.g., Andrews et al. (2016), Berlingieri et al. (2017), Olmstead-Rumsey (2020), Autor et al. (2020)). This paper suggests that falling interest rates may be one of the factors behind the important patterns documented in this extensive literature. The findings are also related to the empirical literature in asset pricing exploring the effects of interest rates on asset returns (e.g., Koijen et al. (2017), Van Binsbergen (2020)).

There is also a related literature exploring the role of financial constraints in the transmission of monetary policy to firm investment (e.g., Gertler and Gilchrist (1994), Ippolito et al. (2018), Ottonello and Winberry (2020), Vats (2020)). One measure of financial constraints used in this literature is firm size. Relative to this literature, this study emphasizes valuation effects more prominently, and it explores financing and acquisitions in addition to investment. Another related study is Morlacco and Zeke (2021), who show that in response to a decline in the interest rate, large firms increase their spending on customer capital significantly more than small firms. To the best of our knowledge, the empirical demonstration of the snowballing effectthat is, the stronger response of leader outcomes to a decline in interest rates when the initial interest rate is loweris new to the literature.

3.2 Valuation Effect of Falling Rates on Industry Leaders versus Followers

3.2.1 Data

The data set for the analysis is the CRSP-Compustat merged data set from 1980 onward, which is used to compute excess returns for industry leaders versus followers in response to a change in interest rates. The 10-year Treasury yield is used as the default measure of the long-run interest rate, and robustness tests using the real interest rate and alternative definitions of the interest rate yield are also shown.[4]

The analysis focuses on 1980 onward as the default time period since this is the period over which the most consistent time series (e.g., for the real interest rate) is available. Nonetheless, robustness tests are shown for the earliest available CRSP-Compustat data set from 1960 onward. The 10-year yield is used because it is the longest available historical time series. The Fama-French definition is the default classification for industries, and results using alternative definitions of industries are shown as robustness tests.

The baseline definition of industry leaders is size as measured by market value. A firm is classified as an industry leader if it is in the top 5 percent of firms in the industry based on market value at the beginning of the period when excess returns are computed. We also use the top five firms in an industry for robustness. Robustness results in the appendix show similar results when sorting firms based on EBITDA and sales.

[4]We prefer using the nominal interest rate given the measurement error introduced in attempting to measure the real interest rate. Inflation expectations have been relatively well-anchored during the time period analyzed.

3.2.2 Valuation Effects

As mentioned in the introduction, there are sound theoretical arguments for why a decline in interest rates should boost the value of industry leaders relative to industry followers, and for why this effect becomes stronger at low interest rates. For example, if industry followers can only raise financing at a constant spread δ over the interest rate r paid by industry leaders, then falling r benefits industry leaders more than industry followers. Borrowing capacity of a dollar of pledgeable cash-flow stream growing at the rate g is proportional to $\frac{1}{r-g}$ for industry leaders and $\frac{1}{r+\delta-g}$ for industry followers. The difference between them is convex as r falls, and in fact goes to infinity as r gets close to g. Alternatively, even in a world without a borrowing cost spread between industry leaders and industry followers, the model in Liu et al. (2022) shows that a decline in the interest rate has an asymmetric strategic effect that benefits industry leaders. Liu et al. (2022) show theoretically that this asymmetric effect becomes stronger, and snowballs, as the interest rate moves closer to zero.

These theoretical arguments motivate the following empirical specification:

$$R_{i,j,t} = \alpha_{j,t} + \beta_0 D_{i,j,t-1} + \beta_1 D_{i,j,t-1} * \Delta i_t + \beta_2 D_{i,j,t-1} * i_{t-1} + \beta_3 D_{i,j,t-1} * \Delta i_t * i_{t-1} + \varepsilon_{i,j,t} \tag{3.1}$$

where $R_{i,j,t}$ is the dividend and split-adjusted stock return of firm i in industry j from date $t-91$ days to t (i.e., one quarter growth), and $D_{i,j,t-1}$ is an indicator variable equal to 1 if firm i is in the top 5% of market capitalization in its industry j at date $t-91$. Firms with $D_{i,j,t-1} = 1$ are called leaders while the rest are called followers. The variable i_t is the 10-year nominal U.S. Treasury interest rate, with i_{t-1} being the interest rate 91 days prior and Δi_t being the change in the interest rate from date $t-91$ to t. All regressions are value-weighted and standard errors are dually clustered by industry and date. The parameters $\alpha_{j,t}$ are industry-time period fixed effects.

The key coefficients of interest are β_1 and β_3. A negative estimate of β_1 implies that a decline in the interest rate leads to a larger increase in the stock return of industry leaders. A positive estimate of β_3 implies that this effect is stronger when the level of interest rates is lower. In other words, a negative estimate of β_1 and a positive estimate of β_3 signify that industry leaders experience higher excess returns when interest rates fall, and this effect is amplified when interest rates start from a low level.

Table 3.1 shows the results of estimating (3.1) on the merged CRSP-Compustat data set from 1980 onward. Only the relevant coefficients are displayed in the tables, but the actual regression includes all variables specified in equation (3.1). Column (1) estimates equation (3.1) without interactions with the level of interest rate. The coefficient β_1 is negative and significant; leaders earn positive excess returns when the interest rate falls.

Column (2) presents estimates from the full specification (3.1). The coefficient β_3 is positive and significant. Excess returns for leaders are higher in response to a fall in the interest rate when the level of the interest rate is lower. This is succinctly captured by β_1 which reflects the increase in excess returns when interest rates fall near the zero lower bound (i.e., when $i_{t-1} \approx 0$). The excess return near the zero lower bound in column (2) (3.6) is three times the average excess return of 1.2 in column (1).

One concern with these results is that the measure of industry leaders is spuriously correlated with balance sheet factors that are more sensitive to interest rate movements. For example, perhaps leaders are more levered and a fall in the interest rate helps lower the interest burden. To test for this, and other related concerns, we include a number of firm level characteristics as controls by including all the interaction of the firm level characteristic with the change in interest rate as well as the level of the interest rate. We include the following firm-level characteristics, a

	Stock Return					
	(1)	(2)	(3)	(4)	(5)	(6)
Top 5 Percent=1 x Δi	-1.411***	-3.072**	-3.618***	-3.360***	-3.836***	-2.964***
	(0.243)	(0.976)	(0.779)	(0.954)	(0.720)	(0.541)
Top 5 Percent=1 x Δi x Lagged i		0.215*	0.261**			0.191***
		(0.087)	(0.079)			(0.049)
Top 5 Percent=1 x Δi x Lagged real i (Clev)				0.441*	0.472**	
				(0.185)	(0.158)	
Firm β x Δi						12.12***
						(0.716)
Firm β x Δi x Lagged i						-1.122***
						(0.082)
Sample	All	All	All	All	All	All
Controls	N	N	Y	N	Y	
Industry-Date FE	Y	Y	Y	Y	Y	Y
N	65,944,610	65,944,610	47,399,717	64,113,949	46,579,398	64,608,224
R-sq	0.253	0.254	0.257	0.250	0.253	0.251

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Regression results for the specification $R_{i,j,t} = \alpha_{j,t} + \beta_0 D_{i,j,t} + \beta_1 D_{i,j,t}\Delta i_t + \beta_2 D_{i,j,t} i_{t-1} + \beta_3 D_{i,j,t}\Delta i_t i_{t-1} + X_{i,j,t}\gamma_0 + \Delta i_t X_{i,j,t}\gamma_1 + i_{t-1}X_{i,j,t}\gamma_2 + \Delta i_t i_{t-1} X_{i,j,t}\gamma_3 + \varepsilon_{i,j,t}$ for firm i in industry j at date t. $R_{i,j,t}$ is defined here as the retrun to holding the stock (including dividends) of firm i in industry j from date $t-91$ to t (one quarter growth). $D_{i,j,t}$ is defined here as an indicator equal to 1 at date t when a firm i is in the top 5% of market capitalization in its industry j on date $t-91$. Firms with $D_{i,j,t}$=1 are called leaders while the rest are called followers. i_t is defined as the nominal 10-year Treasury yield, with i_{t-1} being the interest rate 91 days prior and Δi_t being the change in the interest rate from date $t-91$ to t. Controls X include a firm's asset-liability ratio, debt-equity ratio, book-to-market ratio, and percent of pre-tax income that goes to taxes. Industry classifications are the Fama-French industry classifications (FF). Lagged real rates were built using monthly 10-year inflation expectations from the Cleveland Fed and the daily 10-year Treasury yield at the beginning of each month (post-1982). Standard errors are dually clustered by industry and date.

Table 3.1: Differential Interest Rate Responses of Leaders vs. Followers: Top 5 Percent

firm's asset-liability ratio, debt-equity ratio, book-to-market ratio, and the percent of pre-tax income that goes to taxes. The number of observations decreases because we have to limit the sample to Compustat firms with the available data on firm financials. Column (3) shows that the inclusion of this extensive list of firm-level controls does not change the coefficients of interest materially.

Columns (4) and (5) use the ten year real interest rate for the level of the lagged interest rate in equation (3.1). The change in the interest rate continues to be measured by the change in the 10-year nominal bond yield given that there are no reasonable

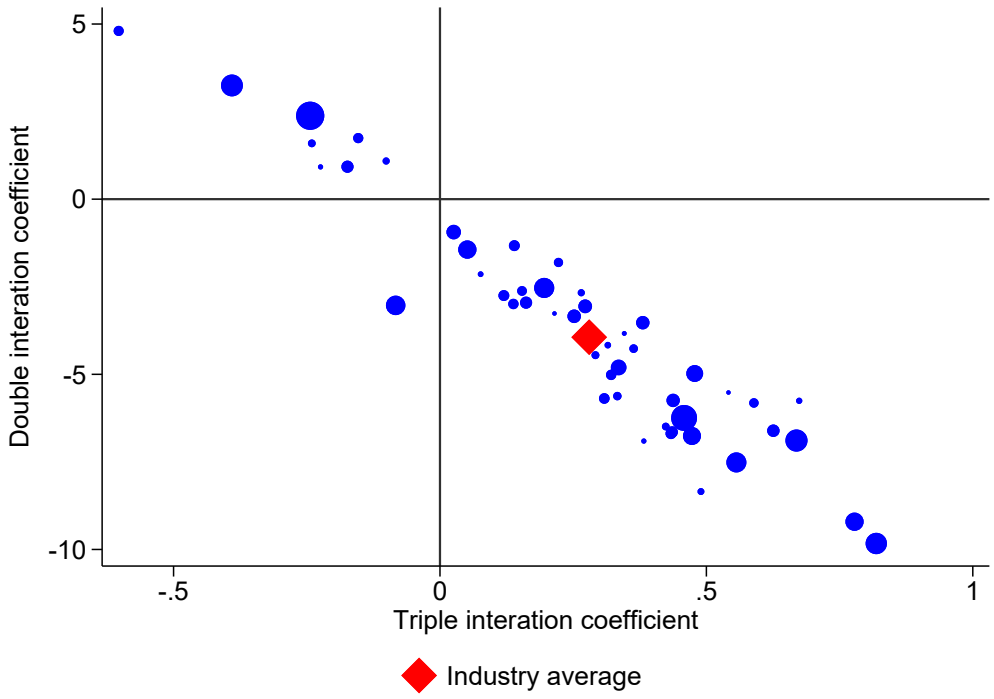
estimates of the change in the real yield over short time intervals. Furthermore, the change in nominal and real yields over a short horizon is likely to be dominated by the change in the nominal interest rate. The real interest rate is calculated by subtracting 10-year inflation expectations published by the Cleveland Federal Reserve. Using the real interest rate, the snowballing coefficient (β_3) on the interaction term increases significantly.

Column (6) controls for another firm-level attribute that may lead to a bias in the estimate of the snowballing coefficient β_3. What if industry leaders are more cyclical? If a fall in the interest rate represents changing economic expectations, industry leaders might generally be more responsive to changing market conditions irrespective of the level of interest rate. To test for this possibility, the market beta of each firm is estimated using historical data as of $t-1$ and then it is interacted with both the change in the interest rate and the level of the interest rate in column (6). As before, the main coefficients of interest are not materially affected.

To assess how broad these core findings are across industries, Figure 3.1 presents estimates of β_1 and β_3 from equation (3.1) for each industry in the sample. The vertical axis is β_1 for an industry while the horizontal axis is β_3. The red dot is the average effect from Table 3.1. Almost all the points are in the lower right quadrant of the scatter plot, which indicates a positive estimate of β_3 and a negative estimate of β_1. For the grand majority of the industries, a decline in the interest rate boosts the value of the leaders relative to the followers (a negative β_1) , and this effect because stronger if the decline occurs from an already low level of interest rates (a positive β_3). The core findings are not driven by a few industries.

Table 3.2 performs a time-series version of the excess return test implemented in Table 3.1. In particular, the results are based on the following specification:

$$R_t = \alpha + \beta_0 i_{t-1} + \beta_1 \Delta i_t + \beta_2 \Delta i_t * i_{t-1} + \varepsilon_t \tag{3.2}$$



The figure plots the coefficients β_2^j alongside β_3^j from the regression $R_{i,j,t} = \alpha_{j,t} + \beta_0 D_{i,j,t-1} + \beta_1 D_{i,j,t-1} * \Delta i_t + \beta_2^j D_{i,j,t-1} * i_{t-1} + \beta_3^j D_{i,j,t-1} * \Delta i_t * i_{t-1} + \varepsilon_{i,j,t}$ estimated for each Fama French industry j seperately. Points are weighted by the industry share of aggregate market capitalisation. The average values for each coefficient are indicated on each axis.

Figure 3.1: Coefficients at the Industry-level

where R_t is the market-capitalization weighted average of returns for a stock portfolio that goes long industry-leader stocks and goes short industry-follower stocks from date $t-91$ to t. We refer to this portfolio as the leader portfolio. More specifically, The leader portfolio returns R_t are calculated as the weighted average of leader less follower returns

$$R_t = \sum_{f=1}^{F} \omega_{f,t-1}(R_{f,t}^{leader} - R_{f,t}^{follower})$$

where $R_{f,t}^{leader}$ denotes leader returns in industry f at time t, and $\omega_{f,t}$ are the industry weights, equal to industry f's share of total market capitalization at time t. Let $\mathcal{L}_f$ be the set of leaders in industry f. Then leader returns in industry f are calculated as

$$R_{f,t}^{leader} = \sum_{i \in \mathcal{L}_f} \gamma_{i,t-1} R_{i,t}$$

where $\gamma_{i,t} = \frac{V_{i,t}}{\sum_{j \in \mathcal{L}_f} V_{j,t}}$ denotes firm i's share of market capitalization among leaders in industry f. Follower returns are calculated equivalently. Given that observations have overlapping differences, we compute standard errors using a Newey-West procedure with a maximum lag length of 60 days to account for built-in correlation.

A negative estimate of coefficient β_1 would signify that a decline in interest rates boosts the return on the leader portfolio, while a positive estimate of β_2 would signify that the positive response of the return on the leader portfolio to a decline in interest rates is larger when the level of the interest rate is lower. In this specification, β_2 is the relevant snowballing coefficient.

The estimates reported in columns (1) and (2) confirm earlier results. A decline in the interest rate is associated with positive returns for the leader portfolio, and this positive return response to a decline in the interest rate is larger in magnitude when the interest rate is lower. Column (3) uses the 10-year real interest rate level as before. The coefficient on the interaction between the real rate and the change in interest rate is even stronger than in Table 3.1.

Column (4) shows that the results are driven by both positive and negative changes in interest rates. In particular, the excess return results are materially unchanged whether only positive changes in interest rates or only negative changes in interest rate are used. Column (5) shows that the results are not driven by industry leaders that may have higher duration of cash flows for mechanical or spurious reasons. If industry leaders had higher duration for spurious reasons, then they would have a higher price to earnings (PE) ratio and the difference in the PE ratio between the industry leader and follower at the time of interest rate shock would explain our asymmetric valuation response to a decline in r. Column (5) controls for a PE portfolio

	Portfolio Return				
	(1)	(2)	(3)	(4)	(5)
Δi_t	-1.264***	-3.803***	-3.517***	-4.198***	-3.654***
	(0.313)	(0.595)	(0.540)	(0.891)	(0.787)
i_{t-1}		0.0572		0.154*	0.103
		(0.050)		(0.069)	(0.067)
$\Delta i_t \times i_{t-1}$		0.284***		0.363***	0.312**
		(0.057)		(0.078)	(0.106)
real i_{t-1} (Clev)			0.148		
			(0.080)		
$\Delta i_t \times$ real i_{t-1} (Clev)			0.553***		
			(0.117)		
$(\Delta i_t > 0)$=1 $\times \Delta i_t$				0.815	
				(1.676)	
$(\Delta i_t > 0)$=1 $\times \Delta i_t \times i_{t-1}$				-0.138	
				(0.173)	
PE Portfolio Return					-0.257***
					(0.070)
N	9,669	9,669	9,250	9,669	8,032
R-sq	0.051	0.093	0.090	0.096	0.187

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Regression results for the specification $R_t = \alpha + \beta_0 i_{t-1} + \beta_1 \Delta i_t + \beta_2 \Delta i_t i_{t-1} + \varepsilon_t$ at date t. R_t is defined as the market-capitalization weighted average of returns for a stock portfolio that goes long in leader stocks and goes short in follower stocks from date $t-91$ to t. Leaders are defined as the firms in the top 5% of market capitalization in its FF industry on date $t-91$. i_t is defined as the nominal 10-year Treasury yield, with i_{t-1} being the interest rate 91 days prior and Δi_t being the change in the interest rate from date $t-91$ to t. Standard errors are Newey-West with a maximum lag length of 60 days prior. Real rates were built using monthly 10-year inflation expectations from the Cleveland Fed and the daily 10-year Treasury yield (post-1982).

Table 3.2: Portfolio Returns Response to Interest Rate Changes: Top 5 Percent

that is long the top 5% of firms by PE in an industry and short the rest. Inclusion of the PE portfolio return does not change the coefficients of interest, and the return of the leader-minus-follower portfolio is itself negatively correlated with the return of the PE portfolio.[5] This result shows that lower r impacts relative firm valuations not only through changing the discount rate but also through the endogenous changes in future cash flows that favor the current leader.

[5]The number of observations declines because earnings data are missing on certain dates.

Tables C.1.1 and C.1.2 in the appendix show the robustness of results in Tables 3.1 and 3.2 to using CRSP-Compustat data from 1960 onward.[6] Table C.1.3 in the appendix shows robustness to alternative definitions: top 5 instead of top 5 percent for industry leadership, SIC codes instead of Fama French industry classification, and sorting on EBITDA and sales instead of market value for defining leadership. Overall, the snowballing coefficient is positive and significant across the specifications, indicating that a decline in interest rates boost the valuation of leaders relative to followers by more when the initial interest rate is low.

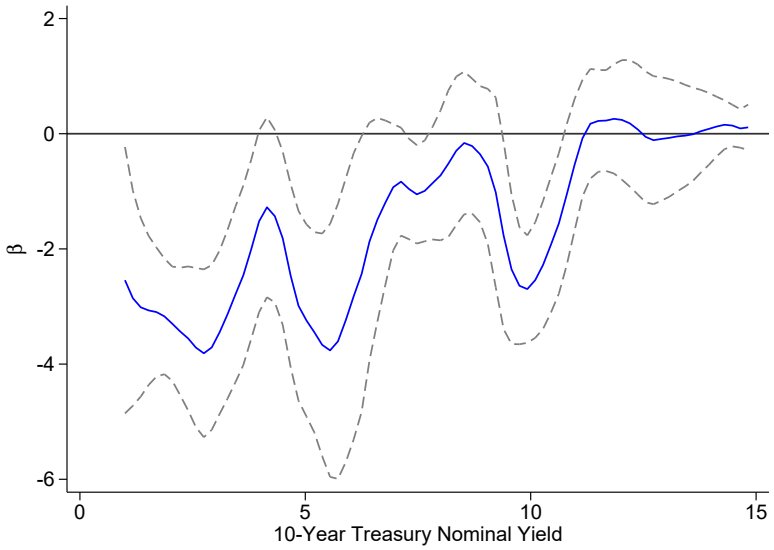
In empirical asset pricing tests of a portfolio's return, it is common to control for risk factors such as the excess market return or a growth minus value portfolio. However, it may be the case that the relative valuation effect from lower interest rates on the leader minus follower portfolio is due to a relative decline in risk for leaders relative to followers.[7] Indeed, an evaluation of credit spreads in Section 3.4 below suggests that the riskiness of the debt of leaders relative to followers falls as interest rates in the overall economy decline from low levels. As a result, controlling for risk factors in the estimation of equation (3.2) would be over-controlling; if a decline in interest rates from already low levels leads to positive valuation effects for leaders relative to followers because of exposure to risk factors, then that should be included in the overall estimate of how low interest rates benefit leaders.

Figure 3.2 helps visualize the snowballing effect, and the critical interest rate at which the snowballing effect becomes active. More specifically, the figure reports non-parametric estimates of the effect of a change in interest rates on the leader portfolio (β) at various grid points for i_{t-1}, which is the lagged 10-year nominal Treasury rate. Moving from right to left in the figure, the coefficient estimate of β becomes statistically significantly negative when the level of the nominal interest rate i_{t-1} falls

[6]The real interest rate prior to 1980 is computed by subtracting realized inflation from the nominal rate.

[7]The model by Liu et al. (2022) can be intepreted as a micro-foundation for why lower interest rates may increase the risk of followers relative to leaders.

into the 5 and 6% region. The 10 year nominal U.S. Treasury rate has been below 5% since 2000, with only a few exceptions.



The figure plots coefficient β from the specification $R_t = \alpha + \beta \Delta i_t + \varepsilon_t$, where points are weighted using Epanechnikov's kernel centered at 0.1 increments on the x-axis grid point of nominal interest rates at t-91 days. The choice of bandwidth is determined using a Silverman bandwidth (Silverman (1986)) for such kernel (bandwidth = 0.68). R_t is defined as the market-capitalization weighted average of returns for a stock portfolio that goes long in leader stocks and goes short in follower stocks from date t-91 days to t. Leaders are defined as the firms in the top 5% of market capitalization in its FF industry on date t-91. Δi_t is the change in the 10-year treasury interest rate from date $t-91$ to t. Standard errors are Newey-West with a maximum lag length of 60 days prior.

Figure 3.2: Estimating $\beta(i^*) = \frac{\partial R_t}{\partial \Delta i_t} \mid_{i_{t-1}=i^*}$

3.2.3 Timing

The changes in interest rates that should affect relative valuation should be those that are deemed more persistent. In theory, purely transitory changes in interest rates should not affect relative valuation of leaders and followers as it is the longer-term effect of a lower interest rate on endogenous cash flows that are critical. As a result, the baseline specification constructs returns and interest rate changes at a quarterly frequency. Figure 3.3 plots the histograms of interest rate changes in the sample, from daily to annual frequency. On average, interest rates declined during this time period. However, there is substantial variation with the change in the interest

rate being positive on a high fraction of days. As already shown, the key findings are symmetric to whether the change in the interest rate is positive or negative.

As one moves from daily to annual frequency, the range of interest rate changes increases. This is another reason to focus on longer term differences; investors need sufficient time to incorporate a large change in interest rates when forming expectations.

Table C.1.4 in the appendix repeats the core specification for interest rate changes at frequencies ranging from daily to annual. The effect tends to be stronger when the interest rate change is computed over longer horizons, consistent with the idea that it is the more persistent decline in interest rates that boost the value of the leaders relative to the followers.

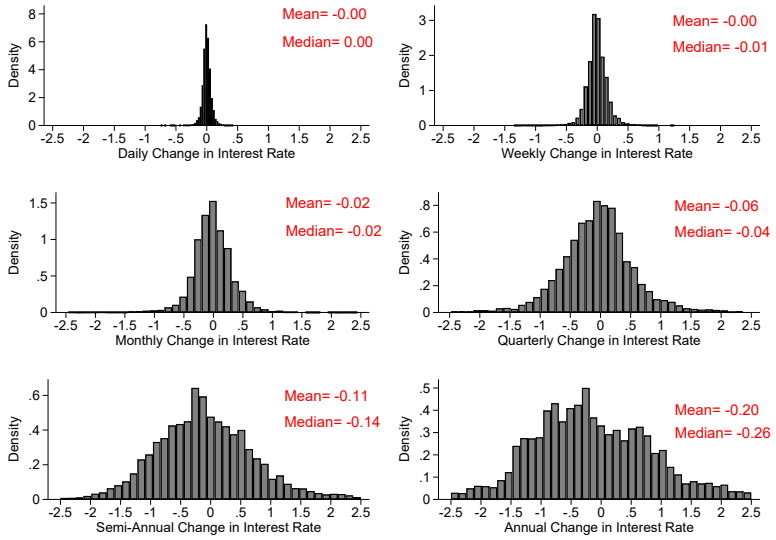


Figure 3.3: Distribution of Interest Rate Changes at Varying Frequencies

Another robustness test concerns the exact interest rate used in the specification. For example, do the excess return results depend on whether the change in the interest rate is at the short versus the long end of the yield curve? Statistically this is a somewhat hard test to perform because interest rate movements along the yield curve tend to be highly correlated. Table C.1.5 in the appendix shows the correlation

matrix of quarterly changes in forward rates of varying non-overlapping durations. The correlations are generally quite high, leading to problems of collinearity in joint testing. The lowest correlation is in the range of 0.7 to 0.75 between change in 0-2 forward rate and longer term forward rates (e.g. 10-30).

Table 3.3 presents estimates of equation (3.2) using the forward rate of varying duration. The main takeaway is that the results shown above are similar for interest rate changes throughout the yield curve (columns (1) through (6)). When both the 0-2 and 10-30 forward rates are put in the specification together (columns (7) and (8)), both ends of the yield curve appear to be independently important, with some evidence that the longer end of the yield curve is more important.

	30-Year		2-Year		10-30 Forward		2-Year & 10-30 Fwd.	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δi_t	-1.296***	-4.333***						
	(0.344)	(0.741)						
$\Delta i_t \times i_{t-1}$		0.335***						
		(0.073)						
$\Delta i_{t,0,2}$			-0.740**	-3.490***			-0.359	-2.303**
			(0.251)	(0.674)			(0.341)	(0.786)
$\Delta i_{t,0,2} \times i_{t-1}$				0.270***				0.160*
				(0.058)				(0.069)
$\Delta i_{t,10,30}$					-1.221***	-3.947***	-0.809	-2.657**
					(0.350)	(0.769)	(0.496)	(0.953)
$\Delta i_{t,10,30} \times i_{t-1}$						0.306***		0.247*
						(0.076)		(0.104)
N	9,669	9,669	9,669	9,669	9,669	9,669	9,669	9,669
R-sq	0.042	0.078	0.031	0.072	0.034	0.063	0.038	0.088

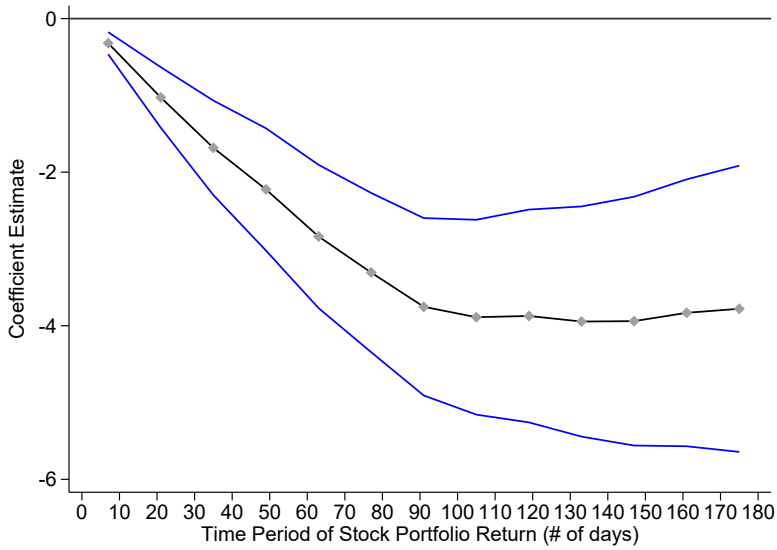
Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Regression results for the specification $R_t = \alpha + \beta_0 i_{t-1} + \beta_1 \Delta i_t + \beta_2 \Delta i_t i_{t-1} + \varepsilon_t$ at date t in columns 1-2 and $R_t = \alpha + \beta_0 i_{t-1} + \beta_{1,1} \Delta i_{t,0,2} + \beta_{1,2} \Delta i_{t,10,30} + \beta_{1,3} \Delta i_{t,0,10} + \beta_{2,1} \Delta i_{t,0,2} i_{t-1} + \beta_{2,2} \Delta i_{t,10,30} i_{t-1} + \beta_{2,3} \Delta i_{t,0,10} i_{t-1} + \varepsilon_t$ at date t in columns 3-8. R_t is defined as the market-capitalization weighted average of returns for a stock portfolio that goes long in leader stocks and goes short in follower stocks from date $t - 91$ to t. Leaders are defined as the firms in the top 5% of market capitalization in its FF industry on date $t - J$. i_t is defined as the nominal 30-year Treasury yield, with i_{t-1} being the interest rate J days prior and Δi_t being the change in the interest rate from date $t - 91$ to t. $i_{t,0,2}$, $i_{t,0,10}$ and $i_{t,10,30}$ are the 2-year and 10-year Treasury yield and 10 to 30 forward Treasury yield, respectively. Standard errors are Newey-West with a maximum lag length of 60 days prior. We cannot reject that the main and interaction coefficients in columns 7 and 8 are not equal.

Table 3.3: Portfolio Returns Response to Interest Rate Changes: Along the Yield Curve

Figure 3.4 plots the coefficients $\{\beta_{0,j}\}$ of the following specification: $R_{t+j} = \alpha_j + \beta_{0,j}\Delta i_t + \beta_{1,j}\Delta i_{t-1} + \beta_{2,j}\Delta i_t * i_{t-1} + \varepsilon_t R_{t+j}$ is defined as the market-capitalization weighted average of returns for a stock portfolio that goes long in leader stocks and goes short in follower stocks from date t to $t+j$. In this specification, Δi_t is defined as the change in the interest rate from date t to $t+91$. The coefficients $\beta_{0,j}$ can be interpreted as the effect of a change in interest rates from $t-91$ to t on the returns of the leader portfolio from time t to time $t+j$ when the level of interest rates at $t-1$ is equal to zero. In other words, the figure represents the impulse response function at a daily frequency of the leader portfolio return to a change in interest rate over one quarter.

As the figure shows, the effect of a change in interest rates starts quickly but the full effect is not realized until about 90 days. Further, there is no evidence of reversal over the following quarter. The increase in the value of the leader portfolio is persistent.



The figure plots the coefficients $\{\beta_{0,j}\}$ of the specification $R_{t+j} = \alpha_j + \beta_{0,j}\Delta i_t + \beta_{1,j}\Delta i_{t-1} + \beta_{2,j}\Delta i_t * i_{t-1} + \varepsilon_t$ at date t. R_{t+j} is defined as the market-capitalization weighted average of returns for a stock portfolio that goes long in leader stocks and goes short in follower stocks from date t to $t+j$. Δi_t is defined here as the change in the interest rate from date t to $t+91$. Leaders are defined as the firms in the top 5% of market capitalization in its FF industry on date t. Standard errors are Newey-West with a maximum lag length of 60 days prior.

Figure 3.4: Impulse Response of Changes in Interest Rate when Rate is Zero

3.3 Using High-frequency Monetary Policy Shocks

Changes in economy-wide interest rates are not exogenous, and so there remains a concern that the snowballing effect could be spuriously related to other variables moving with interest rates. This is an even larger concern when moving to investment outcomes, as done in the next section. In order to capture changes in interest rates that are less likely to be related to other economy-wide changes, the empirical analysis in the rest of the study uses high-frequency identified monetary policy shocks ϵ_t^m from Gorodnichenko and Weber (2016).[8]

The shocks are measured using the response of Federal Funds Rate Futures within a 60-minute time window (-20 minutes until +40 minutes) around FOMC meeting announcements. If no other macroeconomic announcements occur at the same time, the Futures response measures the exogenous response of interest rates to monetary policy. These shocks are available for the period between 1994 and 2019. The shocks only occur on days of Federal Open market committee meetings, which occur roughly every six weeks.

Figure 3.5 plots the evolution of the Federal funds target rate since 1980, alongside the cumulative high frequency monetary policy shocks over the same period. The axis is compressed for the high frequency shocks. Two features of Figure 3.5 stand out. First, the overall time series patterns are similar. Second, the cumulative high frequency shocks are actually a substantial part of the overall decline in the target rate over the period. Put differently, the use of high frequency shocks captures a large part of the times series variation in monetary policy.

To address the economic power of these shocks further, we estimate the passthrough of the shocks to US Treasury yields at various maturities:

[8]Similar methodologies have been used by Nakamura and Steinsson (2018) and Ottonello and Winberry (2020). The original paper is Gürkaynak et al. (2005)

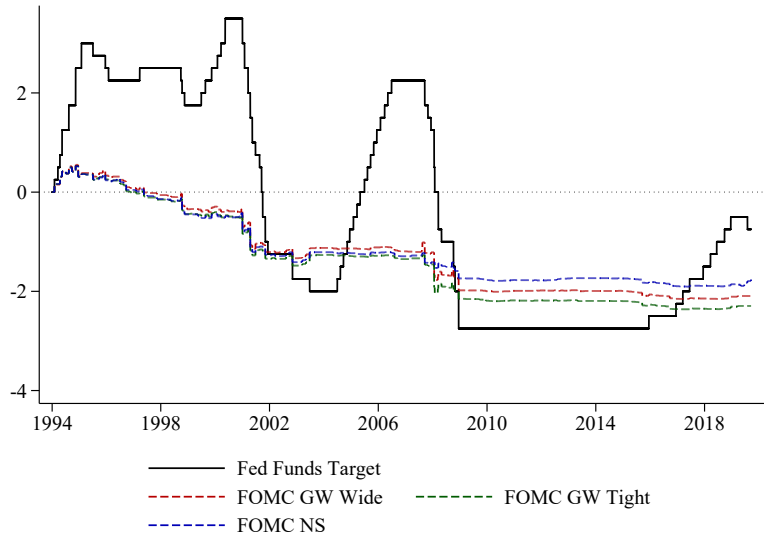


Figure 3.5: Evolution of Federal Funds Target and Shocks

$$\Delta i_t^h = \alpha^h + \beta^h \epsilon_t^{HF} + \eta_t^h$$

where $\Delta i_t^h = i_t^h - i_{t-91}^h$ is the change in treasury yield of duration h between time $t-91$ and time t, while ϵ_t^{HF} is the sum of all high frequency shocks between time $t-91$ and t. We refer to the sum of the high frequency shocks at the quarterly level as monetary policy shocks. Table 3.4 presents the estimates β^h of this pass-through along the yield curve.

	(1) 3 Mo	(2) 1 Yr	(3) 2 Yr	(4) 3 Yr	(5) 5 Yr	(6) 7 Yr	(7) 10 Yr	(8) 20 Yr	(9) 30 Yr
ϵ^{HF}	1.876***	0.613*	1.367***	1.142***	0.892**	0.704*	0.613*	0.294	0.289
	(0.307)	(0.298)	(0.337)	(0.336)	(0.327)	(0.302)	(0.298)	(0.246)	(0.242)
N	6,283	6,283	6,283	6,283	6,283	6,283	6,283	6,283	6,283
R-sq	0.242	0.025	0.104	0.069	0.043	0.029	0.025	0.007	0.007

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Regression results for the specification $\Delta i_t^h = \alpha^h + \beta^h \epsilon_t^{HF} + \eta_t^h$ where $\Delta i_t^h = i_t^h - i_{t-91}^h$ is the change in treasury yield of duration h between time $t-91$ and time t, while ϵ_t^{HF} is the sum of all high frequency shocks between time $t-91$ and t. We consider yields on treasuries of three month duration alongside one, two, three, five, seven, ten, twenty and thirty year durations.

Table 3.4: Response to high frequency shocks along the yield curve

We can see that ten year yields move roughly one to one with monetary policy shocks at the quarterly frequency. Indeed monetary policy shocks shift the whole yield curve upwards, with larger effects at shorter durations. The one-for-one pass through of monetary policy shocks on 10 year Treasury yields is a convenient feature of the analysis, as the quantitative effect of monetary policy shocks on outcome variables can be directly compared to the quantitative effect of changes in 10 year yields.

We are now in a position to use the monetary policy shocks to estimate the effect of changes in interest rates on relative valuation. For the rest of the analysis, we use Compustat data recorded at a quarterly frequency, which allows us to investigate the response of a large array of firm level variables. We estimate the impact of monetary policy shocks on firms one quarter percent valuation change $R_{i,j,t} = \frac{\Delta P_{i,j,t}}{P_{i,j,t-1}}$ in the following local projection:

$$R_{i,j,t} = \alpha_{j,t} + \alpha_i + \beta_0 D_{i,j,t} + \beta_1 D_{i,j,t}\epsilon_t^{HF} + \beta_2 D_{i,j,t} FFR_{t-1} + \beta_3 D_{i,j,t}\epsilon_t^{HF} FFR_{t-1} + X_{i,j,t}\gamma + \sum_{\ell=1}^{3} \boldsymbol{\delta}_\ell \boldsymbol{\omega}_{j,t-\ell} + \varepsilon_{i,j,t}$$

$R_{i,j,t}$ is defined here as the percentage valuation change of firm i in industry j from date $t-1$ to t (one quarter growth), while FFR_{t-1} being the federal funds target rate at the end of the previous quarter and ϵ_t^{HF} being the sum of high frequency shocks between time $t-1$ and t. Controls X include a firm's asset-liability ratio, debt-equity ratio, book-to-market ratio, and percent of pre-tax income that goes to taxes. The vector $\boldsymbol{\omega_{j,t}} = \{R_{i,j,t}, D_{i,j,t}, D_{i,j,t}\epsilon_t^{HF}, D_{i,j,t}\epsilon_t^{HF} FFR_{t-1}, X_{i,j,t}\}$ contains lagged values of all variables in the system. Real rates are built using monthly 10-year inflation expectations from the Cleveland Fed and the federal funds target rate at the end of each quarter (post-1982). The variable $D_{i,j,t}$ again defines leaders in a

manner analogous to that of Section 3.2. Table 3.5 reports estimates of β_1 and β_2 from equation 3.3 on quarterly Compustat data from 1980 onward.

	Stock Return				
	(1)	(2)	(3)	(4)	(5)
ϵ^{HF} x Top 5 Percent=1	1.641	-11.07*	-11.46*	-11.01*	-11.39*
	(1.908)	(5.700)	(5.910)	(5.672)	(5.882)
ϵ^{HF} x Top 5 Percent=1 x lagged FFR		3.051**	3.374**		
		(1.320)	(1.343)		
ϵ^{HF} x Top 5 Percent=1 x lagged real FFR				3.057**	3.380**
				(1.321)	(1.345)
Controls	N	N	Y	N	Y
Industry-Date & firm FE	Y	Y	Y	Y	Y
N	353,590	353,590	335,670	353,590	335,670
R-sq	0.164	0.165	0.180	0.165	0.180

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Regression results for the lag augmented local projection specification $R_{i,j,t} = \alpha_{j,t} + \alpha_i + \beta_0 D_{i,j,t} + \beta_1 D_{i,j,t}\epsilon_t^{HF} + \beta_2 D_{i,j,t} FFR_{t-1} + \beta_3 D_{i,j,t}\epsilon_t^{HF} FFR_{t-1} + X_{i,j,t}\gamma + \sum_{\ell=1}^{3} \boldsymbol{\delta}_\ell \boldsymbol{\omega}_{j,t-\ell} + \varepsilon_{i,j,t}$ for firm i in industry j at date t. $R_{i,j,t}$ is defined here as the percentage valuation change of firm i in industry j from date $t-1$ to t (one quarter growth). $D_{i,j,t}$ is defined here as an indicator equal to 1 at date t when a firm i is in the top 5% of market capitalization in its industry j on date $t-1$. Firms with $D_{i,j,t}$=1 are called leaders while the rest are called followers. i_t is defined as the nominal 10-year Treasury yield, with FFR_{t-1} being the federal funds target rate at the end of the previous quarter and ϵ_t^{HF} being the sum of high frequency shocks between time $t-1$ and t. Controls X include a firm's asset-liability ratio, debt-equity ratio, book-to-market ratio, and percent of pre-tax income that goes to taxes. Industry classifications are the Fama-French industry classifications (FF). The vector $\boldsymbol{\omega_{j,t}} = \{R_{i,j,t}, D_{i,j,t}, D_{i,j,t}\epsilon_t^{HF}, D_{i,j,t}\epsilon_t^{HF} FFR_{t-1}, X_{i,j,t}\}$ contains lagged values of all variables in the system. Real rates were built using monthly 10-year inflation expectations from the Cleveland Fed and the federal funds target rate at the end of each quarter (post-1982). Lag augmentation implies heteroskedasticity-robust standard errors are sufficient, according to Olea and Plagborg-Møller (2020).

Table 3.5: Differential Responses of Leaders vs. Followers to Monetary Policy shocks: Quarterly data

Qualitatively, the results in Table support the existence of a snowballing effect. An expansionary monetary policy shock which lowers interest rates boosts the value of leaders relative to followers, and this effect is amplified when the initial interest rate is already low. However, the effects are substantially larger when using the monetary policy shocks. One potential reason is that economy-wide interest rates tend to fall when the overall economy is weak. A weaker economy may be associated with a decline in the size of the total pie in any industry, which would differentially lower the value of leaders who currently have a larger slice of the pie. This unobservable

factor may be biasing the coefficient in Table 3.1 toward zero. Under this logic, the use of the endogenous economy-wide interest rate leads to a smaller valuation effect of the leader relative to the follower compared to the use of the exogenous monetary policy shocks.

3.4 Financial Effects of Falling Rates

3.4.1 Pass-through of lower interest rates for industry leaders and followers

A decline in interest rates boosts the value of industry leaders relative to followers, and this effect snowballs as the level of the interest rate becomes lower. We now explore mechanism through which industry leaders gain relative to industry followers when interest rate declines. We first explore whether the decline in economy-wide interest rates such as the 10 year Treasury rate has been associated with a differential decline in the cost of debt financing for industry leaders relative to followers. A stronger pass-through of lower Treasury rates into the cost of debt financing for industry leaders represents another advantage of a low interest rate environment for leaders relative to followers.

As before, industry leaders are defined as the largest 5% of firms in each Fama-French industry, measured by market capitalization. We define each firms' borrowing cost as the the ratio of interest expense to total liabilities, which is simply average rate of interest paid on it's liabilities. We treat the largest 5% of borrowing costs in the sample as missing in order to exclude any outliers in the data. Figure 3.6 plots the evolution of the median borrowing cost faced by both leaders and followers, displaying both a clear downward trend and also a stark increase in spreads since 1980. The spread in the 1980s was 31 basis points whereas the spread in the 2010s is 127 basis points.

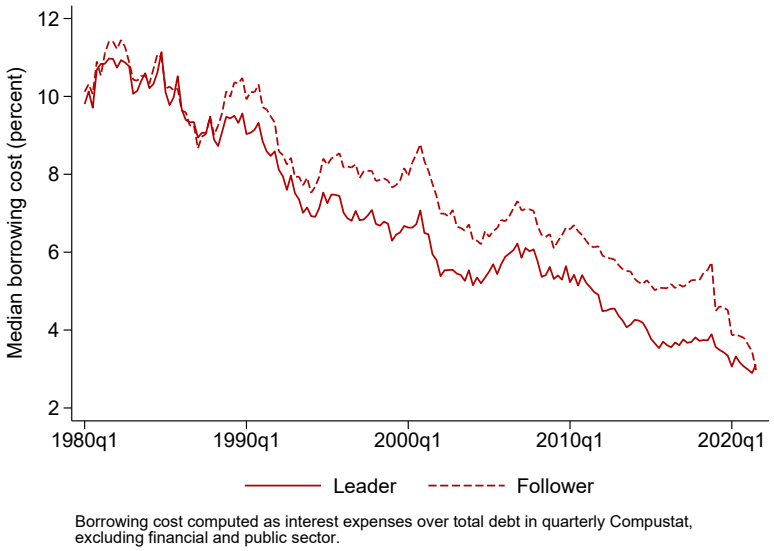


Figure 3.6: Borrowing Costs of Leaders and Followers since 1980

The interest rate spread between market leaders and market followers widened even though the level of interest rate fell considerably. We present estimates of the effect of a decline in interest rates as defined by the monetary policy shocks discussed in Section 3.3 on the cost of debt financing for industry leaders versus followers. As above, we measure borrowing costs using the average interest rate paid by the firm on all debt. We calculate this as the total interest expense divided by total debt. We exclude the top 5% observed values of borrowing costs, due to the presence of implausibly large values.

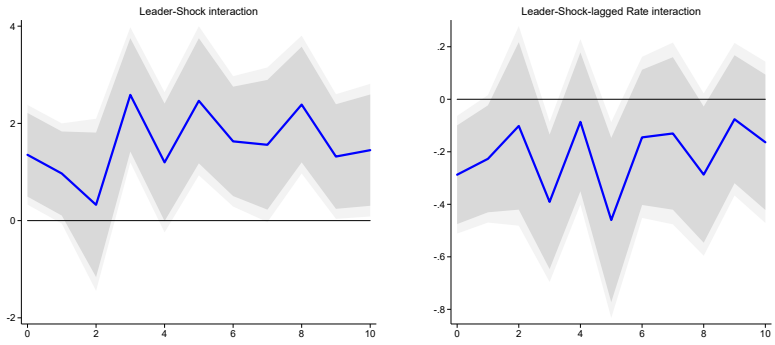
The baseline specification is given by

$$Y_{i,j,t+h} = \alpha_i + \alpha_{j,t} + \beta_{1,h}\epsilon_t^{HF} * D_{i,j,t-1} + \beta_{2,h}\epsilon_t^{HF} * D_{i,j,t-1} * FFR_{t-1} + \delta_h^1 D_{i,j,t-1} + \sum_{\ell=1}^{3} \Gamma_h' \boldsymbol{W}_{i,t-\ell} + \epsilon_{i,t+h} \tag{3.3}$$

where $Y_{i,t}$ is the outcome variable of interest for firm i, $D_{i,j,t-1}$ is an indicator variable equal to 1 if firm i is in the top 5% of market capitalization in its industry j at date $t-1$, while $\boldsymbol{W}_{i,t}$ is a vector containing all variables in the system. We also

control for firm α_i and industry - time fixed effects $\alpha_{j,t}$. Olea and Plagborg-Møller (2021) show that augmenting the local projection with lags of each variable removes the need to correct standard errors for autocorrelation, meaning heteroskedasticity robust standard errors are appropriate when estimating equation 3.3. The estimates provided below are from letting Y equal to borrowing costs.

For this specification, the coefficients of interest are $\{\beta_{1,h}\}$ and $\{\beta_{2,h}\}$, which give the differential response of the borrowing costs for leaders at the zero lower bound ($FFR_{t-1} = 0$), and the rate at which this effect changes as rates rise, respectively. Figure 3.7 plots the impulse responses of borrowing costs to a negative shock in interest rates. As it shows, a decline in the interest rate due to monetary policy shocks leads to a lower interest rate of leaders relative to followers (right panel), and this effect becomes larger as the level of the initial interest rate is lower (right panel). The effect of lower interest rates is persistent; it does not revert for the 10 years after the initial shock.



The left panel plots estimates of $\beta_{1,h}$, while the right panel plots estimates of $\beta_{2,h}$, estimated from the local projection $r_{i,j,t+h} = \alpha_i + \alpha_{j,t} + \beta_{1,h}\epsilon_t^{HF} * D_{i,j,t-1} + \beta_{2,h}\epsilon_t^{HF} * D_{i,j,t-1} * FFR_{t-1} + \delta_h^1 D_{i,j,t-1} + \sum_{\ell=1}^{3} \Gamma_h' \boldsymbol{W}_{i,t-\ell} + \epsilon_{i,t+h}$ where r denotes the average interest rate of firm i and $\boldsymbol{W}_{i,t} = \{r_{i,j,t}, D_{i,j,t}, D_{i,j,t}\epsilon_t^{HF}, D_{i,j,t}\epsilon_t^{HF} FFR_{t-1}\}$ is a vector of all variables in the system. The shading indicating 90% and 95% confidence intervals.

Figure 3.7: Response of borrowing cost to interest rate shock

To estimate the medium run response of monetary policy shocks on borrowing costs, we take the four quarter average between $t+5$ and $t+8$ as $\bar{Y}_{i,j,t+6} = \frac{1}{4}\sum_{\ell=-1}^{2} Y_{i,j,t+6+\ell}$, which gives the average change one year ahead for these years. We

then use this long run value in the LP estimation equation 3.3 to estimate medium run changes. Columns 1 and 2 of Table 3.6 report the estimated coefficients from the regression using borrowing costs as the left hand side variable. The estimate implies that when the Federal Funds rate is 2%, a 10 basis point decline in the Federal Funds rate (roughly one standard deviation) leads to a 15 basis point relative decline in the cost of borrowing of an industry leader relative to a follower. This effect is amplified to 24 basis points when the economy is very close to the zero lower bound.

	Borrowing cost		Debt		Leverage		Shares	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Top 5 Percent=1 x ϵ^{HF}	2.177***	2.277***	-0.697***	-0.852***	-0.145***	-0.151***	0.232***	0.201***
	(0.575)	(0.580)	(0.175)	(0.175)	(0.024)	(0.024)	(0.076)	(0.072)
Top 5 Percent=1 x ϵ^{HF} x FFR_{t-1}	-0.303**	-0.323***	0.125***	0.149***	0.0282***	0.0292***	-0.0452**	-0.0364**
	(0.124)	(0.124)	(0.041)	(0.041)	(0.006)	(0.006)	(0.018)	(0.018)
Controls	N	Y	N	Y	N	Y	N	Y
Industry-Date & firm FE	Y	Y	Y	Y	Y	Y	Y	Y
N	133,364	130,914	181,494	177,196	230,019	222,611	246,125	234,418
R-sq	0.779	0.779	0.943	0.939	0.883	0.876	0.982	0.984

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Regression results for the lag augmented local projection specification $\bar{Y}_{i,j,t+6} = \alpha_{j,t} + \alpha_i + \beta_0 D_{i,j,t} + \beta_1 D_{i,j,t} \Delta i_t + \beta_2 D_{i,j,t} i_{t-1} + \beta_3 D_{i,j,t} \epsilon_t^{HF} FFR_{t-1} + X_{i,j,t}\gamma + \sum_{\ell=1}^{3} \boldsymbol{\delta}_\ell \boldsymbol{\omega}_{j,t-\ell} + \varepsilon_{i,j,t}$ for firm i in industry j at date t. $\bar{Y}_{i,j,t+6} = \frac{1}{4}\sum_{\ell=-1}^{2} X_{i,j,t+6+\ell}$ is defined here as the four quarter average of variable X from period $t+5$ to $t+7$. We let Y be firm's debt, shares outstanding (log after average), borrowing costs and leverage. $D_{i,j,t}$ is defined here as an indicator equal to 1 at date t when a firm i is in the top 5% of market capitalization in its industry j on date $t-1$. Firms with $D_{i,j,t}$=1 are called leaders while the rest are called followers. i_t is defined as the nominal 10-year Treasury yield, with FFR_{t-1} being the federal funds target rate at the end of the previous quarter and ϵ_t^{HF} being the sum of high frequency shocks between time $t-1$ and t. Industry classifications are the Fama-French industry classifications (FF). The vector $\boldsymbol{\omega_{j,t}} = \{Y_{i,j,t}, D_{i,j,t}, D_{i,j,t}\epsilon_t^{HF}, D_{i,j,t}\epsilon_t^{HF} FFR_{t-1}, Z_{i,j,t}\}$ contains lagged values of all variables in the system. Controls Z include a total assets, real sales growth and the net current assets ratio of firm. Real rates were built using monthly 10-year inflation expectations from the Cleveland Fed and the federal funds target rate at the end of each quarter (post-1982). Lag augmentation implies heteroskedasticity-robust standard errors are sufficient, according to Olea and Plagborg-Møller (2020).

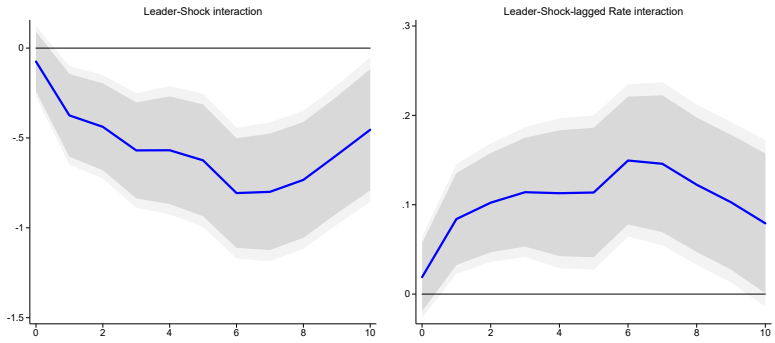
Table 3.6: Differential long run responses to Monetary Policy shocks - Financial Variables

In standard asset pricing models, the rise in the spread between industry leaders and industry followers would be compensation for additional risk. If industry followers become riskier relative to industry leaders when there is a decline in aggregate measures of interest rates, then this effect boosts the value of industry leaders relative to industry followers, and it therefore should be included as part of the advantage lower interest rates give to industry followers. There is a broader question of why lower

interest rates boost the riskiness of followers relative to leaders; this is an interesting question for future research.

3.4.2 Capital Structure Adjustments

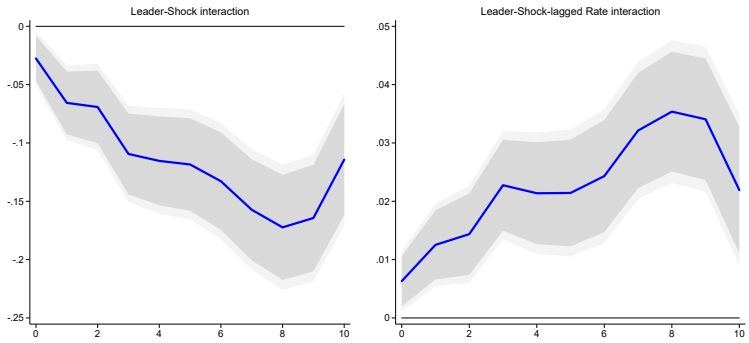
Industry leaders take advantage of the lower cost of debt financing, a fact shown in Figures 3.8 and 3.9. These figures plot $\{\beta_{1,h}\}$and$\{\beta_{2,h}\}$ from the estimation of equation 3.3 with the natural logarithm of debt as the left hand side variable in Figure 3.8 and the book total liabilities to total assets ratio in Figure 3.9. Both figures show a large and persistent effect of lower interest rates coming from monetary policy shocks on the capital structure of industry leaders relative to industry followers. Industry leaders raise debt financing in response to expansionary monetary policy shocks more than industry followers, and this effect snowballs as the level of the initial interest rate is lower. Ultimately, this has a persistent effect on the leverage ratio of leaders relative to followers.



The left panel plots estimates of $\beta_{1,h}$, while the right panel plots estimates of $\beta_{2,h}$, estimated from the local projection $debt_{i,j,t+h} = \alpha_i + \alpha_{j,t} + \beta_{1,h}\epsilon_t^{HF} * D_{i,j,t-1} + \beta_{2,h}\epsilon_t^{HF} * D_{i,j,t-1} * FFR_{t-1} + \delta_h^1 D_{i,j,t-1} + \sum_{\ell=1}^{3} \Gamma_h' \boldsymbol{W}_{i,t-\ell} + \epsilon_{i,t+h}$ where debt denotes the log of the total debt of firm i and $\boldsymbol{W}_{i,t} = \{debt_{i,j,t}, D_{i,j,t}, D_{i,j,t}\epsilon_t^{HF}, D_{i,j,t}\epsilon_t^{HF} FFR_{t-1}\}$ is a vector of all variables in the system. The shading indicating 90% and 95% confidence intervals.

Figure 3.8: Response of debt to interest rate shock

Columns 3 through 6 of Table 3.6 help to quantify this effect. When the economy is very close to the zero lower bound, a 10 basis point decline in the Federal Funds

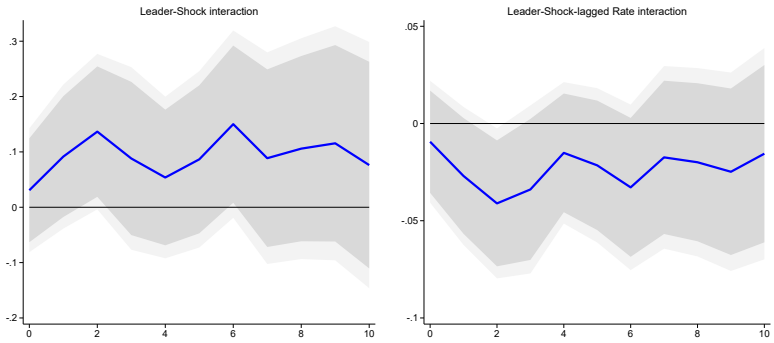


The left panel plots estimates of $\beta_{1,h}$, while the right panel plots estimates of $\beta_{2,h}$, estimated from the local projection $lev_{i,j,t+h} = \alpha_i + \alpha_{j,t} + \beta_{1,h}\epsilon_t^{HF} * D_{i,j,t-1} + \beta_{2,h}\epsilon_t^{HF} * D_{i,j,t-1} * FFR_{t-1} + \delta_h^1 D_{i,j,t-1} + \sum_{\ell=1}^{3} \Gamma_h' \boldsymbol{W}_{i,t-\ell} + \epsilon_{i,t+h}$ where assets denotes the log of total assets held by firm i and $\boldsymbol{W}_{i,t} = \{lev_{i,j,t}, D_{i,j,t}, D_{i,j,t}\epsilon_t^{HF}, D_{i,j,t}\epsilon_t^{HF} FFR_{t-1}\}$ is a vector of all variables in the system. The shading indicating 90% and 95% confidence intervals.

Figure 3.9: Response of leverage = liabilities/assets to interest rate shock

rate leads to a 5.2% relative increase in debt issued and a 1 percentage point relative increase in the book leverage ratio.

What do industry leaders use with the additional debt financing they raise in response to expansionary monetary policy shocks? This is a critical question given the tendency over time for companies to buy back shares using debt financing (e.g., Yardeni et al. (2019)), and results from the literature that suggest that some firms use a lower cost of debt financing to buy back shares instead of boosting investment (e.g., Aramonte (2020)). Figure 3.10 shows evidence that at least some of the rise in debt financing is associated with share buybacks. More specifically, Figure 3.10 plots $\{\beta_{1,h}\}$and$\{\beta_{2,h}\}$ from the estimation of equation 3.3 using the natural logarithm of common shares outstanding from Compustat as the left hand side variable. Expansionary monetary policy reduces the number of shares outstanding for leaders relative to followers, and this effect gets stronger for expansionary monetary policy shocks when initial interest rates are already low. Columns 7 and 8 present the regression coefficients for common shares outstanding, which confirm the patterns in the figure.



The left panel plots estimates of $\beta_{1,h}$, while the right panel plots estimates of $\beta_{2,h}$, estimated from the local projection $shares_{i,j,t+h} = \alpha_i + \alpha_{j,t} + \beta_{1,h}\epsilon_t^{HF} * D_{i,j,t-1} + \beta_{2,h}\epsilon_t^{HF} * D_{i,j,t-1} * FFR_{t-1} + \delta_h^1 D_{i,j,t-1} + \sum_{\ell=1}^{3} \Gamma_h' \boldsymbol{W}_{i,t-\ell} + \epsilon_{i,t+h}$ where shares denotes the log of common shares of firm i outstanding and $\boldsymbol{W}_{i,t} = \{shares_{i,j,t}, D_{i,j,t}, D_{i,j,t}\epsilon_t^{HF}, D_{i,j,t}\epsilon_t^{HF} FFR_{t-1}, MV_{i,j,t}\}$ is a vector of all variables in the system. The shading indicating 90% and 95% confidence intervals.

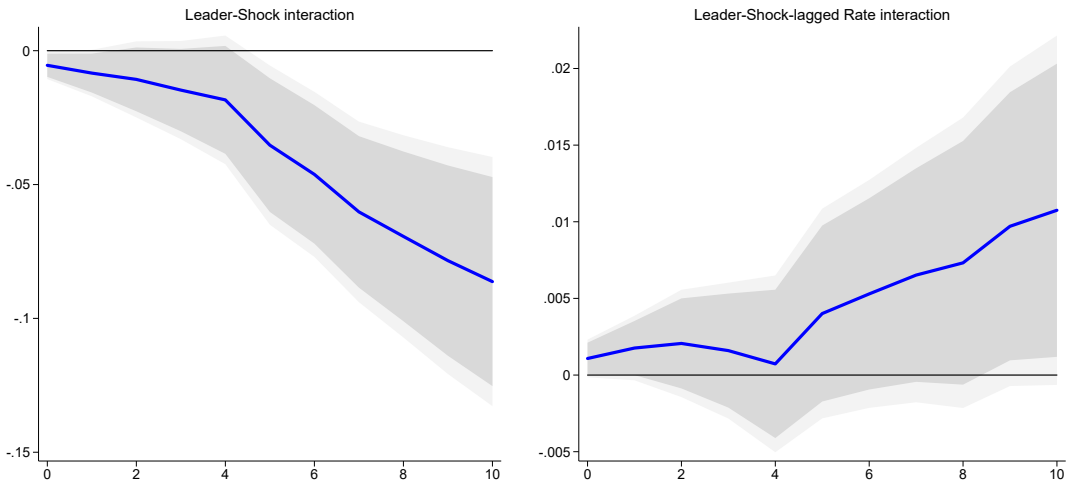
Figure 3.10: Response of log of common shares outstanding to interest rate shock

3.5 Real Effects of Lower Interest Rates

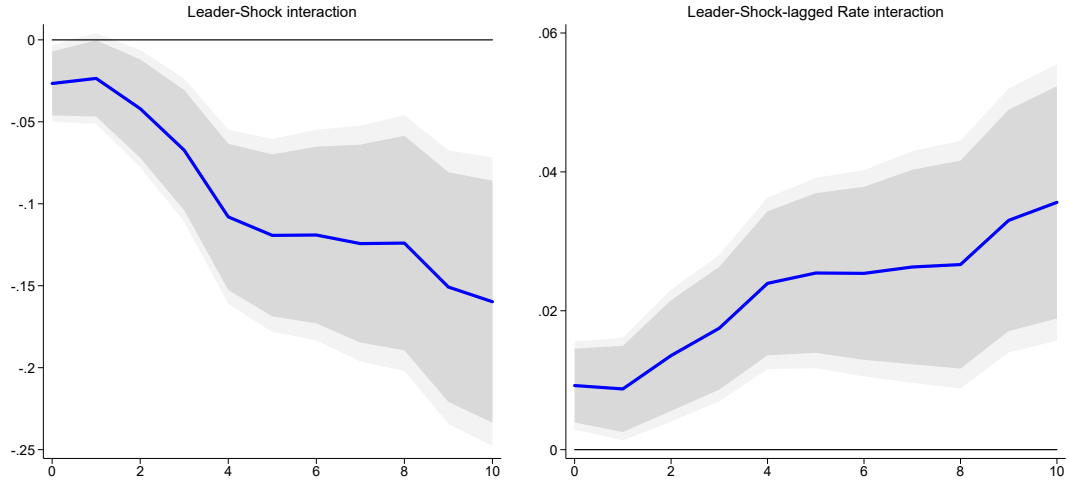
Expansionary monetary policy shocks have large effects on the financial policy of leaders versus followers, and these effects snowball at lower levels of the initial interest rate. This section explores the real effects of expansionary monetary policy shocks.

Figures 3.11a and 3.11b show the estimates of equation (3.3) letting Y equal to cumulative capital expenditures and cash acquisitions respectively. The results show that in response to an expansionary monetary policy shock which sends interest rates lower, industry leaders boost capital expenditures and cash acquisitions by more than industry followers. Furthermore, this stronger effect gets even stronger if the initial interest rate is lower. Therefore, the snowballing effect applies to real effects.

Table 3.7 shows these results in a regression format. For capital expenditure and cash acquisition specification, the left hand side variable is the sum of the quarterly flows from $t-1$ to $t+5$ scaled by assets as of $t-1$. As the results show, industry leaders boost capital expenditures and cash acquisitions by substantially more than followers when interest rates fall. When the economy is near the zero lower bound, a 10 basis point decline in the Federal Funds rate leads to a 0.4 percentage point rise



(a) Capital Investment



(b) Acquisitions

The left panels plots estimates of $\beta_{1,h}$, while the right panel plots estimates of $\beta_{2,h}$, estimated from the local projection $Y_{i,j,t+h} = \alpha_i + \alpha_{j,t} + \beta_{1,h}\epsilon_t^{HF} * D_{i,j,t-1} + \beta_{2,h}\epsilon_t^{HF} * D_{i,j,t-1} * FFR_{t-1} + \delta_h^1 D_{i,j,t-1} + \sum_{\ell=1}^{3} \Gamma_h' \boldsymbol{W}_{i,t-\ell} + \epsilon_{i,t+h}$ where $Y_{i,j,t+h} = \frac{\sum_{k=0}^{h} C_{i,j,t+k}}{assets_{i,j,t-1}}$ and C denotes firm i's net acquisitions or capital investment cash flows while $\boldsymbol{W}_{i,t} = \{Y_{i,j,t}, D_{i,j,t}, D_{i,j,t}\epsilon_t^{HF}, D_{i,j,t}\epsilon_t^{HF} FFR_{t-1}\}$ is a vector of all variables in the system. The shading indicating 90% and 95% confidence intervals.

Figure 3.11: Capital Expenditures and Acquisitions

in capital expenditures and a 1.0 percentage point rise in cash acquisitions relative to total assets. The snowballing effect is also present, but the result is statistically weaker for capital expenditures when including control variables. Overall, a 10 basis

	Capital Exp		Acquisitions		PPE	
	(1)	(2)	(3)	(4)	(5)	(6)
Top 5 Percent=1 x ϵ^{HF}	-0.0257	-0.0124	-0.134***	-0.120***	-0.265***	-0.273***
	(0.020)	(0.020)	(0.034)	(0.034)	(0.085)	(0.086)
Top 5 Percent=1 x ϵ^{HF} x FFR_{t-1}	0.00200	-0.000635	0.0298***	0.0277***	0.0421**	0.0437**
	(0.004)	(0.004)	(0.008)	(0.008)	(0.020)	(0.020)
Controls	N	Y	N	Y	N	Y
Industry-Date & firm FE	Y	Y	Y	Y	Y	Y
N	260,091	247,613	243,338	231,143	245,455	234,790
R-sq	0.753	0.788	0.268	0.328	0.989	0.989

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Regression results for the lag augmented local projection specification $\bar{Y}_{i,j,t} = \alpha_{j,t} + \alpha_i + \beta_0 D_{i,j,t} + \beta_1 D_{i,j,t} \Delta i_t + \beta_2 D_{i,j,t} i_{t-1} + \beta_3 D_{i,j,t} \epsilon_t^{HF} FFR_{t-1} + X_{i,j,t}\gamma + \sum_{\ell=1}^{3} \boldsymbol{\delta}_\ell \boldsymbol{\omega}_{j,t-\ell} + \varepsilon_{i,j,t}$ for firm i in industry j at date t. We let Y be the firm's capital investment and acquisitions cash flow and property, plant and equipment. When y is a cash flow, we have $\bar{Y}_{i,j,t} = \frac{\sum_{k=0}^{5} C_{i,j,t+k}}{assets_{i,j,t-1}}$ is defined here as the sum of cash flows between $t-1$ and $t+5$, scaled by initial total assets in $t-1$. When the dependent variable of interest $Y = \log(PPE)$ is property, plant and equipment, the left hand side variable is given by $\bar{Y}_{i,j,t} = \log\left(\frac{1}{4}\sum_{\ell=-1}^{2} PPE_{i,j,t+6+\ell}\right)$. $D_{i,j,t}$ is defined here as an indicator equal to 1 at date t when a firm i is in the top 5% of market capitalization in its industry j on date $t-1$. Firms with $D_{i,j,t}$=1 are called leaders while the rest are called followers. i_t is defined as the nominal 10-year Treasury yield, with FFR_{t-1} being the federal funds target rate at the end of the previous quarter and ϵ_t^{HF} being the sum of high frequency shocks between time $t-1$ and t. Industry classifications are the Fama-French industry classifications (FF). The vector $\boldsymbol{\omega_{j,t}} = \{Y_{i,j,t}, D_{i,j,t}, D_{i,j,t}\epsilon_t^{HF}, D_{i,j,t}\epsilon_t^{HF} FFR_{t-1}, Z_{i,j,t}\}$ contains lagged values of all variables in the system. Controls Z include a total assets, real sales growth and the net current assets ratio of firm. Real rates were built using monthly 10-year inflation expectations from the Cleveland Fed and the federal funds target rate at the end of each quarter (post-1982). Lag augmentation implies heteroskedasticity-robust standard errors are sufficient, according to Olea and Plagborg-Møller (2020).

Table 3.7: Differential long run responses to Monetary Policy shocks - Real variables

point decline in the Federal Funds rate near the zero lower bound is associated with a 2 percent rise in PPE for industry leaders relative to industry followers.

Overall, the results on real effects show that industry leaders invest or acquire capital assets in response to a decline in interest rates more strongly than industry followers, and that this effect becomes stronger when initial interest rates are lower. This result hints at the importance of declining interest rates in explaining product market competition: the big get bigger when interest rates decline, especially as they decline toward zero. These findings also support the model proposed by Chatterjee and Eyigungor (2020), who argue that a lower risk-free rate benefits bigger firms

because they can increase leverage by more than smaller firms, and therefore acquire more of the new product varieties arriving into the economy.

3.6 Conclusion

Using CRSP-Compustat merged data from 1962 onwards, we find that falling interest rates boost the relative valuation of industry leaders relative to industry followers, and the relative valuation effect becomes largest as the initial interest rate approaches zero. This result is robust to the use of high frequency monetary policy shocks as a source of variation in economy-wide interest rates. A decline in the interest rate disproportionately lowers the cost of borrowing of industry leaders, who take advantage of the lower cost of borrowing to raise additional debt financing, increase leverage, repurchase shares, boost capital investment, and conduct acquisitions. All of these effects snowball as the level of the interest rate decline; that is, a decline in interest rates has a stronger effect on all of these outcomes of leaders relative to followers when the initial level of the interest rate is already low. The findings provide empirical support to the idea that extremely low interest rates may be a culprit in explaining the rise of superstar firms in the U.S. economy.

Appendix A

Additional Material for Chapter 1

A.1 Firm Data Construction

All data is accessed through WRDS. Data cleaning for Compustat follows standard practice in the investment-macro literature (for example: Ottonello and Winberry (2020)) From the raw Compustat data, I exclude the financial sector (SIC: 6000-6999) and the heavily regulated utilities sector (SIC: 4900 - 4999). Firms incorporated outside the US are excluded as well as those with negative sales, negative total assets or negative employment. Furthermore, I exclude firms with acquisitions exceeding five percent of total assets. I also require firms to be present in the sample both in the pre-reform period (prior to 1982) and in the post-reform period (after 1982). Data is winsorized at the 2-98 percent level. To deflate nominal quantities, I use implicit price deflators from the Bureau of Economic Analysis (`https://apps.bea.gov/iTable/iTable.cfm?reqid=19&step=2#reqid=19&step=2&isuri=1&1921=survey`).

Further data is being sourced from CRSP and Thomson-Reuters s-34 files. CRSP and the TR holdings data are being merged at the CUSIP-year-month level. Finally, in some cases, total holdings by one institutional manager exceed total shares outstanding for that firm (221 observations). Consistent with prior literature such as

Ben-David et al. (2019), I drop observations where holdings of one institutional manager in a particular firm exceed 50 %. This drops a total of 1,397 observations out of 5.8 million. Ultimately, the CRSP data is used to update shares outstanding relative ot the Thomson-Reuters data. Then, we compute holding shares at the manager level. I remove observations where total holdings across all managers exceed a share of 100 % (.2 % of all observations, 13,562 manager-quarters).

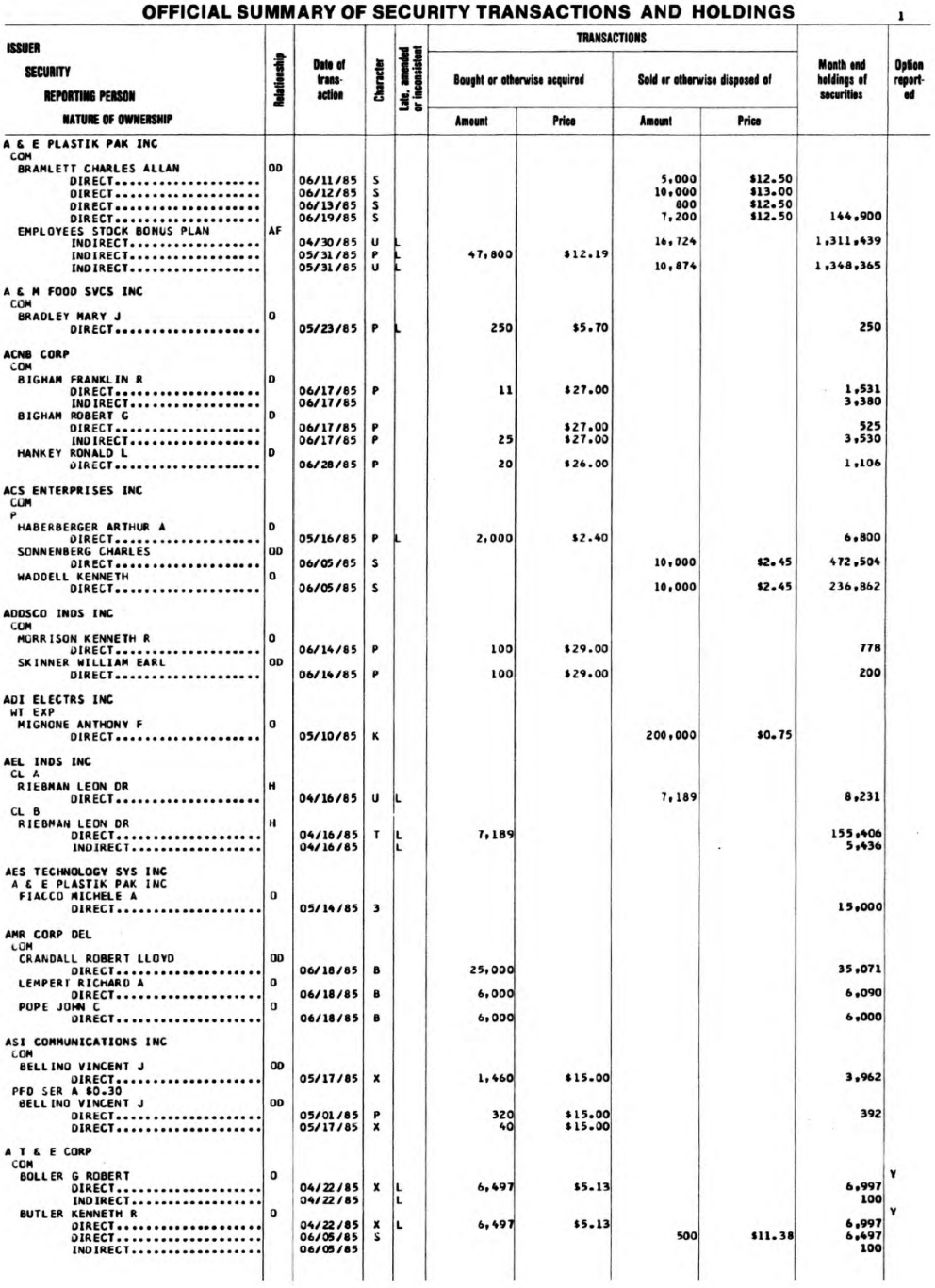
A.2 Insider Trading Data Construction

The first component of insider trading data for the 1978-1985 period consists of newly digitized data from the SEC's Summary of Security Transactions and Holdings. The data contains all corporate insider transactions for US public companies featuring company name, insider name, insider role, share type, transaction data, sale-purchase indicator, transaction amount and price as well as end-of-month shareholdings for each insider. Figure A.2.1 provides an example for a scanned page from the source data. For each year, there are around 1000 such pages with raw data.

I convert the data to Excel using OCR software (ABBYY Fine Reader). Next, I eliminate duplicate records and records with scanning mistakes (transaction amount or price incorrectly read). Mistakes in reading numbers, "O" instead of "0" for example, are corrected as well. Overall, I retain 88.5% of the original records.[1]

In the final step, I merge the insider trading data to Compustat using company names (Compustat variable comnam) and STATA's matchit algorithm. I keep matches with a similarity score above the 25th percentile, which keeps type-I matching errors close to zero and therefore reduces statistical noise in the estimation step. The final dataset features 2103 unique non-financial, non-utility firms.

[1] 971,058 separate transactions out of 1,097,401



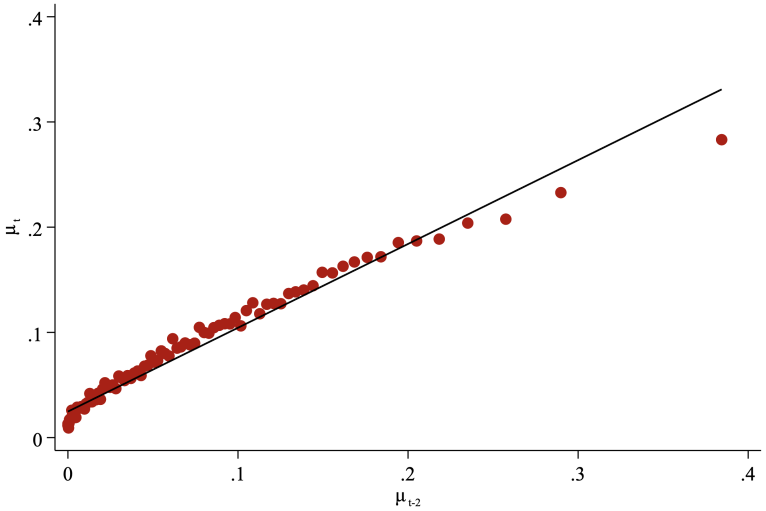
OFFICIAL SUMMARY OF SECURITY TRANSACTIONS AND HOLDINGS 1

ISSUER / SECURITY / REPORTING PERSON / NATURE OF OWNERSHIP	Relationship	Date of transaction	Character	Late, amended or inconsistent	TRANSACTIONS: Bought or otherwise acquired — Amount	Bought or otherwise acquired — Price	Sold or otherwise disposed of — Amount	Sold or otherwise disposed of — Price	Month end holdings of securities	Option reported
A & E PLASTIK PAK INC										
COM										
BRAMLETT CHARLES ALLAN	OD									
DIRECT		06/11/85	S				5,000	$12.50		
DIRECT		06/12/85	S				10,000	$13.00		
DIRECT		06/13/85	S				800	$12.50		
DIRECT		06/19/85	S				7,200	$12.50	144,900	
EMPLOYEES STOCK BONUS PLAN	AF									
INDIRECT		04/30/85	U	L			16,724		1,311,439	
INDIRECT		05/31/85	P	L	47,800	$12.19				
INDIRECT		05/31/85	U	L			10,874		1,348,365	
A & M FOOD SVCS INC										
COM										
BRADLEY MARY J	O									
DIRECT		05/23/85	P	L	250	$5.70			250	
ACNB CORP										
COM										
BIGHAM FRANKLIN R	D									
DIRECT		06/17/85	P		11	$27.00			1,531	
INDIRECT		06/17/85							3,380	
BIGHAM ROBERT G	D									
DIRECT		06/17/85	P			$27.00			525	
INDIRECT		06/17/85	P		25	$27.00			3,530	
HANKEY RONALD L	D									
DIRECT		06/28/85	P		20	$26.00			1,106	
ACS ENTERPRISES INC										
COM										
P										
HABERBERGER ARTHUR A	D									
DIRECT		05/16/85	P	L	2,000	$2.40			6,800	
SONNENBERG CHARLES	OD									
DIRECT		06/05/85	S				10,000	$2.45	472,504	
WADDELL KENNETH	O									
DIRECT		06/05/85	S				10,000	$2.45	236,862	
ADDSCO INDS INC										
COM										
MORRISON KENNETH R	O									
DIRECT		06/14/85	P		100	$29.00			778	
SKINNER WILLIAM EARL	OD									
DIRECT		06/14/85	P		100	$29.00			200	
ADI ELECTRS INC										
WT EXP										
MIGNONE ANTHONY F	O									
DIRECT		05/10/85	K				200,000	$0.75		
AEL INDS INC										
CL A										
RIEBMAN LEON DR	H									
DIRECT		04/16/85	U	L			7,189		8,231	
CL B										
RIEBMAN LEON DR	H									
DIRECT		04/16/85	T	L	7,189				155,406	
INDIRECT		04/16/85		L					5,436	
AES TECHNOLOGY SYS INC										
A & E PLASTIK PAK INC										
FIACCO MICHELE A	O									
DIRECT		05/14/85	3						15,000	
AMR CORP DEL										
COM										
CRANDALL ROBERT LLOYD	OD									
DIRECT		06/18/85	B		25,000				35,071	
LEMPERT RICHARD A	O									
DIRECT		06/18/85	B		6,000				6,090	
POPE JOHN C	O									
DIRECT		06/18/85	B		6,000				6,000	
ASI COMMUNICATIONS INC										
COM										
BELLINO VINCENT J	OD									
DIRECT		05/17/85	X		1,460	$15.00			3,962	
PFD SER A $0.30										
BELLINO VINCENT J	OD									
DIRECT		05/01/85	P		320	$15.00			392	
DIRECT		05/17/85	X		40	$15.00				
A T & E CORP										
COM										
BOLLER G ROBERT	O									Y
DIRECT		04/22/85	X	L	6,497	$5.13			6,997	
INDIRECT		04/22/85		L					100	
BUTLER KENNETH R	O									Y
DIRECT		04/22/85	X	L	6,497	$5.13			6,997	
DIRECT		06/05/85	S				500	$11.38	6,497	
INDIRECT		06/05/85							100	

Figure A.2.1: Example for scanned insider trading data from 1985

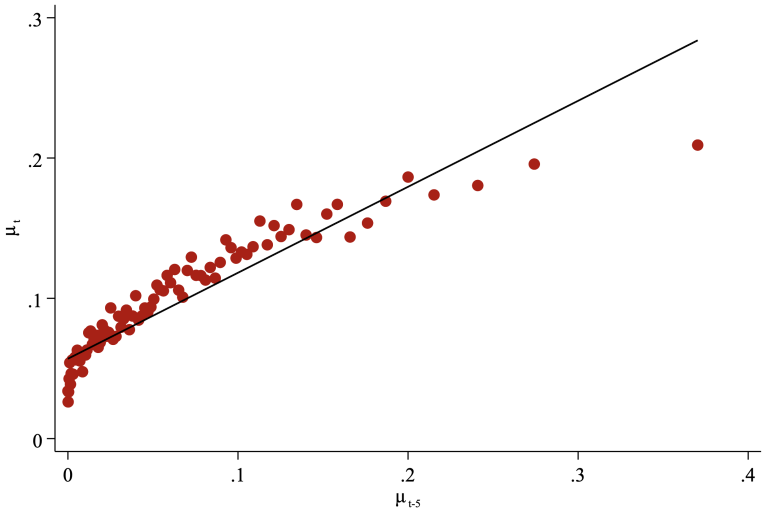
A.3 Supplementary Results and Robustness Checks

A.3.1 Autocorrelations



Binned scatter plot of contemporaneous μ and its second lag. The number of bins is 100.
Time frequency is yearly. μ is defined as the share of short-termist firm owners.

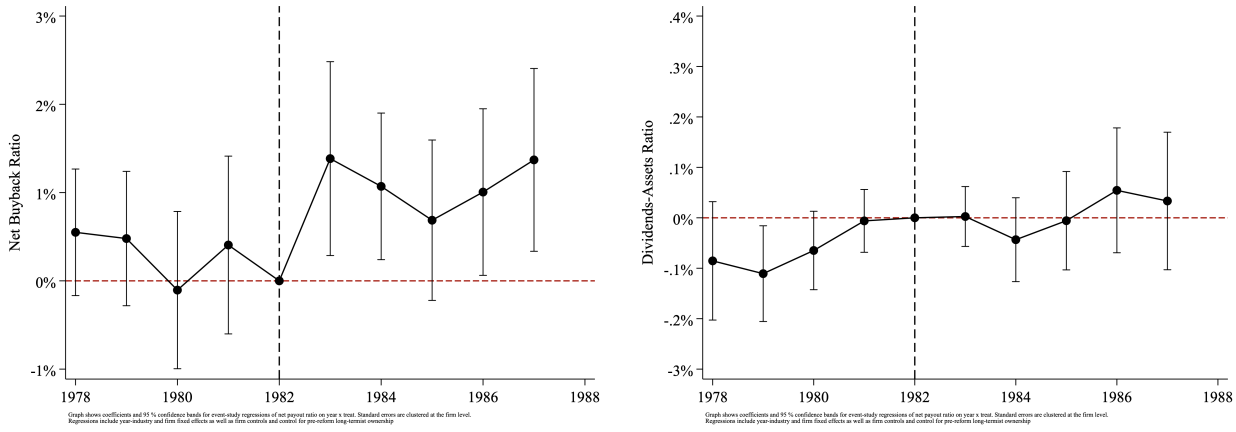
Figure A.3.1: Second lag autocorrelation of μ



Binned scatter plot of contemporaneous μ and its fourth lag. The number of bins is 100.
Time frequency is yearly. μ is defined as the share of short-termist firm owners.

Figure A.3.2: Fifth lag autocorrelation of μ

A.3.2 Composition of Payout Response



(a) Net Buyback Ratio

(b) Dividends Assets Ratio

Figure A.3.3: Composition of Net Payout Response

A.3.3 Robustness checks for different investor definitions

4 Quarters

	$\frac{NetBuybacks}{Assets}$	$\frac{Dividends}{Assets}$	$\frac{NetPayouts}{Assets}$	$\frac{NetBuybacks}{Assets}$	$\frac{Dividends}{Assets}$	$\frac{NetPayouts}{Assets}$
Post	-0.07	-0.08***	-0.14			
	(0.15)	(0.02)	(0.15)			
Treated x Post	11.04***	1.10	12.14***	9.07**	1.01	10.08**
	(3.70)	(0.77)	(3.85)	(4.12)	(0.91)	(4.28)
LT share x Post	0.59	-0.38***	0.22	1.18	-0.37**	0.81
	(0.62)	(0.15)	(0.65)	(0.77)	(0.16)	(0.80)
N	16596	16596	16596	16593	16593	16593
R^2	.322	.872	.392	.448	.898	.505
Firm FE	x	x	x	x	x	x
Year-industry FE				x	x	x
Firm Controls	x	x	x	x	x	x

This table shows how payouts evolve after buyback liberalization in Nov 1982, controlling for lagged size and RoA. Treatment is defined continuously as the pre-reform share of short-termist institutional ownership. The post-period covers 1983-87. The pre-period covers 1978-82. All regressions include firm and year-industry fixed effects. Standard errors are clustered at the firm level. $***p < .01, **p < .05, *p < .1$

Table A.3.1: Payout Results: 4 Quarter Investor Cutoff

	$\frac{GrossInv}{Assets}$	$\frac{GrossInv}{Assets}$	$\frac{GrossInv}{Assets}$	$\frac{NetInv}{Assets}$	$\frac{NetInv}{Assets}$	$\frac{NetInv}{Assets}$
Treated x Post	-7.93*	-7.24*	-10.18***	-6.23	-8.27*	-10.17**
	(4.44)	(3.97)	(3.78)	(5.06)	(4.97)	(4.99)
LT share x Post	-1.95**	-1.37**	-1.44**	-2.95***	-2.48***	-2.17**
	(0.76)	(0.69)	(0.73)	(0.92)	(0.89)	(0.95)
N	16031	16028	16026	16031	16028	16026
R^2	.414	.618	.708	.318	.369	.52
Firm Controls	x	x	x	x	x	x
Firm FE		x	x		x	x
Year-industry FE	x		x	x		x

This table shows how investment evolves after buyback liberalization in Nov 1982. Treatment is defined continuously as the pre-reform share of short-termist ownership. The post-period covers 1983-87. The pre-period is 1978-1982. Standard errors are clustered at the firm level. Firm controls are lagged size and RoE. $***p < .01, **p < .05, *p < .1$

Table A.3.2: Investment Results: 4 Quarter Investor Cutoff

5 Quarters

	$\frac{NetBuybacks}{Assets}$	$\frac{Dividends}{Assets}$	$\frac{NetPayouts}{Assets}$	$\frac{NetBuybacks}{Assets}$	$\frac{Dividends}{Assets}$	$\frac{NetPayouts}{Assets}$
Post	-0.09	-0.08***	-0.18			
	(0.15)	(0.02)	(0.15)			
Treated x Post	9.39***	1.27**	10.67***	6.80**	0.91	7.71**
	(2.91)	(0.52)	(3.00)	(3.22)	(0.60)	(3.32)
LT share x Post	0.10	-0.46***	-0.36	0.89	-0.41**	0.49
	(0.67)	(0.15)	(0.71)	(0.81)	(0.17)	(0.84)
N	16622	16622	16622	16619	16619	16619
R^2	.322	.872	.393	.447	.898	.504
Firm FE	x	x	x	x	x	x
Year-industry FE				x	x	x
Firm Controls	x	x	x	x	x	x

This table shows how payouts evolve after buyback liberalization in Nov 1982, controlling for lagged size and RoA. Treatment is defined continuously as the pre-reform share of short-termist institutional ownership. The post-period covers 1983-87. The pre-period covers 1978-82. All regressions include firm and year-industry fixed effects. Standard errors are clustered at the firm level. $***p < .01, **p < .05, *p < .1$

Table A.3.3: Payout Results: 5 Quarter Investor Cutoff

	$\frac{GrossInv}{Assets}$	$\frac{GrossInv}{Assets}$	$\frac{GrossInv}{Assets}$	$\frac{NetInv}{Assets}$	$\frac{NetInv}{Assets}$	$\frac{NetInv}{Assets}$
Treated x Post	-8.56***	-7.59**	-9.43***	-7.87**	-9.06**	-11.09***
	(3.15)	(3.15)	(3.04)	(3.89)	(4.09)	(4.03)
LT share x Post	-1.37*	-0.83	-0.89	-2.35**	-1.80*	-1.42
	(0.80)	(0.75)	(0.78)	(0.99)	(0.95)	(1.02)
N	16052	16049	16047	16052	16049	16047
R^2	.415	.62	.708	.318	.37	.52
Firm Controls	x	x	x	x	x	x
Firm FE		x	x		x	x
Year-industry FE	x		x	x		x

This table shows how investment evolves after buyback liberalization in Nov 1982. Treatment is defined continuously as the pre-reform share of short-termist ownership. The post-period covers 1983-87. The pre-period is 1978-1982. Standard errors are clustered at the firm level. Firm controls are lagged size and RoE. $***p < .01, **p < .05, *p < .1$

Table A.3.4: Investment Results: 5 Quarter Investor Cutoff

7 Quarters

	$\frac{NetBuybacks}{Assets}$	$\frac{Dividends}{Assets}$	$\frac{NetPayouts}{Assets}$	$\frac{NetBuybacks}{Assets}$	$\frac{Dividends}{Assets}$	$\frac{NetPayouts}{Assets}$
Post	-0.15	-0.10***	-0.25			
	(0.15)	(0.02)	(0.16)			
Treated x Post	7.19***	1.13***	8.32***	5.57***	1.07***	6.64***
	(1.73)	(0.29)	(1.78)	(1.87)	(0.33)	(1.91)
LT share x Post	-1.14	-0.69***	-1.83**	-0.11	-0.67***	-0.78
	(0.76)	(0.18)	(0.80)	(0.90)	(0.20)	(0.92)
N	16629	16629	16629	16626	16626	16626
R^2	.322	.873	.392	.447	.898	.504
Firm FE	x	x	x	x	x	x
Year-industry FE				x	x	x
Firm Controls	x	x	x	x	x	x

This table shows how payouts evolve after buyback liberalization in Nov 1982, controlling for lagged size and RoA. Treatment is defined continuously as the pre-reform share of short-termist institutional ownership. The post-period covers 1983-87. The pre-period covers 1978-82. All regressions include firm and year-industry fixed effects. Standard errors are clustered at the firm level. $***p < .01, **p < .05, *p < .1$

Table A.3.5: Payout Results: 7 Quarter Investor Cutoff

	$\frac{GrossInv}{Assets}$	$\frac{GrossInv}{Assets}$	$\frac{GrossInv}{Assets}$	$\frac{NetInv}{Assets}$	$\frac{NetInv}{Assets}$	$\frac{NetInv}{Assets}$
Treated x Post	-4.01**	-3.17*	-5.00***	-5.25**	-4.74**	-6.57***
	(1.75)	(1.75)	(1.74)	(2.19)	(2.23)	(2.26)
LT share x Post	-1.14	-0.79	-0.44	-1.58	-1.41	-0.60
	(0.91)	(0.87)	(0.90)	(1.13)	(1.09)	(1.16)
N	16060	16057	16055	16060	16057	16055
R^2	.415	.619	.708	.318	.369	.52
Firm Controls	x	x	x	x	x	x
Firm FE		x	x		x	x
Year-industry FE	x		x	x		x

This table shows how investment evolves after buyback liberalization in Nov 1982. Treatment is defined continuously as the pre-reform share of short-termist ownership. The post-period covers 1983-87. The pre-period is 1978-1982. Standard errors are clustered at the firm level. Firm controls are lagged size and RoE. $***p < .01, **p < .05, *p < .1$

Table A.3.6: Investment Results: 7 Quarter Investor Cutoff

8 Quarters

	$\frac{NetBuybacks}{Assets}$	$\frac{Dividends}{Assets}$	$\frac{NetPayouts}{Assets}$	$\frac{NetBuybacks}{Assets}$	$\frac{Dividends}{Assets}$	$\frac{NetPayouts}{Assets}$
Post	-0.14	-0.09***	-0.23			
	(0.15)	(0.02)	(0.15)			
Treated x Post	6.09***	0.74***	6.83***	4.78***	0.68**	5.47***
	(1.48)	(0.28)	(1.52)	(1.62)	(0.31)	(1.65)
LT share x Post	-1.85**	-0.72***	-2.57***	-0.79	-0.70***	-1.48
	(0.87)	(0.22)	(0.92)	(1.00)	(0.24)	(1.03)
N	16605	16605	16605	16602	16602	16602
R^2	.32	.872	.391	.446	.898	.503
Firm FE	x	x	x	x	x	x
Year-industry FE				x	x	x
Firm Controls	x	x	x	x	x	x

This table shows how payouts evolve after buyback liberalization in Nov 1982, controlling for lagged size and RoA. Treatment is defined continuously as the pre-reform share of short-termist institutional ownership. The post-period covers 1983-87. The pre-period covers 1978-82. All regressions include firm and year-industry fixed effects. Standard errors are clustered at the firm level. $***p < .01, **p < .05, *p < .1$

Table A.3.7: Payout Results: 8 Quarter Investor Cutoff

	$\frac{GrossInv}{Assets}$	$\frac{GrossInv}{Assets}$	$\frac{GrossInv}{Assets}$	$\frac{NetInv}{Assets}$	$\frac{NetInv}{Assets}$	$\frac{NetInv}{Assets}$
Treated x Post	-3.22**	-3.59**	-4.25***	-4.25**	-4.82**	-5.61***
	(1.57)	(1.55)	(1.55)	(1.93)	(1.95)	(1.97)
LT share x Post	-0.95	-0.17	-0.10	-1.45	-0.79	-0.27
	(1.02)	(1.00)	(1.03)	(1.25)	(1.23)	(1.29)
N	16047	16044	16042	16047	16044	16042
R^2	.414	.619	.708	.317	.369	.519
Firm Controls	x	x	x	x	x	x
Firm FE		x	x		x	x
Year-industry FE	x		x	x		x

This table shows how investment evolves after buyback liberalization in Nov 1982. Treatment is defined continuously as the pre-reform share of short-termist ownership. The post-period covers 1983-87. The pre-period is 1978-1982. Standard errors are clustered at the firm level. Firm controls are lagged size and RoE. $***p < .01, **p < .05, *p < .1$

Table A.3.8: Investment Results: 8 Quarter Investor Cutoff

A.4 Further Results

	Correlation
4 quarters	0.8054
5 quarters	0.9144
7 quarters	0.9294
8 quarters	0.8847
Turnover	0.7152
Mean	0.6376

4 quarters refers to using a median holding period of 4 quarters (rather than 6 in the baseline) to define short-termist owners. The same applies to the other measures involving quarters. Further measures are an institution's turnover ratio and the mean holding period.

Table A.4.1: Alternative constructions for μ

A.5 International Aggregate Evidence

In each of the following plots, the dark vertical dashed line indicates the year where the respective country liberalized share buybacks.

	$\frac{GrossInv}{Capital}$	$\frac{GrossInv}{Capital}$	$\frac{GrossInv}{Capital}$	$\frac{NetInv}{Capital}$	$\frac{NetInv}{Capital}$	$\frac{NetInv}{Capital}$
Treated x Post	-1.78***	-1.67***	-2.21***	-3.16***	-2.61***	-3.40***
	(0.60)	(0.56)	(0.57)	(0.82)	(0.84)	(0.89)
LT share x Post	-3.73**	-1.93	-1.32	-0.74	-0.54	-1.55
	(1.83)	(1.73)	(1.89)	(2.56)	(2.62)	(2.95)
N	14350	14346	14247	14350	14346	14247
R^2	.0286	.501	.619	.0877	.31	.473
Firm Controls	x	x	x	x	x	x
Firm FE		x	x		x	x
Year-industry FE			x			x

This table shows how investment, measured as gross or net investment normalized by the size of the capital stock, evolves after buyback liberalization in Nov 1982. Treatment is defined as being above the 75 percentile of short-termist ownership prior to the reform. The post-period covers 1983-87. The pre-period is 1978-1982. Standard errors are clustered at the firm level. Firm controls are lagged size and RoE. $***p < .01, **p < .05, *p < .1$

Table A.4.2: Investment-Capital Ratio

	78-81	78-81	83-87	83-87
Sale Flag				
μ_{t-1}	-0.8980***	-0.4980	1.1450***	1.5754***
	(0.3083)	(0.3689)	(0.1428)	(0.1697)
RoE		-1.4735***		-0.4459***
		(0.2167)		(0.0940)
Size		-0.0006		-0.0023***
		(0.0005)		(0.0003)
LT Inst. Holdings		-0.1642		0.0644
		(0.1751)		(0.0978)
Constant	-0.2121***	-0.0841**	-0.0164	-0.0260
	(0.0259)	(0.0351)	(0.0170)	(0.0222)
N	11675	11147	32845	30575
Pseudo R2	5.3e-04	.0046	.0014	.0043

Logit Regression results for predicting insider sales. Standard errors are Huber-White heteroskedasticity robust. $***p < .01, **p < .05, *p < .1$

Table A.4.3: Logit Estimates

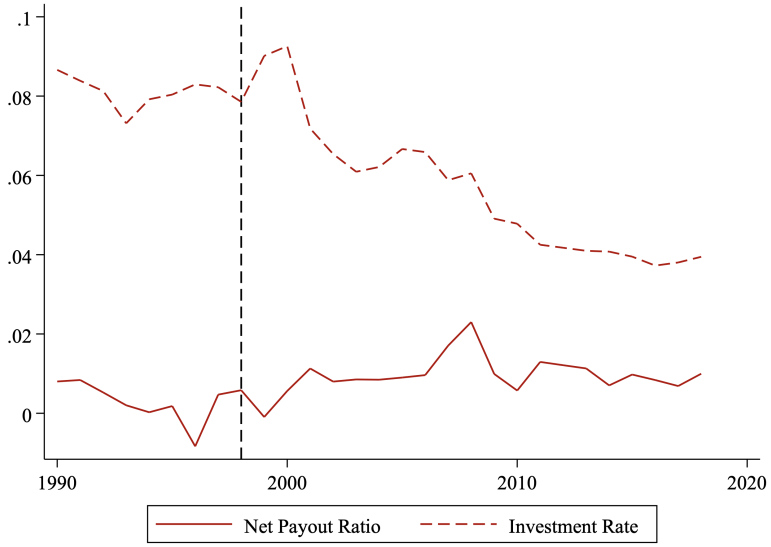


Figure A.5.1: Aggregate Trends: Germany



Figure A.5.2: Aggregate Trends: France

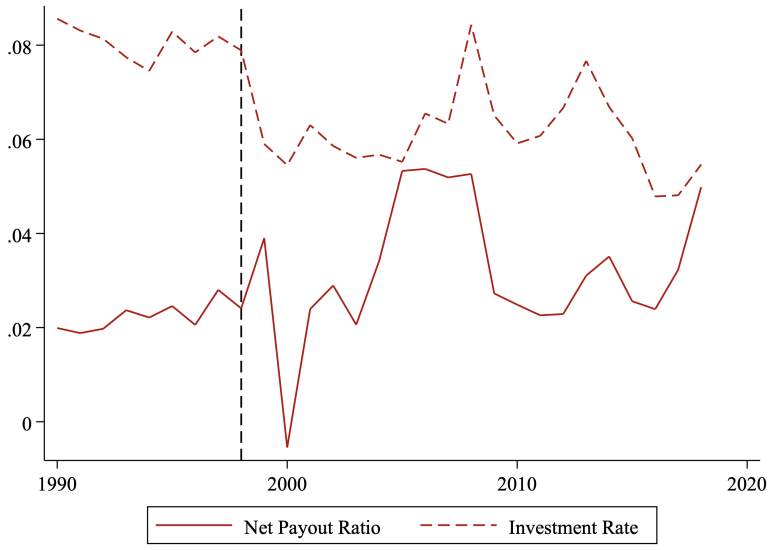


Figure A.5.3: Aggregate Trends: Netherlands

Appendix B

Additional Material for Chapter 2

B.1 Data Sources and Construction

B.1.1 CRSP

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

B.1.2 TAQ

I use the trades repository of TAQ, which captures every single trade at the security level for the major American stock exchanges with a millisecond timestamp. I drop preferred stock, warrants, convertibles and callable bonds. As noted in the prior literature (see for example Brownlees and Gallo (2006)), this ultra-high frequency data contains trades reported with errors. To correct for those, I proceed in two steps. First, I drop all trades that have been corrected later (variable TR_CORR $\neq$ 00). Second, I drop observations that deviate by more than 2.5 % from either the previous or the next trade. On June 25 2020 for the 4.00 - 6.00 Eastern time

window, for example, this drops 7,372 observations out of 439,977. All these data cleaning steps are performed at the millisecond time frequency. I then collapse trades by minute, taking the average across all reported quotes so there are at most 120 observations per firm over a 2-hour time window and normalizing the price to one in the first minute for ease of comparison.

B.1.3 Compustat Global Security Daily

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

For Europe, I identify all banks directly subject to ECB supervision from the ECB's list of supervised entities from March 01, 2020: `https://www.bankingsupervision.europa.eu/ecb/pub/pdf/ssm.listofsupervisedentities202004.en.pdf?4c3154a498837f7e7ccf8324ad6f7041`. I then check which of these institutions are publicly listed. This is critical as more than half of those institutions are not publicly listed. The non-listed groups mostly consists of co-operatives and banks with public ownership. I identify 26 publicly listed, ECB-supervised banks in Germany, France, Italy, Spain, Belgium and the Netherlands. Those will consist the group of ECB-supervised banks in the analysis of publicly listed banks.

B.1.4 Debt Prices: TRACE and Mergent FISD

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

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

B.1.5 FR-Y9C

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

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

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

B.1.6 Thomson One Data

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

B.2 Proofs

Proof of Proposition 2.2.1: see Acharya et al. (2017)

B.2.1 Proof of Proposition 2.2.2

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

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

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

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

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

The FOC is:

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

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

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

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

The general expression for shareholder payoff:

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

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

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 Lemma 2.2.3: From Proposition 2.2.1, 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 2.2.2. Hence, disagreement between shareholders and debtholders follows immediately.

B.2.2 Proof of Proposition 2.2.4

Remember that debt value was given by:

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

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

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

B.2.3 Proof of Proposition 2.2.5

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

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

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

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

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.2.4 Proof of Proposition 2.2.6

Remember that equity and debt value are respectively given by:

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

I begin by analyzing equity value:. Following, proposition 2.2.1, the dividend policy that maximizes equity value is a corner solution depending on the franchise value. $V <= V*$ implies full payouts, $V > V^*$ implies no payouts.

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

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

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

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

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

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

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

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

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

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

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

B.2.5 Proof of Proposition 2.2.7

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

This choice can be visualized through the following matrix:

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

Table B.2.1: Shareholder Payoffs with two-dimensional choice

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

(1) $EV(c, risky) \in argmax_d EV(d, risky)$ & $argmax_d EV(d, risky) \geq argmax_d EV(d, safe)$

(2) $EV(0, safe) \geq EV(0, risky)$

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

Case 1:

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

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:

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

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

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

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

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

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

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:

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

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

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

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

$$\implies \quad (\bar{a}-\underline{a})(\bar{a}-\ell+c)^2 + 2\epsilon(\bar{a}-\ell+c)^2 + 2(\bar{a}-\underline{a})(\bar{a}-\ell+c)V + 4\epsilon(\bar{a}-\ell+c)V \geq$$

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

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

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

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

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

Now, if $(\bar{a}+\underline{a}-2\ell+2c) < 0$, we get a contradiction since V would have to be less than or equal to a negative number, which violates the assumptions about positivity

of V. Hence, we need $(\bar{a}+\underline{a}-2\ell+2c)>0$. This implies $\frac{\bar{a}+\underline{a}}{2}+c>\ell$. Intuitively, the bank cannot be too levered. Else it will select the risky distribution regardless, even with a payout restriction in place.

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

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

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

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

So I now analyse when the following two conditions hold:

$$V3 > V1$$

$$V3 > V2$$

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

$$\begin{aligned}
& \ell - \underline{a} - \frac{c}{2} + \epsilon > \frac{\ell^2 - \bar{a}\ell - \underline{a}\ell + \bar{a}\underline{a} - \frac{(\bar{a}-\underline{a})\epsilon}{2}}{2\ell - \bar{a} - \underline{a}} \\
\implies \quad & (\ell - \underline{a} - \frac{c}{2} + \epsilon)(2\ell - \bar{a} - \underline{a}) > \ell^2 - \bar{a}\ell - \underline{a}\ell + \bar{a}\underline{a} - \frac{(\bar{a}-\underline{a})\epsilon}{2} \\
\implies \quad & 2\ell^2 - 2\ell\underline{a} - \ell c - \bar{a}\ell + \bar{a}\underline{a} + \frac{\bar{a}c}{2} - \ell\underline{a} + \underline{a}^2 + \frac{\underline{a}c}{2} + \epsilon(2\ell - \bar{a} - \underline{a}) > \\
& \ell^2 - \bar{a}\ell - \underline{a}\ell + \bar{a}\underline{a} - \frac{(\bar{a}-\underline{a})\epsilon}{2} \\
\implies \quad & \ell^2 - 2\ell\underline{a} - \ell c + \frac{\bar{a}c}{2} + \underline{a}^2 + \frac{\underline{a}c}{2} + \epsilon(2\ell - \bar{a} - \underline{a}) > -\frac{(\bar{a}-\underline{a})\epsilon}{2} \\
\implies \quad & \ell(\ell - \underline{a} - c) - \ell\underline{a} + \underline{a}^2 + \frac{c(\bar{a}+\underline{a})}{2} + \epsilon(2\ell - \bar{a} - \underline{a}) > -\frac{(\bar{a}-\underline{a})\epsilon}{2} \qquad \text{(B.1)}
\end{aligned}$$

The following Lemma facilitates this comparison greatly:

Lemma B.2.1 *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 B.1 is monotonically increasing in ℓ and the right-hand side is always negative so to prove Lemma B.2.1, 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 B.1, 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 B.1 reads as (again ignoring the ϵ-term) :

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

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

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

Hence, Equation $B.1$ 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 B.1 now reads as:

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

So continuation values exist so that Equation B.1 is also satisfied at the upper bound. Together with monotonicity and with the proof for Case 1, this proves Lemma B.2.1.

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

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

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

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

The proof strategy is slightly different now. As in the previous proof for Lemma B.2.1, 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.2.2 *For* $\underline{\ell} = \max(\frac{\bar{a}+\underline{a}}{2}, \underline{a} + c)$ *and* $c > \frac{\bar{a}-\underline{a}}{4}$, $\exists \bar{\ell} \leq \frac{\bar{a}+\underline{a}}{2} + c$ *with* $\bar{\ell} > \underline{\ell}$ *such that the intersection of the upper bound from* $(V3)$ *and the lower bound from* $(V2)$ *is non-empty on* $(\underline{\ell}, \bar{\ell}]$

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

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

The interpretation is the following. The payout restriction exhibits only complementarity with the risk-taking decision if it is strong enough, not only to lead to a change in payout policy (which is mechanical) but also to change the risk-taking

decision of the bank. The risk-taking decision in turn is only affected on the margin if c is large enough. For c small, the change in payoffs for the bank across states is not sufficient to induce cutting back on the risk-taking margin when a payout restriction is imposed.

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

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

Substituting into Equation B.2 yields:

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

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 B.2 reduces to:

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

In sum, due to continuity of the left-hand side of the inequality in Equation B.2, 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 B.2. 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.2.1 and B.2.2 proves proposition 2.2.7.

B.3 Summary Statistics

B.3.1 TAQ data

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

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

Table B.3.2: TAQ Summary statistics; June 25, 2020

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

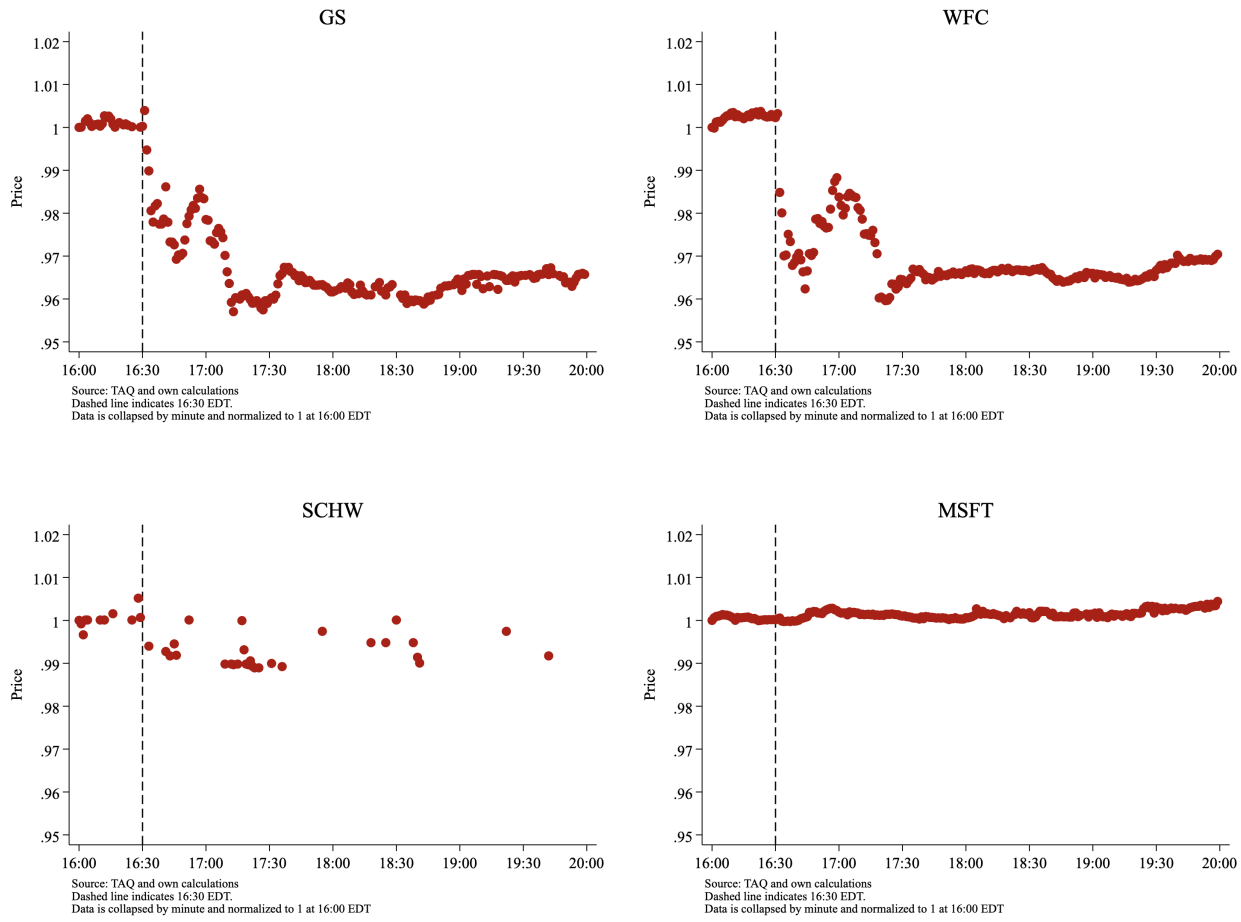
Table reports prices, shares outstanding, size of trade and market value for TAQ data on 12/18/2020 for the 4.00 to 6.00 ET time window. Prices are normalized to 1 at 4.00 ET.

Table B.3.3: TAQ Summary statistics; December 18, 2020

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

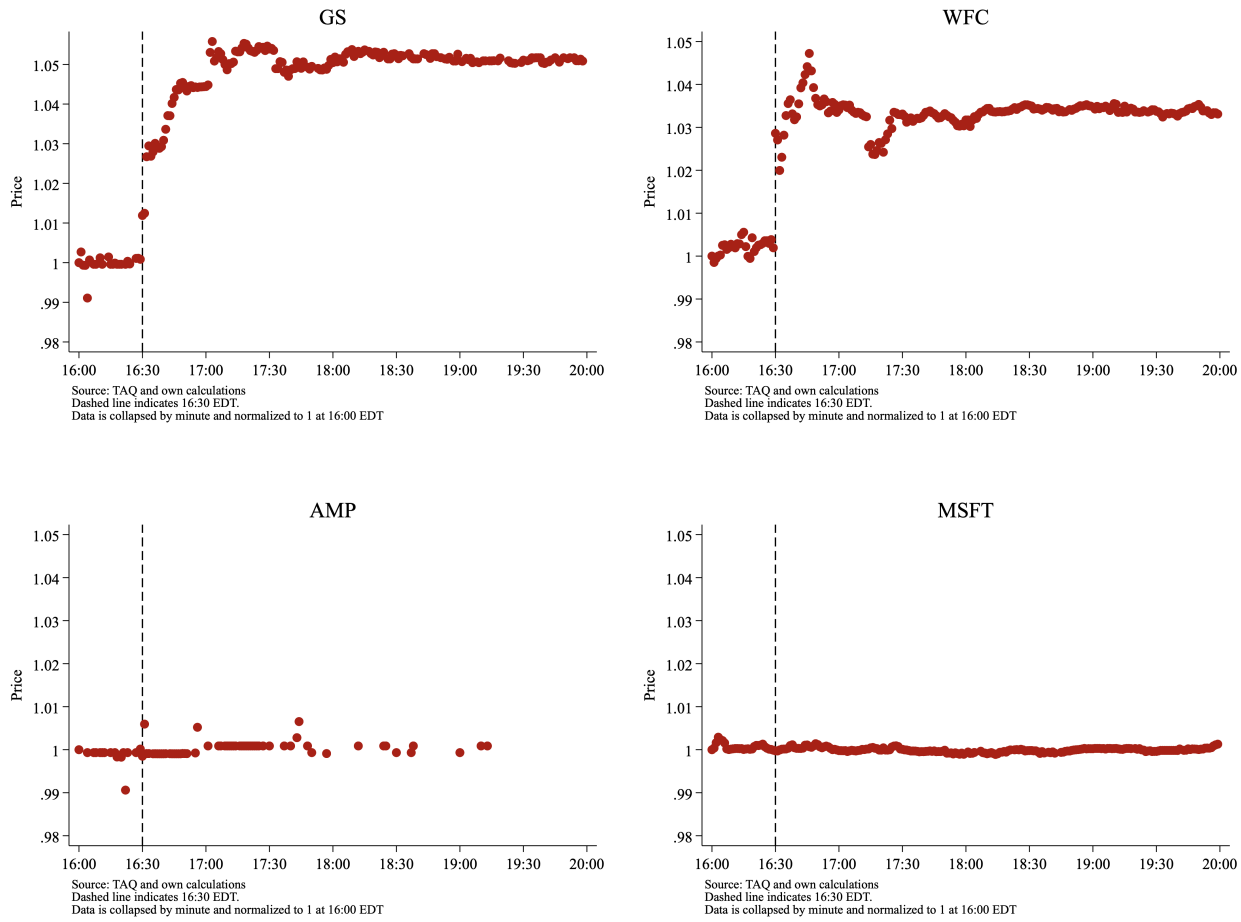
Table reports prices, shares outstanding, size of trade and market value for TAQ data on 03/25/2021 for the 4.00 to 6.00 ET time window. Prices are normalized to 1 at 4.00 ET.

Table B.3.4: TAQ Summary statistics; March 25, 2021



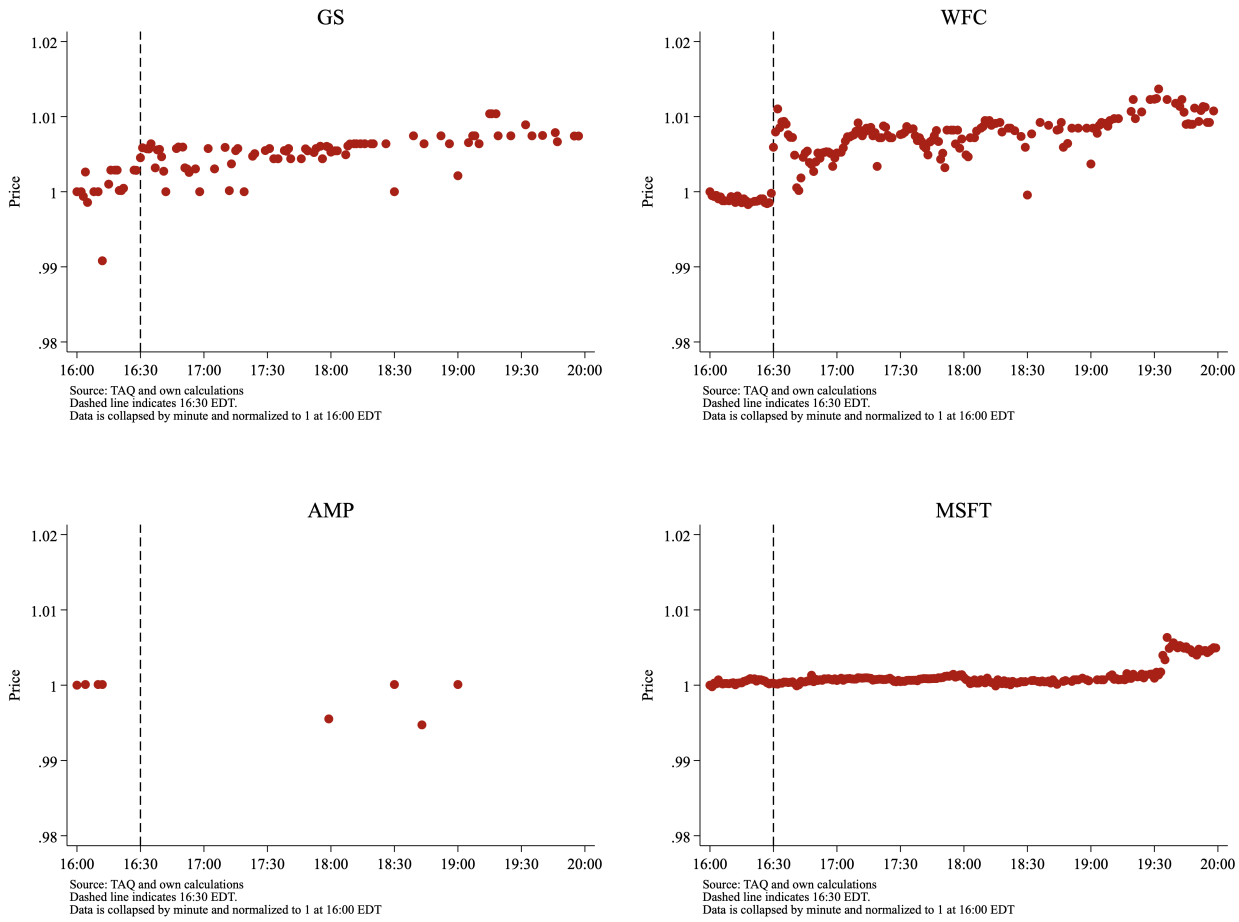
Stock price reaction for Goldman Sachs (GS), Wells Fargo (WFC), Charles Schwab (SCHW) and Microsoft (MSFT). Data is from TAQ. Dashed vertical line indicates 4.30 ET. Prices are collapsed by minute and normalized to 1 at 4.00 ET.

Figure B.3.1: Stock Price Reaction around 06/25/2020 Fed announcement for Goldman Sachs, Wells Fargo, Charles Schwab, Microsoft



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

Figure B.3.2: Stock Price Reaction around 12/18/2020 Fed announcement for Goldman Sachs, Wells Fargo, Ameriprise, Microsoft



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

Figure B.3.3: Stock Price Reaction around 03/25/2020 Fed announcement for Goldman Sachs, Wells Fargo, Ameriprise, Microsoft

B.3.2 CDS Data

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

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

Table B.3.5: CDS spreads around 06/25/2020

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

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

Table B.3.6: CDS spreads around 12/18/2020

B.3.3 Corporate Bond Data

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

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

Table B.3.7: Corporate Bond Trade Summary Statistics

B.3.4 Thomson One Syndicated Loan Data

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

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

Table B.3.8: Syndicated Loans: Summary Statistics

B.4 Further Results

B.4.1 Further Balance Sheet Variables

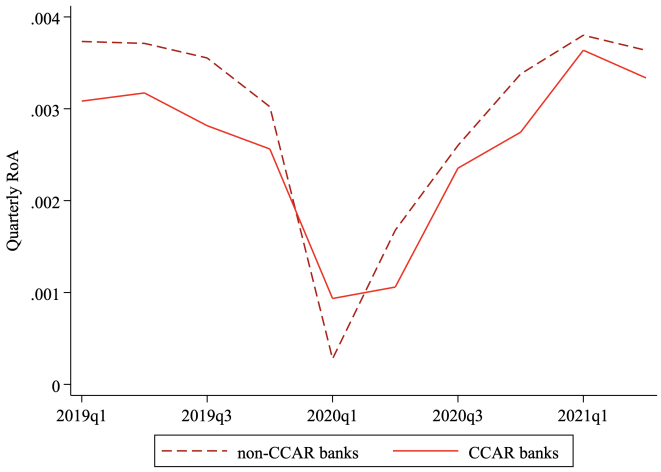


Figure reports return on assets for CCAR banks and largest non-CCAR banks. Profitability is defined as net income over total assets. Data is from FR Y9-C.

Figure B.4.4: Return on Assets

Figure B.4.4 reports the evolution of quarterly return on assets for CCAR and non-CCAR banks. We can see that return on assets evolves in parallel over the course of 2020. In particular, RoA does not seem affected by the announcements of payout restrictions in June and December 2020.

B.4.2 Further Evidence on Payouts

Figure B.4.5 re-computes the net payout ratio but adjusts net income for loan-loss provisioning. Specifically, I use adjusted net income by subtracting the contribution of loan-loss provisioning from unadjusted net income. This robustness check ensures that the time series of the net payout ratio is not driven by loan-loss provisioning, which underwent substantial fluctuations over the course of the Covid recession.

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

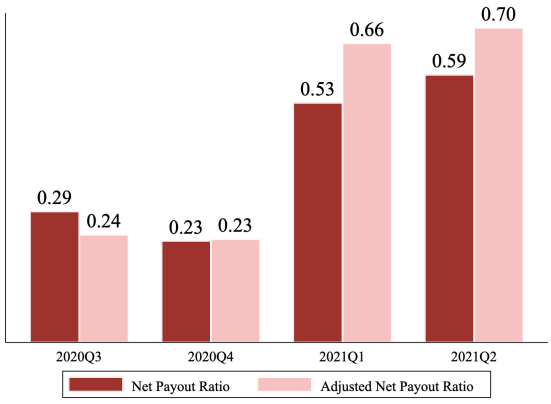


Figure reports net payout ratio for CCAR banks. Net payout ratio is defined as dividends plus net share buybacks, divided by net income. This figure is reported by dark red bars. Light red bars use adjusted net income which adjusts for the contribution of loan loss provisions to net income. Data is from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

Figure B.4.5: Net Payout Ratio 2020Q3 - 2021 Q2 (using adjusted net payout ratio)

pronounced since the release of loan loss reserves contributed substantially to banks' net income in early 2021.

Figure B.4.6 compares the net payout ratios of the CCAR banks on the right-hand side to those of non-CCAR banks on the left-hand side around the relaxation of payout restrictions in December 2020.

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

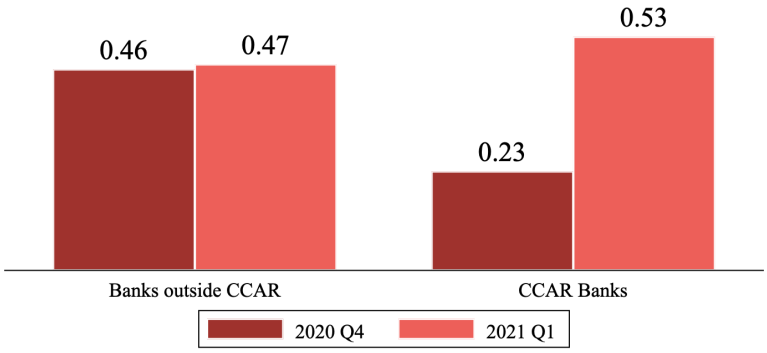
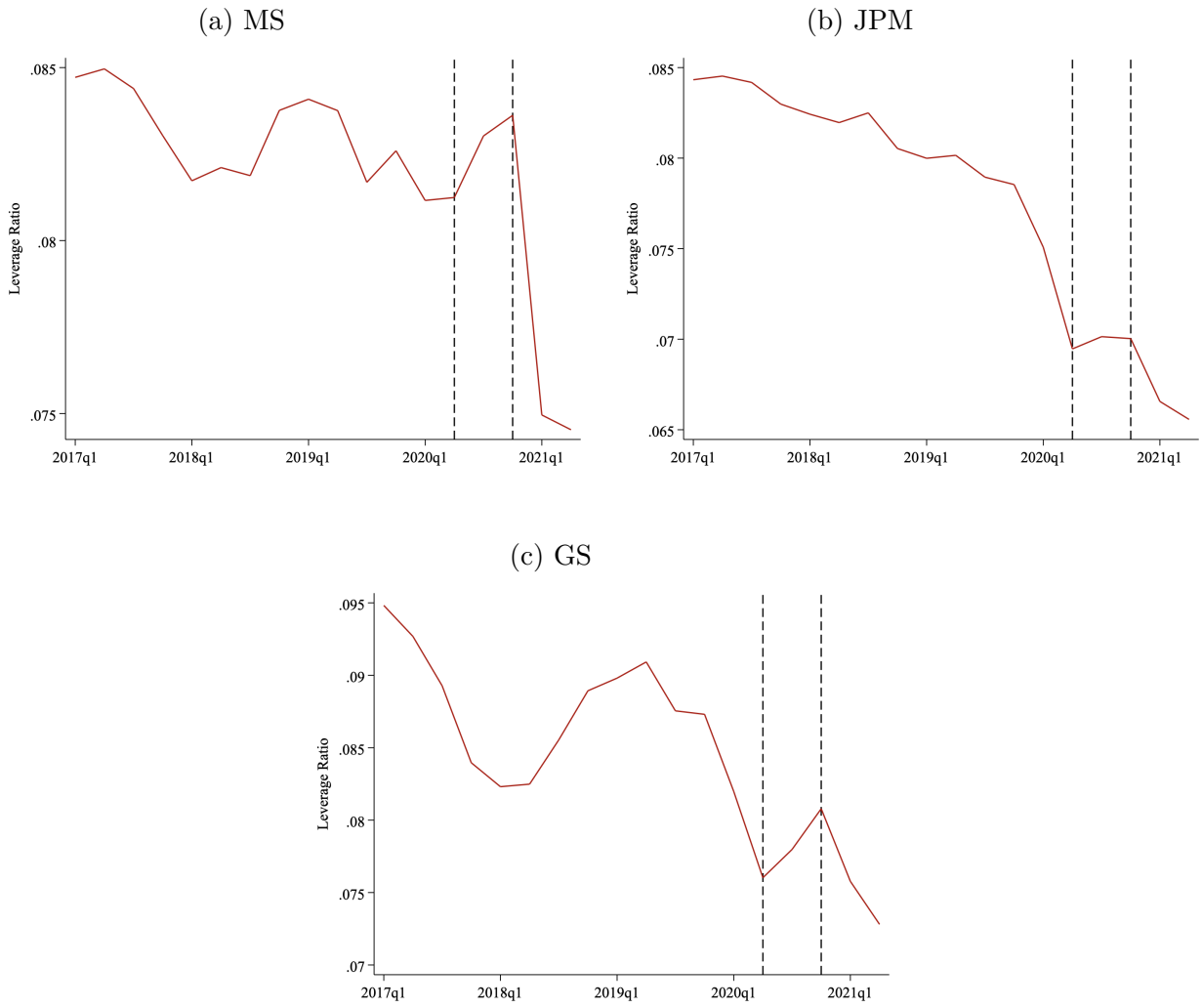


Figure reports net payout ratio for 2020 Q4 and 2021 Q1 for CCAR banks and largest 14 banks outside CCAR. Net payout ratio is defined as dividends plus net share buybacks, divided by net income. Data is from Compustat and FR Y9-C.

Figure B.4.6: Net Payout Ratio : CCAR banks vs. Others

B.4.3 Individual Bank Leverage



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

Figure B.4.7: Leverage Ratio of selected banks

B.4.4 Term Structure of CDS Response

Figure B.4.8 reports the entire term structure of estimated CDS responses around the announcement of payout restrictions on 06/25/2020 along with 95 % confidence bands.Limiting payouts lowers CDS spreads for CCAR-banks across all maturities of CDS spreads. The estimated coefficient is highly significant and hovers between 2 and 3 basis points.

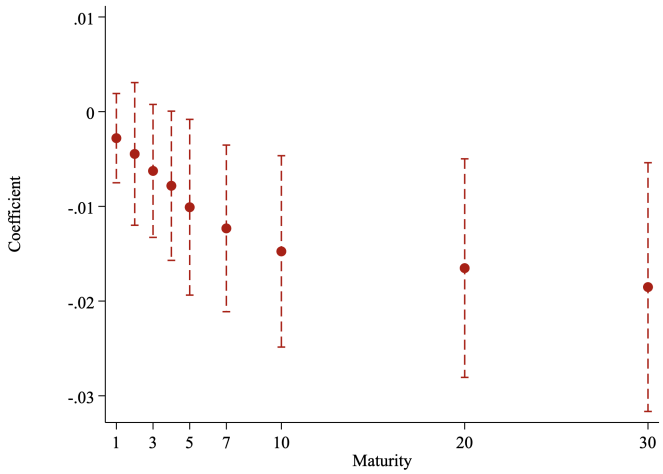


Figure reports point estimate and 95 % confidence interval for differences-in-differences coefficient in a regression of CDS spread at maturity as indicated by x-axis onto post-dummy interacted with flag for CCAR banks using a +/- 5 trading day window around 06/25/2020.

Figure B.4.8: Term Structure of CDS Response around 06/25/2020

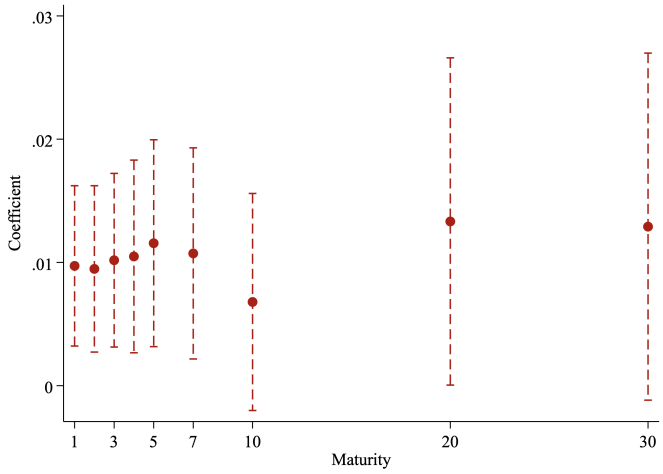


Figure reports point estimate and 95 % confidence interval for differences-in-differences coefficient in a regression of CDS spread at maturity as indicated by x-axis onto post-dummy interacted with flag for CCAR banks using a +/- 5 trading day window around 06/25/2020.

Figure B.4.9: Term Structure of CDS Response around 12/18/2020

Figure B.4.9 reports the term structure for CDS spreads for financial firms around 12/18/2020 when payout restrictions are partly being lifted. The point estimate is around 1.2 basis points for shorter maturities and approaches 1.5 basis points at longer

time horizons. Across the entire term structure, we observe a statistically significant increase in CDS spreads.

B.4.5 Robustness Checks for Cumulative Abnormal Returns

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

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

Table B.4.1: CAR after 06/25/2020 Unweighted Regression (Banks only)

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

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

Table B.4.2: CAR after 06/25/2020 Weighted Regression (Financial Firms Only)

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

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

Table B.4.3: CAR after 06/25/2020 Unweighted Regression (Financial Firms Only)

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

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

Table B.4.4: CAR after 12/18/2020 Unweighted Regression (Banks Only)

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

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

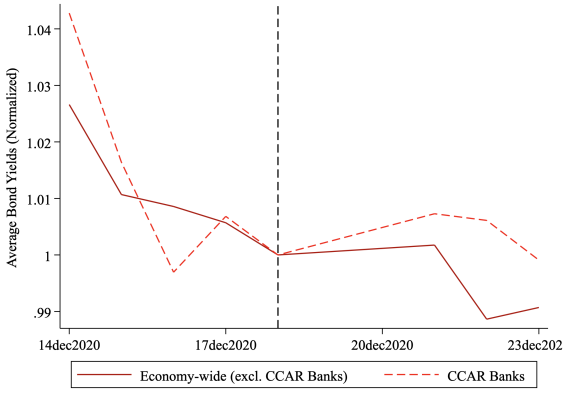
Table B.4.5: CAR after 12/18/2020 Weighted Regression (Financial Firms Only)

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

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

Table B.4.6: CAR after 12/18/2020 Unweighted Regression (Financial Firms Only)

B.4.6 More Corporate Bond Results



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

Figure B.4.1: Corporate Bond Yields around 12/18/2020

B.4.7 Further Results on Lending Margin



Figure B.4.2: Lending by non-CCAR banks around December 2020

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

$$\theta = \frac{Below\ IG\ Lending_{it}}{Below\text{-}IG\ Lending_{it} + IG\ Lending_{it}} \tag{B.3}$$

Figure B.4.3 reports the empirical CDF of θ for 2020 Q3 and Q4 compared to 2021 Q1. We can see that after the liberalization of payouts, the new empirical CDF comes close to first-order stochastically dominating the pre-reform empirical CDF. Economically, this implies that across the distribution, banks select slightly riskier lending portfolios.

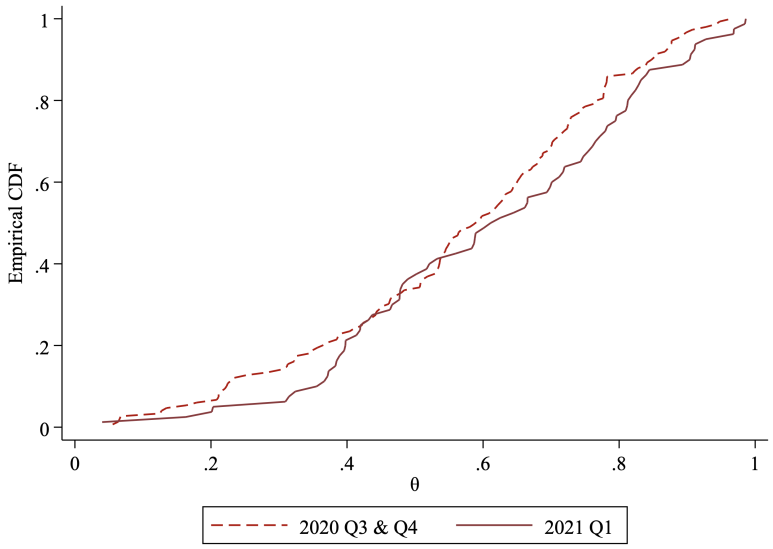


Figure reports $\theta = \frac{Below\ IG\ Lending_{it}}{Below\text{-}IG\ Lending_{it}+IG\ Lending_{it}}$, the fraction of below-investment grade syndicated lending to total syndicated lending for CCAR banks. Dashed line reports θ for 2020 Q3 and Q4, solid line reports θ for 2021 Q1. Data is from Thomson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

Figure B.4.3: Empirical CDF of θ across CCAR-banks

B.4.8 Eurozone 03/27 DiD Plot

Figure B.4.4 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.

B.4.9 Details for Government Savings Calculation

Accounting

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

June 25, 2020 Table B.4.5 contains balance sheet variables for the aggregate of the domestic CCAR banks:

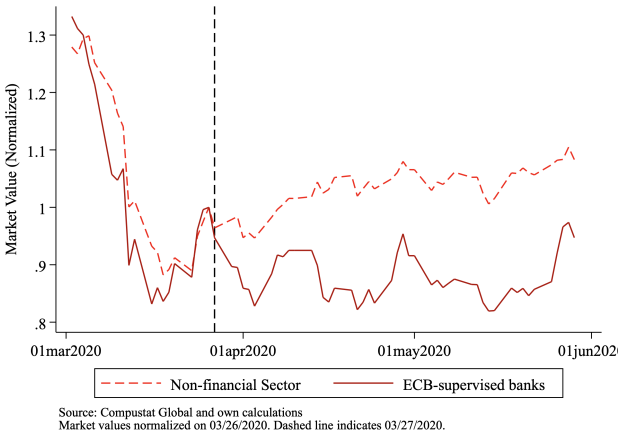


Figure reports market values for ECB-supervised banks (solid line) and non-financial firms (dashed line, excludes SIC codes 6000 - 6799). Market values are normalized to one on 03/26/2020. The vertical dashed line indicates 03/27/2020. Source: Compustat Global and own calculations.

Figure B.4.4: Robustness for DiD Plot

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

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

Figure B.4.5: Balance Sheet 2020 Q1

December 18, 2020 Table B.4.6 contains balance sheet variables for the aggregate of the domestic CCAR banks:

Mapping to data

I map this to my framework as follows:

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

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

Figure B.4.6: Balance Sheet 2020 Q3

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

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

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

Finally, I exploit the following two equations implicit in Equation 2.14:

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

Calculations for December 18, 2020

$$\Delta EV = \textit{2.7\% x } EV = 41.99$$
$$\Delta DV^{LT} = \textit{.049 \% x 6.35 x 1357 } = 4.22$$
$$\Delta DV^{ST,partlyinsured} = \textit{.02 \% x 8110} = 1.62$$

Appendix C

Additional Material for Chapter 3

C.1 Tables

	Stock Return					
	(1)	(2)	(3)	(4)	(5)	(6)
Top 5 Percent=1 x Δi	-0.923***	-2.935**	-4.021***	-1.961***	-2.901***	-3.083***
	(0.197)	(0.847)	(0.817)	(0.554)	(0.608)	(0.484)
Top 5 Percent=1 x Δi x Lagged i		0.225**	0.312***			0.229***
		(0.076)	(0.074)			(0.042)
Top 5 Percent=1 x Δi x Lagged real i (Clev and Fred)				0.294*	0.449***	
				(0.111)	(0.117)	
Firm β x Δi						10.22***
						(0.861)
Firm β x Δi x Lagged i						-0.980***
						(0.101)
Sample	All	All	All	All	All	All
Controls	N	N	Y	N	Y	
Industry-Date FE	Y	Y	Y	Y	Y	Y
N	74,103,576	74,103,576	46,832,612	74,103,576	46,832,612	73,745,550
R-sq	0.394	0.394	0.406	0.394	0.406	0.397

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table C.1.1: Differential Interest Rate Responses of Leaders vs. Followers: Top 5 Percent (Full Sample)

Regression results for the specification $R_{i,j,t} = \alpha_{j,t} + \beta_0 D_{i,j,t} + \beta_1 D_{i,j,t}\Delta i_t + \beta_2 D_{i,j,t} i_{t-1} + \beta_3 D_{i,j,t}\Delta i_t i_{t-1} + X_{i,j,t}\gamma + \varepsilon_{i,j,t}$ for firm i in industry j at date t. $R_{i,j,t}$ is defined here as the retrun to holding the stock (including dividends) of firm i in industry j from date $t-91$ to t (one quarter growth). $D_{i,j,t}$ is defined here as an indicator equal to 1 at date t when a firm i is in the top 5% of market capitalization in its industry j on date $t-91$. Firms with $D_{i,j,t}$=1 are called leaders while the rest are called followers. i_t is defined as the nominal 10-year Treasury yield, with i_{t-1} being the interest rate 91 days prior and Δi_t being the change in the interest rate from date $t-91$ to t. Controls X include a firm's asset-liability ratio, debt-equity ratio, book-to-market ratio, and percent of pre-tax income that goes to taxes. Industry classifications are the Fama-French industry classifications (FF). Lagged real rates were built using monthly 10-year inflation expectations from the Cleveland Fed and the daily 10-year Treasury yield at the beginning of each month (post-1982), and the CPI series from the FED (pre-1982). Standard errors are dually clustered by industry and date.

	Portfolio Return				
	(1)	(2)	(3)	(4)	(5)
Δi_t	-1.089***	-3.279***	-1.915***	-3.702***	-3.475***
	(0.280)	(0.580)	(0.465)	(0.854)	(0.815)
i_{t-1}		0.0340		0.0192	0.0554
		(0.048)		(0.072)	(0.063)
$\Delta i_t \times i_{t-1}$		0.251***		0.270***	0.347**
		(0.056)		(0.078)	(0.113)
real i_{t-1} (Clev and Fred)			0.0239		
			(0.067)		
$\Delta i_t \times$ *real* i_{t-1} (Clev and Fred)			0.192*		
			(0.085)		
$(\Delta i_t > 0)$=1 $\times \Delta i_t$				0.482	
				(1.541)	
$(\Delta i_t > 0)$=1 $\times \Delta i_t \times i_{t-1}$				-0.0436	
				(0.167)	
PE Portfolio Return					-0.246***
					(0.053)
N	13,843	13,843	13,843	13,843	11,205
R-sq	0.031	0.053	0.039	0.054	0.130

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table C.1.2: Portfolio Returns Response to Interest Rate Changes: Top 5 Percent (Full Sample)

Regression results for the specification $R_t = \alpha + \beta_0 i_{t-1} + \beta_1 \Delta i_t + \beta_2 \Delta i_t i_{t-1} + \varepsilon_t$ at date t. R_t is defined as the market-capitalization weighted average of returns for a stock portfolio that goes long in leader stocks and goes short in follower stocks from date $t-91$ to t. Leaders are defined as the firms in the top 5% of market capitalization in its FF industry on date $t-91$. i_t is defined as the nominal 10-year Treasury yield, with i_{t-1} being the interest rate 91 days prior and Δi_t being the change in the interest rate from date $t-91$ to t. Standard errors are Newey-West with a maximum lag length of 60 days prior. Real rates were built using monthly 10-year inflation expectations from the Cleveland Fed and the daily 10-year Treasury yield (post-1982), and the CPI series from the FED (pre-1982).

	Top 5		SIC		EBITDA		SALES	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Top 5 Percent=1 x Δi	-1.132***	-3.518**	-1.239***	-3.655***	-1.383***	-4.145***	-1.132***	-3.200**
	(0.252)	(1.057)	(0.209)	(0.797)	(0.248)	(0.933)	(0.321)	(1.171)
Top 5 Percent=1 x Δi x Lagged i		0.268**		0.267***		0.318***		0.236*
		(0.092)		(0.069)		(0.082)		(0.100)
Sample	All	All	All	All	All	All	All	All
Industry-Date FE	Y	Y	Y	Y	Y	Y	Y	Y
N	65,944,610	65,944,610	65,908,099	65,908,099	41,953,229	41,953,229	51,625,374	51,625,374
R-sq	0.392	0.393	0.391	0.391	0.412	0.413	0.400	0.400

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table C.1.3: Differential Interest Rate Responses of Leaders vs. Followers: Robustness Checks

Regression results for the specification $R_{i,j,t} = \alpha_{j,t} + \beta_0 D_{i,j,t} + \beta_1 D_{i,j,t}\Delta i_t + \beta_2 D_{i,j,t} i_{t-1} + \beta_3 D_{i,j,t}\Delta i_t i_{t-1} + X_{i,j,t}\gamma + \varepsilon_{i,j,t}$ for firm i in industry j at date t. The definitions are the same as in Table 2 except for $D_{i,j,t}$. In columns 1 and 2, leaders are chosen by the top 5 number of firms by market capitalization within an industry and date. In columns 3 and 4, leaders are chosen by the top 5% of firms by market capitalization within an industry and date, where we change the definition of industry to be the 2-digit Standard Industry Classification (SIC) codes. In columns 5 and 6, leaders are chosen by the top 5% of firms by earnings before interest, taxes, depreciation, and amortization (EBITDA) within an industry and date. In columns 7 and 8, leaders are chosen by the top 5% of firms by sales within an industry and date. Standard errors are dually clustered by industry and date.

	Yearly		Semi-Yearly		Monthly		Weekly		Daily	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Δi_t	-1.301**	-5.554***	-1.388***	-4.530***	-1.003***	-2.443***	-0.943***	-1.734***	-0.829***	-1.139***
	(0.416)	(0.993)	(0.349)	(0.688)	(0.203)	(0.443)	(0.168)	(0.307)	(0.167)	(0.214)
i_{t-1}		0.178		0.0640		0.0227		0.0122*		0.00847***
		(0.135)		(0.079)		(0.019)		(0.005)		(0.001)
$\Delta i_t \times i_{t-1}$		0.466***		0.359***		0.160***		0.0899**		0.0370
		(0.096)		(0.069)		(0.040)		(0.035)		(0.027)
Sample	All	All	All	All	All	All	All	All	All	All
N	9,706	9,706	9,615	9,615	9,738	9,738	9,755	9,755	9,734	9,734
R-sq	0.036	0.099	0.053	0.107	0.035	0.051	0.030	0.037	0.018	0.023

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table C.1.4: Portfolio Returns Response to Interest Rate Changes: Top 5 Percent, Different Frequencies

Regression results for the specification $R_t = \alpha + \beta_0 i_{t-1} + \beta_1 \Delta i_t + \beta_2 \Delta i_t i_{t-1} + \varepsilon_t$ at date t. R_t is defined as the market-capitalization weighted average of returns for a stock portfolio that goes long in leader stocks and goes short in follower stocks from date $t - 91$ to t. Leaders are defined as the firms in the top 5% of market capitalization in its FF industry on date $t - J$. i_t is defined as the nominal 10-year Treasury yield, with i_{t-1} being the interest rate J days prior and Δi_t being the change in the interest rate from date $t - 91$ to t. For columns 1 and 2, $J = 364$; columns 3 and 4, $J = 28$; columns 5 and 6, $J = 7$; columns 7 and 8, $J = 1$, where 1 is one trading day. Standard errors are Newey-West with a maximum lag length of 60 days prior.

Variables	0-2	2-3	3-5	5-7	7-10	10-30
0-2	1.00					
2-3	0.85	1.00				
3-5	0.85	0.85	1.00			
5-7	0.80	0.76	0.67	1.00		
7-10	0.70	0.65	0.47	0.53	1.00	
10-30	0.80	0.77	0.93	0.95	0.94	1.00

Table C.1.5: Correlation Table of Forward Rates

Bibliography

Acemoglu, Daron, Michael Kremer, and Atif Mian, "Incentives in markets, firms, and governments," *The Journal of Law, Economics, and Organization*, 2008, *24* (2), 273–306.

_ **, Simon Johnson, Amir Kermani, James Kwak, and Todd Mitton**, "The value of connections in turbulent times: Evidence from the United States," *Journal of Financial Economics*, 2016, *121* (2), 368–391.

Acharya, Viral, Robert Engle, and Diane Pierret, "Testing macroprudential stress tests: The risk of regulatory risk weights," *Journal of Monetary Economics*, 2014, *65*, 36–53.

Acharya, Viral V and S. Viswanathan, "Leverage, moral hazard, and liquidity," *The Journal of Finance*, 2011, *66* (1), 99–138.

_ **, Hamid Mehran, and Anjan V Thakor**, "Caught between Scylla and Charybdis? Regulating bank leverage when there is rent seeking and risk shifting," *The Review of Corporate Finance Studies*, 2016, *5* (1), 36–75.

_ **, Hanh T Le, and Hyun Song Shin**, "Bank capital and dividend externalities," *The Review of Financial Studies*, 2017, *30* (3), 988–1018.

_ **, Irvind Gujral, Nirupama Kulkarni, and Hyun Song Shin**, "Dividends and bank capital in the financial crisis of 2007-2009," *NBER Working Paper No. 16896*, 2011.

_ **, Robert F Engle III, and Sascha Steffen**, "Why did bank stocks crash during COVID-19?," *NBER Working Paper No. 28559*, 2021.

Admati, Anat and Martin Hellwig, *The Bankers' New Clothes: What's Wrong with Banking and What to Do about It-Updated Edition*, Princeton University Press, 2014.

Admati, Anat R, Peter M DeMarzo, Martin F Hellwig, and Paul Pfleiderer, "The leverage ratchet effect," *The Journal of Finance*, 2018, *73* (1), 145–198.

Adrian, Tobias and Adam B Ashcraft, "Shadow Banking Regulation," *Annual Review of Financial Economics*, 2012, *4* (1), 99–140.

Akcigit, Ufuk and Sina Ates, "Lessons on Declining Business Dynamism from Endogenous Growth Theory," *Working Paper*, 2019.

Allen, Franklin, Antonio E Bernardo, and Ivo Welch, "A theory of dividends based on tax clienteles," *The Journal of Finance*, 2000, *55* (6), 2499–2536.

_ , Elena Carletti, and Robert Marquez, "Credit market competition and capital regulation," *The Review of Financial Studies*, 2011, *24* (4), 983–1018.

Almeida, Heitor, Vyacheslav Fos, and Mathias Kronlund, "The real effects of share repurchases," *Journal of Financial Economics*, 2016, *119* (1), 168–185.

Andrews, Dan, Chiara Criscuolo, and Peter N. Gal, "The Best versus the Rest: The Global Productivity Slowdown, Divergence across Firms and the Role of Public Policy," *OECD Productivity Working Papers*, 2016, (5).

Aramonte, Sirio, "Mind the buybacks, beware of the leverage," 2020.

Asriyan, Vladimir, Luc Laeven, Alberto Martin, Alejandro Van der Ghote, and Victoria Vanasco, "Falling Interest Rates and Credit Misallocation: Lessons from General Equilibrium," *Working Paper*, 2021.

Auerbach, Alan J, "Wealth maximization and the cost of capital," *The Quarterly Journal of Economics*, 1979, *93* (3), 433–446.

Autor, David, David Dorn, Lawrence F Katz, Christina Patterson, and John Van Reenen, "The fall of the labor share and the rise of superstar firms," *The Quarterly Journal of Economics*, 2020, *135* (2), 645–709.

Baker, Andrew, David F Larcker, and Charles CY Wang, "How Much Should We Trust Staggered Difference-In-Differences Estimates?," *Available at SSRN 3794018*, 2021.

Banyi, Monica L, Edward A Dyl, and Kathleen M Kahle, "Errors in estimating share repurchases," *Journal of Corporate Finance*, 2008, *14* (4), 460–474.

Barber, Brad M and Terrance Odean, "Trading is hazardous to your wealth: The common stock investment performance of individual investors," *The Journal of Finance*, 2000, *55* (2), 773–806.

Barclay, Michael J and Terrence Hendershott, "Price discovery and trading after hours," *The Review of Financial Studies*, 2003, *16* (4), 1041–1073.

Begenau, Juliane, "Capital Requirements, Risk Choice, and Liquidity Provision in a business-cycle model," *Journal of Financial Economics*, 2020, *136* (2), 355–378.

_ and Tim Landvoigt, "Financial regulation in a quantitative model of the modern banking system," *NBER Working Paper No. 28501*, 2021.

Ben-David, Itzhak, Francesco Franzoni, Rabih Moussawi, and John Sedunov, "The Granular Nature of Large Institutional Investors," *CEPR Discussion Papers No. 13427*, 2019.

Ben-Rephael, Azi, Jacob Oded, and Avi Wohl, "Do firms buy their stock at bargain prices? Evidence from actual stock repurchase disclosures," *Review of Finance*, 2014, *18* (4), 1299–1340.

Beraja, Martin, Erik Hurst, and Juan Ospina, "The aggregate implications of regional business cycles," *Econometrica*, 2019, *87* (6), 1789–1833.

Berlingieri, Giuseppe, Patrick Blanchenay, and Chiara Criscuolo, "The Great Divergene(s)," Technical Report 39, The Organisation for Economic Co-operation and Development 2017.

Binsbergen, Jules H Van, "Duration-Based stock valuation: Reassessing stock market performance and volatility," *NBER Working Paper*, 2020, (27367).

Boissel, Charles and Adrien Matray, "Higher Dividend Taxes, No Problem! Evidence from Taxing Entrepreneurs in France," *Working Paper*, 2019.

Bolton, Patrick, Jose Scheinkman, and Wei Xiong, "Executive compensation and short-termist behaviour in speculative markets," *The Review of Economic Studies*, 2006, *73* (3), 577–610.

Bosshardt, Joshua and Ali Kakhbod, "The Effect of Liquidity Regulation on US Bank Risk-Taking: Evidence from Reserve Requirements and the Liquidity Coverage Ratio," *Available at SSRN 3550912*, 2020.

Bradford, David F, "The incidence and allocation effects of a tax on corporate distributions," *journal of Public Economics*, 1981, *15* (1), 1–22.

Brennan, Michael J and Anjan V Thakor, "Shareholder preferences and dividend policy," *The Journal of Finance*, 1990, *45* (4), 993–1018.

Brownlees, Christian T and Giampiero M Gallo, "Financial econometric analysis at ultra-high frequency: Data handling concerns," *Computational Statistics & Data Analysis*, 2006, *51* (4), 2232–2245.

Brunnermeier, Markus K and Yuliy Sannikov, "The I Theory of Money," *NBER Working Paper No. 22533*, 2016.

Calomiris, Charles W, Florian Heider, and Marie Hoerova, "A theory of bank liquidity requirements," *Columbia Business School Research Paper*, 2015, *2*, p10.

Campbell, John Y, Andrew W Lo, and A Craig MacKinlay, "4. Event-Study Analysis," in "The econometrics of financial markets," Princeton University Press, 2012, pp. 149–180.

_ , **John J Champbell, John W Campbell, Andrew W Lo, and A Craig MacKinlay**, *The econometrics of financial markets*, Princeton University Press, 1997.

Carleton, Willard T, James M Nelson, and Michael S Weisbach, "The influence of institutions on corporate governance through private negotiations: Evidence from TIAA-CREF," *The Journal of Finance*, 1998, *53* (4), 1335–1362.

Chatterjee, Satyajit and Burcu Eyigungor, "The Firm Size and Leverage Relationship and Its Implications for Entry and Business Concentration," 2020.

Chodorow-Reich, Gabriel, "Regional data in macroeconomics: Some advice for practitioners," *Journal of Economic Dynamics and Control*, 2020, p. 103875.

_ , **Olivier Darmouni, Stephan Luck, and Matthew Plosser**, "Bank liquidity provision across the firm size distribution," *Journal of Financial Economics*, 2021.

Chousakos, K and G Gorton, "Bank health post-crisis," *Financial Stability Review*, 2017, (21), 55–67.

Corbae, Dean and Pablo D'Erasmo, "Capital requirements in a quantitative model of banking industry dynamics," *NBER Working Paper No. 25424*, 2019.

Coval, Joshua and Erik Stafford, "Asset Fire Sales (and Purchases) in Equity Markets," *Journal of Financial Economics*, 2007, *86* (2), 479–512.

Crane, Alan D, Sébastien Michenaud, and James P Weston, "The effect of institutional ownership on payout policy: Evidence from index thresholds," *The Review of Financial Studies*, 2016, *29* (6), 1377–1408.

Crouzet, Nicolas and Janice C Eberly, "Understanding weak capital investment: The role of market concentration and intangibles," *NBER Working Paper*, 2019, (25869).

Delis, Manthos D, Iftekhar Hasan, and Nikolaos Mylonidis, "The risk-taking channel of monetary policy in the US: Evidence from corporate loan data," *Journal of Money, Credit and Banking*, 2017, *49* (1), 187–213.

Demirgüç-Kunt, Asli, Alvaro Pedraza, and Claudia Ruiz Ortega, "Banking sector performance during the covid-19 crisis," *World Bank Policy Research Working Paper*, 2020, *9363.*

_ **and Enrica Detragiache**, "Does deposit insurance increase banking system stability? An empirical investigation," *Journal of Monetary Economics*, 2002, *49* (7), 1373–1406.

Derrien, François, Ambrus Kecskés, and David Thesmar, "Investor horizons and corporate policies," *Journal of Financial and Quantitative Analysis*, 2013, *48* (6), 1755–1780.

Dewatripont, Mathias and Jean Tirole, "Macroeconomic shocks and banking regulation," *Journal of Money, Credit and Banking*, 2012, *44*, 237–254.

Diamond, Douglas W and Anil K Kashyap, "Liquidity requirements, liquidity choice, and financial stability," in "Handbook of macroeconomics," Vol. 2, Elsevier, 2016, pp. 2263–2303.

Edmans, Alex, Itay Goldstein, and Wei Jiang, "The real effects of financial markets: The impact of prices on takeovers," *The Journal of Finance*, 2012, *67* (3), 933–971.

_ , Luis Goncalves-Pinto, Moqi Groen-Xu, and Yanbo Wang, "Strategic news releases in equity vesting months," *The Review of Financial Studies*, 2018, *31* (11), 4099–4141.

_ , Vivian W Fang, and Katharina A Lewellen, "Equity vesting and investment," *The Review of Financial Studies*, 2017, *30* (7), 2229–2271.

Eisdorfer, Assaf, "Empirical Evidence of Risk Shifting in Financially Distressed Firms," *The Journal of Finance*, 2008, *63* (2), 609–637.

Farhi, Emmanuel and François Gourio, "Accounting for macro-finance trends: Market power, intangibles, and risk premia," *NBER Working Paper 25282*, 2018.

Farre-Mensa, Joan, Roni Michaely, and Martin C Schmalz, "Financing payouts," *Ross School of Business Paper*, 2020, (1263).

Floyd, Eric, Nan Li, and Douglas J Skinner, "Payout policy through the financial crisis: The growth of repurchases and the resilience of dividends," *Journal of Financial Economics*, 2015, *118* (2), 299–316.

Gertler, Mark and Simon Gilchrist, "Monetary policy, business cycles, and the behavior of small manufacturing firms," *The Quarterly Journal of Economics*, 1994, *109* (2), 309–340.

Gilje, Erik P, "Do Firms Engage in Risk-Shifting? Empirical Evidence," *The Review of Financial Studies*, 2016, *29* (11), 2925–2954.

Godlewski, Christophe J, "How to get a syndicated loan fast? The role of syndicate composition and organization," *Finance*, 2010, *31* (2), 051–092.

Goetz, Martin, Luc Laeven, and Ross Levine, "Do bank insiders impede equity issuances?," *NBER Working Paper*, 2020, (27442).

Gorodnichenko, Yuriy and Michael Weber, "Are sticky prices costly? Evidence from the stock market," *American Economic Review*, 2016, *106* (1), 165–99.

Gorton, Gary, Andrew Metrick, Andrei Shleifer, and Daniel K Tarullo, "Regulating the shadow banking system," *Brookings Papers on Economic Activity*, 2010, pp. 261–312.

Graham, John R, Campbell R Harvey, and Shiva Rajgopal, "The economic implications of corporate financial reporting," *Journal of Accounting and Economics*, 2005, *40* (1-3), 3–73.

Greenwald, Daniel L, Martin Lettau, and Sydney C Ludvigson, "How the wealth was won: Factors shares as market fundamentals," *NBER Working Paper No. 25769*, 2019.

Gropp, Reint, Hendrik Hakenes, and Isabel Schnabel, "Competition, Risk-Shifting, and Public Bail-out Policies," *The Review of Financial Studies*, 2011, *24* (6), 2084–2120.

_ , Thomas Mosk, Steven Ongena, and Carlo Wix, "Banks response to higher capital requirements: Evidence from a quasi-natural experiment," *The Review of Financial Studies*, 2019, *32* (1), 266–299.

Grullon, Gustavo and Roni Michaely, "Dividends, share repurchases, and the substitution hypothesis," *the Journal of Finance*, 2002, *57* (4), 1649–1684.

_ , Yelena Larkin, and Roni Michaely, "Are US industries becoming more concentrated?," *Review of Finance*, 2019, *23* (4), 697–743.

Gürkaynak, Refet S, Brian Sack, and Eric Swanson, "The sensitivity of long-term interest rates to economic news: Evidence and implications for macroeconomic models," *American economic review*, 2005, *95* (1), 425–436.

Gutiérrez, Germán and Thomas Philippon, "Investment-less growth: An Empirical Investigation," *NBER Working Paper No. 22897*, 2016.

_ and _ , "Declining Competition and Investment in the US," *NBER Working Paper No. 23583*, 2017.

_ and _ , "Ownership, governance and investment," in "AEA Papers and Proceedings" 2018.

Hackbarth, Dirk, Alejandro Rivera, and Tak-Yuen Wong, "Optimal short-termism," *Working Paper*, 2018.

Haddad, Valentin, Alan Moreira, and Tyler Muir, "When selling becomes viral: Disruptions in debt markets in the COVID-19 crisis and the Fed?s response," *NBER Working Paper No. 27168*, 2020.

Hadjinicolaou, George and Avner Kalay, "Wealth redistributions or changes in firm value: an analysis of returns to bondholders and stockholders around dividend anouncements," *Journal of Financial Economics*, 1984, *13* (1), 35–63.

Hanson, Samuel G., Anil K. Kashyap, and Jeremy C. Stein, "A Macroprudential Approach to Financial Regulation," *Journal of Economic Perspectives*, March 2011, *25* (1), 3–28.

Hardy, Bryan, "Covid-19 bank dividend payout restrictions: effects and trade-offs," *BIS Bulletin No.38*, 2021.

Hirtle, Beverly, "Bank holding company dividends and repurchases during the financial crisis," *FRB of New York Staff Report*, 2014, (666).

Holmström, Bengt, "Managerial incentive problems: A dynamic perspective," *The Review of Economic Studies*, 1999, *66* (1), 169–182.

_ **and Jean Tirole**, "Market liquidity and performance monitoring," *Journal of Political Economy*, 1993, *101* (4), 678–709.

_ **and Paul Milgrom**, "Multitask principal-agent analyses: Incentive contracts, asset ownership, and job design," *Journal of Law, Economics, and Organization*, 1991, *7*, 24.

Ippolito, Filippo, Ali K Ozdagli, and Ander Perez-Orive, "The transmission of monetary policy through bank lending: The floating rate channel," *Journal of Monetary Economics*, 2018, *95*, 49–71.

Jagolinzer, Alan D, "SEC Rule 10b5-1 and insiders' strategic trade," *Management Science*, 2009, *55* (2), 224–239.

Jayachandran, Seema, "The jeffords effect," *The Journal of Law and Economics*, 2006, *49* (2), 397–425.

Jeng, Leslie A, Andrew Metrick, and Richard Zeckhauser, "Estimating the returns to insider trading: A performance-evaluation perspective," *Review of Economics and Statistics*, 2003, *85* (2), 453–471.

Jensen, Michael C, "Agency costs of free cash flow, corporate finance, and takeovers," *The American Economic Review*, 1986, *76* (2), 323–329.

_ **and William H Meckling**, "Theory of the firm: Managerial behavior, agency costs and ownership structure," *Journal of financial economics*, 1976, *3* (4), 305–360.

Jiménez, Gabriel, Steven Ongena, José-Luis Peydró, and Jesús Saurina, "Hazardous times for monetary policy: What do twenty-three million bank loans say about the effects of monetary policy on credit risk-taking?," *Econometrica*, 2014, *82* (2), 463–505.

Kahle, Kathleen and René M Stulz, "Are Corporate Payouts Abnormally High in the 2000s?," *NBER Working Paper No.26958*, 2020.

Koijen, Ralph SJ and Motohiro Yogo, "A demand system approach to asset pricing," *Journal of Political Economy*, 2019, *127* (4), 1475–1515.

_ **, Hanno Lustig, and Stijn Van Nieuwerburgh**, "The cross-section and time series of stock and bond returns," *Journal of Monetary Economics*, 2017, *88*, 50–69.

Kroen, Thomas, "Payout Policy Reform and Investor Horizons," *Available at SSRN 3824978*, 2021.

Landier, Augustin, David Alexandre Sraer, and David Thesmar, "The risk-shifting hypothesis: Evidence from subprime originations.," *AFA 2012 Chicago Meetings Paper*, 2015.

Larrain, Borja and Motohiro Yogo, "Does firm value move too much to be justified by subsequent changes in cash flow?," *Journal of Financial Economics*, 2008, *87* (1), 200–226.

Lintner, John, "Distribution of incomes of corporations among dividends, retained earnings, and taxes," *The American Economic Review*, 1956, *46* (2), 97–113.

Liu, Ernest, Atif Mian, and Amir Sufi, "Low interest rates, market power, and productivity growth," *Econometrica*, 2022, *90* (1).

Loecker, Jan De, Jan Eeckhout, and Gabriel Unger, "The rise of market power and the macroeconomic implications," *The Quarterly Journal of Economics*, 2020, *135* (2), 561–644.

López-Espinosa, Germán, Gaizka Ormazabal, and Yuki Sakasai, "Switching from Incurred to Expected Loan Loss Provisioning: Early Evidence," *Journal of Accounting Research*, 2021.

Ma, Yueran, "Nonfinancial firms as cross-market arbitrageurs," *The Journal of Finance*, 2019, *74* (6), 3041–3087.

Mehran, Hamid and Anjan Thakor, "Bank capital and value in the cross-section," *The Review of Financial Studies*, 2011, *24* (4), 1019–1067.

Meulbroek, Lisa K, "An empirical analysis of illegal insider trading," *The Journal of Finance*, 1992, *47* (5), 1661–1699.

Mian, Atif, Andrés Sarto, and Amir Sufi, "Estimating General Equilibrium Multipliers: With Application to Credit Markets," 2019.

Michaely, Roni, Stefano Rossi, and Michael Weber, "Signaling Safety," *Working Paper*, 2019.

Milbradt, Konstantin and Martin Oehmke, "Maturity rationing and collective short-termism," *Journal of Financial Economics*, 2015, *118* (3), 553–570.

Miller, Merton H and Kevin Rock, "Dividend policy under asymmetric information," *The Journal of finance*, 1985, *40* (4), 1031–1051.

Modigliani, Franco and Merton H Miller, "The Cost of Capital, Corporation Finance and the Theory of Investment," *The American Economic Review*, 1958, *48* (3), 261–297.

Morlacco, Monica and David Zeke, "Monetary policy, customer capital, and market power," *Journal of Monetary Economics*, 2021.

Mota, Lira, "The Corporate Supply of (Quasi) Safe Assets," *Working Paper*, 2020.

Myers, Stewart C, "Determinants of Corporate Borrowing," *Journal of Financial Economics*, 1977, *5* (2), 147–175.

Nakamura, Emi and Jón Steinsson, "High-frequency identification of monetary non-neutrality: the information effect," *The Quarterly Journal of Economics*, 2018, *133* (3), 1283–1330.

Nicolò, Gianni De, Giovanni Dell'Ariccia, Luc Laeven, and Fabian Valencia, "Monetary policy and Bank Risk-Taking," *Available at SSRN 1654582*, 2010.

O, Ricardo De La, "The Effects of Buybacks on Capital Allocation," *Working Paper*, 2019.

Olea, José Luis Montiel and Mikkel Plagborg-Møller, "Local Projection Inference is Simpler and More Robust Than You Think," *Econometrica*, 2021, *89* (4).

Olmstead-Rumsey, Jane, "Market Concentration and the Productivity Slowdown," 2020.

Ordonez, Guillermo, "Sustainable shadow banking," *American Economic Journal: Macroeconomics*, 2018, *10* (1), 33–56.

Ottonello, Pablo and Thomas Winberry, "Financial heterogeneity and the investment channel of monetary policy," *Econometrica*, 2020, *88* (6), 2473–2502.

Philippon, Thomas, *The Great Reversal*, Harvard University Press, 2019.

_ , Pierre Pessarossi, and Boubacar Camara, "Backtesting european stress tests," *NBER Working Paper No. 23083*, 2017.

Porta, Rafael La, Florencio Lopez de Silanes, Andrei Shleifer, and Robert W Vishny, "Law and Finance," *Journal of political economy*, 1998, *106* (6), 1113–1155.

Poterba, JM and L Summers, "The Economic Effects of Dividend Taxation,? in E. Altman and M. Subramanyam (eds.), Recent Advances in Corporate Finance, Richard Irwin, Homewood, Ill," 1985.

Rauh, Joshua D, "Risk shifting versus Risk Management: Investment Policy in Corporate Pension Plans," *The Review of Financial Studies*, 2009, *22* (7), 2687–2733.

Sarin, Natasha and Lawrence H Summers, *Have big banks gotten safer?*, Brookings Institution USA, 2016.

Sarto, Andres, "Recovering Macro Elasticities from Regional Data," *Unpublished manuscript, MIT*, 2018.

Schmalz, Martin C, "Common-ownership concentration and corporate conduct," *Annual Review of Financial Economics*, 2018, *10*, 413–448.

Shleifer, Andrei and Robert Vishny, "Equilibrium short horizons of investors and firms," *AEA Papers and Proceedings*, 1990, *80* (2).

Silverman, Bernard W, *Density Estimation for Statistics and Data Analysis*, Routledge, 1986.

Stein, Jeremy C, "Takeover threats and managerial myopia," *Journal of Political Economy*, 1988, *96* (1), 61–80.

_ , "Efficient capital markets, inefficient firms: A model of myopic corporate behavior," *The Quarterly Journal of Economics*, 1989, *104* (4), 655–669.

Summers, Lawrence H, "US economic prospects: Secular stagnation, hysteresis, and the zero lower bound," *Business Economics*, 2014, *49* (2), 65–73.

Syverson, Chad, "Macroeconomics and market power: Context, implications, and open questions," *Journal of Economic Perspectives*, 2019, *33* (3), 23–43.

Terry, Stephen J, "The macro impact of short-termism," *Job market paper. http://people. bu. edu/stephent/files/MIFET_LATEST_DRAFT. pdf*, 2017.

Vadasz, Tamas, "To Cut or Not to Cut: a Model of Bank Dividend Restrictions," *KU Leuven Working Paper*, 2021.

Vats, Nishant, "What does financial heterogeneity say about the transmission of monetary policy," *Working paper*, 2020.

Wang, Zigan, Qie Ellie Yin, and Luping Yu, "Real effects of share repurchases legalization on corporate behaviors," *Journal of Financial Economics*, 2021, *140* (1), 197–219.

Yagan, Danny, "Capital tax reform and the real economy: The effects of the 2003 dividend tax cut," *American Economic Review*, 2015, *105* (12), 3531–63.

Yardeni, Edward, Joe Abbott, and Mali Quintana, "Stock market indicators: S&P 500 buybacks & dividends," 2019.

Ye, Mao, Miles Zheng, and Xiongshi Li, "Price Ceiling, Market Structure, and Payout Policies," *NBER Working Paper No.28054*, 2020.