Financial Covenants and the Business Cycle*

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PRELIMINARY DRAFT

Abstract

Financial covenants in loan contracts allocate control rights between creditors and firm owners conditional on firm performance but not conditional on the aggregate state of the economy. Using data from US public firms I find that firms violating a financial covenant make up for a large fraction of the aggregate decrease in employment and investment growth during the 2001 and 2008 recessions. While financial covenants mitigate financial frictions, they might also contribute to exacerbate aggregate downturns. To investigate this possibility I build a simple model where firms have limited liability and banks are less efficient at running a firm. Contingent control rights, i.e. financial covenants, are optimal when the firm productivity distribution is dispersed enough. A mean-preserving spread in the productivity distribution increases the number of covenant violations which then leads to an aggregate downturn. Writing covenants conditional on firm performance *and* the aggregate state seems preferable in the current setting of the model.

JEL Classification: E32, E44, G31, G32

Keywords: financial constraints, debt contract, covenants, non-price terms, investment, employment

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Figure 1: **Fraction of firms in violation of a covenant** This figure shows annual data of covenant violations by aggregating firm-level data from Compustat. The sample consists of US non-financial firms (excluding SIC 6000-6999).

1 Introduction

Financial covenants allow lenders and borrowers to write more complete contracts and thus mitigate financial frictions. While contracts specify sophisticated contingent control right allocations between firms and creditors depending on the firm's performance aggregate conditions are virtually never part of these covenants. But, as figure 1 shows, the frequency of covenant violations increases strongly during recessions.

This paper is about the interaction of financial covenants and aggregate shocks, and their impact on investment and employment. I first document that firms violating a covenant during an aggregate downturn also make up for a disproportionate part of the overall decline in aggregate employment and investment growth. Then I build a model where financial covenants mitigate financial frictions but also amplify aggregate shocks.

Under which conditions is creditor control in bad states optimal? I build a three period model in the spirit of Dewatripont and Tirole (1994): productivity in the intermediate period is an imperfect signal about final period productivity. The management of a firm needs to obtain a credit line from a bank to finance the investment in the intermediate period. The contract includes how much the firm needs to repay and whether the firm or the bank are in control in the intermediate period. The management is protected by limited liability and therefore engages in risk-shifting as in Jensen and Meckling (1976). When banks are in control of the firm, they tend to under-invest because they cannot recoup all the gains from their investment as the management might shirk when the bank is in control.

When the productivity distribution is dispersed enough there is an optimal income covenant threshold. For income realizations below the threshold the bank is in control, for realizations above the threshold the management is in control of the firm. This rule minimizes the losses from both frictions because over-(under-) investment matters less when final period productivity is likely to be good (bad). An aggregate downturn occurs when the distribution of intermediate productivity becomes more spread out. More firms are pushed below the income covenant threshold and under the more conservative investment strategy of banks.

Covenants come in two main categories (Tirole, 2006): the first category explicitly prevents value-reducing actions by managers, such as diluting existing debt holders or paying excessive dividends to share holders, the second defines control rights depending on the firm's financial performance. I focus on the second category of covenants because these financial covenants are more likely to bind during aggregate downturns but are typically not conditional on the aggregate state.

Relative to the existing macroeconomic literature on financial frictions where constraints are on net worth or working capital, financial covenants include conditions based on earnings, income and cash-flow that affect a different and potentially broader set of firms. In the data I find that most firms violate a covenant after one particularly bad income realization. An economy-wide downturn might therefore cause firms to violate income covenants and loose their access to credit even though the firm's net worth remains large.

What happens after a covenant violation in practice? In case of a violation the bank has the right to ask for the immediate repayment of the entire loan. But, because banks have an interest in keeping the firm from filing for bankruptcy, they rarely do so. Most frequently banks cut access to additional credit, increase the interest rate, impose limits on investment or ask for a partial repayment of the loan. My results as well as the previous literature has found a large impact on a firm's variable after a covenant violation. This suggests that firms cannot easily substitute the decreased funding by banks.

Related literature This paper builds on a large empirical corporate finance literature: Falato and Liang (2016) find a strong negative impact of covenant violations on employment using a regression discontinuity design exploiting the discontinuity around the thresholds. Nini et al. (2009) extract investment caps from loan contracts and show that firms' investment bunches below the cap. Nini et al. (2012) investigate the impact of covenant violation on investment, firm value and CEO turnover. Relative to this literature my paper is focused on aggregate outcomes. Furthermore, I plan to improve upon the identification of the causal effect of covenant violations by using the LTCM default in 1998 as an exogenous shock to bank capital.

Acharya et al. (2013) look at the choice of firms between cash and credit lines as liquidity insurance. Because banks cannot insure against aggregate liquidity shocks they charge firms with cyclical liquidity needs a higher interest rate for a credit line. Firms with higher exposure to the aggregate cycle therefore choose cash. Acharya et al. (2014) extend their own previous model by adding the possibility for firms to engage in iliquidity transformation. This makes the revocation of a credit line optimal after a low profitability. These papers focus on corporate liquidity management whereas my paper is focused on real outcomes.

My model shares features with the models by Aghion and Bolton (1992), Dewatripont and Tirole (1994) and Garleanu and Zwiebel (2009). The main differences are the introduction of an aggregate shock and continuous investment, as I plan to move to a more dynamic and quantitative model.

Gete and Gourio (2015) add covenants to a Bernanke et al. (1999) financial accelerator model and find a dampening effect of covenants on output and employment. Relative to their model I focus on the interaction between covenants and aggregate shocks and I find an amplifying effect of covenants on real variables.

The paper is organized as follows: section 2 describes the data and presents the empirical results for the aggregate and at the firm level. The model is presented in section 3. Section 4 concludes.

2 Empirics

2.1 Data

I use quarterly firm level data starting in 1997 until 2014. The dataset consists of US public firms for which both Compustat accounting variables and their filings with the Securities Exchange Commission (SEC) are available. I use the Compustat SEC links by Nini et al. (2012) and extend it until 2014. This yields about 400'000 SEC filings for about 13'000 firms.

The dummy variable for covenant violations is based on a text classifier which classifies relevant text parts, i.e. two million excerpts containing the word covenant, from firms' SEC filings. To train the classifier I use the covenant violation dataset by Nini et al. (2012). This results in data for 92'379 firm-years from 12'059 unique firms. There are between 17'000 and 27'000 covenant violations found in the data, depending on the definition. Because of missing data in the accounting variables the number of observations in the regressions will be lower.

For a subset of firms I have extracted the financial covenant thresholds as well as the names of the main banks from their SEC filings (*work in progress*). I match the bank names with Call Reports of the Federal Deposit Insurance Corporation (FDIC). Finally, following Landier et al. (2014) I use the link provided in the Call Reports data to match each bank with its parent Bank Holding Company.

2.2 Aggregate impact of covenant violations

Do covenant violations matter for employment and investment? To try to answer this question I plot employment and investment growth rates of firms violating a covenant in a given years against

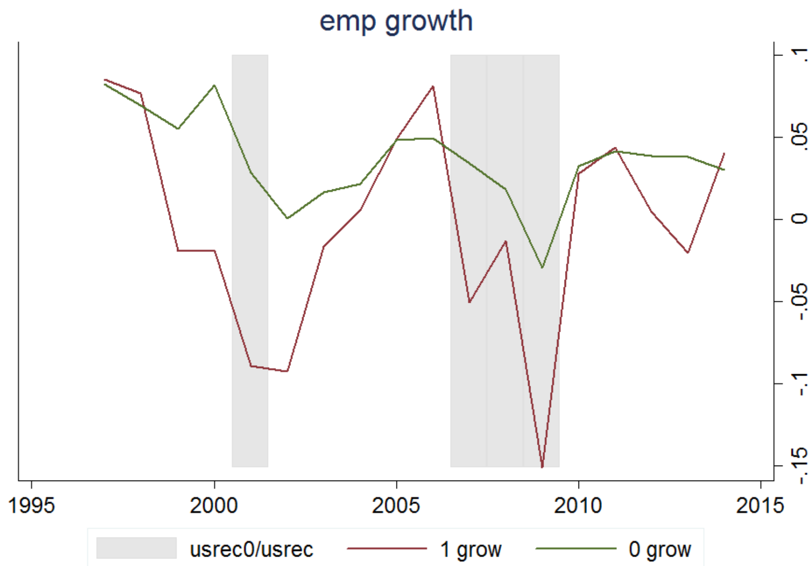

Figure 2: **Employment growth rate** This figure shows annual data of a symmetric employment growth rate by aggregating firm-level data from Compustat. The sample consists of US non-financial firms (excluding SIC 6000-6999). The difference between the growth rates of firm violating a covenant and all others is significant in the years: 1999*, 2000**, 2001*, 2007**, 2009*

the growth rates of all other firms. Because firms who violate a covenant are also more likely to be in violation of a covenant the next year I focus only on new violators, i.e. firms which have not violated a covenant during the previous year. The difference in employment growth rates in figure 2 suggests that covenant violations matter mostly during the two recessions in my sample. Figure 3 for investment points in the same direction.

As for the contribution to aggregate growth rates, all firm violating a covenant for the first time contribute two thirds to the overall decline in employment growth in 2002, and one fifth in 2009.

2.3 Firm-level impact

Because the aggregate results might be driven by large firms I present firm-level regression results in this section. The dependent variable is a measure of employment or investment at the firm. The coefficient of interest, β is the impact of violating a covenant on the the firm's employment and investment. Controls include a set of accounting ratios that are commonly used as financial covenants. Ideally I would include each firm's distance to the covenant thresholds in the regression. This would allow to identify β in a regression discontinuity setting around the covenant thresholds. Because of data limitations (*work in progress*) this is not possible. If all firms had the same covenant thresholds including these accounting ratios would be equivalent to the regression discontinuity

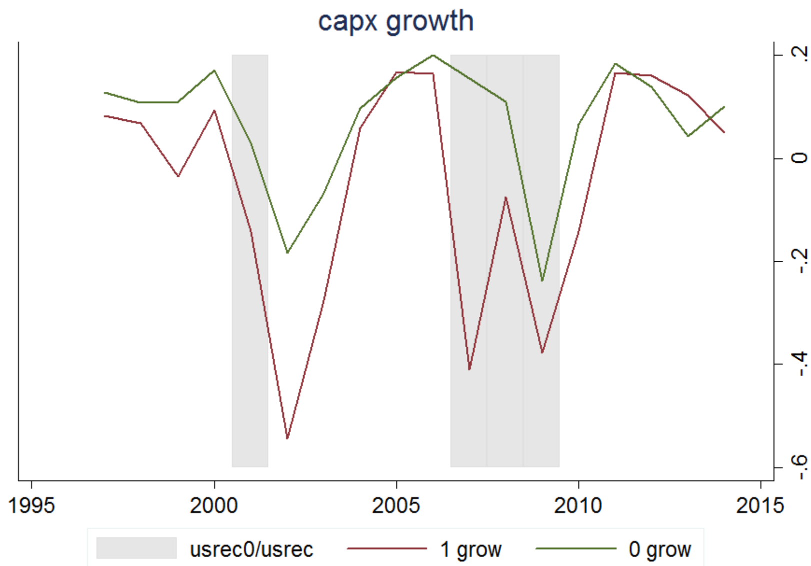

Figure 3: **Investment growth rate** This figure shows annual data of a symmetric investment growth rate by aggregating firm-level data from Compustat. The sample consists of US non-financial firms (excluding SIC 6000-6999). The difference between the growth rates of firm violating a covenant and all others is significant in the years: 2000**, 2003**, 2007*

setting.

$$empgr_{i,s,t} = \alpha_s + \beta viol_{i,t-1} + \gamma \text{covenant controls}_{i,s,t-1} + \theta X_{i,s,t-1}$$

The results in table 1 imply a large effect of covenant violations on firms' real outcomes and the coefficients are in line with the findings of the previous literature. A firm with employment growth at the median falls almost to the 25th percentile of the employment growth distribution (second column). The regression on log employment level (fourth column) implies that a firm at the median of the distribution decreases its labor force by 10 log points in the year following a covenant violation. The coefficient is five times smaller relative to Falato and Liang (2016) who use a regression discontinuity design.

2.4 Towards causality

The empirical challenge is to separate changes in the firm's outlook which might cause the firm to reduce its employment and investment from the impact the covenant violation has on real outcomes through the decreased access to bank finance. I plan to use the variation in exposure of banks to the 1998 Russian sovereign default and the following LTCM losses as in Chava and Purnanandam (2011) to identify the causal impact of covenant violations. I expect firms violating a covenant and borrowing from a more exposed bank to face a stronger restriction in credit, whereas firm characteristics are plausibly unrelated to their lender's exposure to the Russian sovereign default.

WORK IN PROGRESS

	(1) d(inv/at)	(2) empgr	(3) empgr2	(4) logEmp
firstAnnualviol31	-0.00589***	-0.0554***	-0.0481***	-0.0324***
	(-4.72)	(-5.94)	(-9.07)	(-3.95)
opCashFlowToLagAssets	0.00857***	0.0782***	0.0459***	-0.0453**
	(4.23)	(3.66)	(5.89)	(-2.11)
leverage	-0.000606	-0.0134**	-0.0162***	-0.0308**
	(-1.31)	(-2.08)	(-3.20)	(-2.33)
intExpToLagAssets	0.00833***	0.0573**	0.0544**	-0.0515
	(2.68)	(2.16)	(2.12)	(-1.00)
netWorthToAssets	-0.000369*	-0.00153	-0.00280	-0.0264***
	(-1.94)	(-0.34)	(-1.01)	(-4.11)
currentRatio	0.000170***	0.00854***	0.00752***	-0.0227***
	(3.78)	(9.32)	(9.99)	(-10.92)
MB	0.0000630	0.00263***	0.00189***	0.00565***
	(1.55)	(3.80)	(5.17)	(5.34)
sic	Yes	Yes	Yes	No
*year	No	No	Yes	Yes
firmFE	No	No	No	Yes
r2	0.0568	0.0589	0.0727	0.381
N	65910	65034	63930	65420

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 1: **Firm level regressions** This table presents regression results of firm's real variables on dummy variable indicating whether a firm has violated a covenant in a given year, while no violation has occured the previous year. The depedent variable is the change in the investment rate (column 1), a symmetric employment growth rate (column 2), a standard employment growth rate (column 3) and log employment (column 4). All independent variables are lagged by one year. Log assets, change in log assets as well as capital to assets and change in capital to assets are included in all specifications. Standard errors are clustered at the firm and year level (columns 1-3) or at the firm level (column 4)

3 Model

Firms decrease employment and investment after violating a covenant and during aggregate downturns this matters for total employment and investment growth. Why are financial covenants included in loan contracts in the first place and why is their impact stronger during aggregate downturns? To answer these questions I build a simple model with firms and banks where the interaction between an optimal allocation of control rights and an aggregate shock yields a decrease in aggregate investment and output.

Setup Time is discrete and there are three periods. The players are an entrepreneur and a bank, both are risk-neutral. The model is in partial equilibrium and the discount rate is zero. The entrepreneur needs funding in the initial period as well as pre-arranged funding for the intermediate period, i.e. a credit line. I assume that the entrepreneur has no other sources of financing than the bank.

t_0	t_1	t_2
contract:	s & z realized	ϵ realized
control rights	production	production
payments	reinvestment	repayment or default

Table 2: Timing

In the first period the bank and the firm write a contract which specifies control rights for the intermediate periods and the payments to be made in the last period. The banking sector is competitive, therefore the entrepreneur obtains all the surplus. In the intermediate period the idiosyncratic productivity shock and the aggregate shock are realized, production occurs and the player in control decides about investment. In the last period idiosyncratic productivity is realized, production occurs, the entrepreneur may default and payments are made in case of no default.

The intermediate period productivity shock s is an imperfect signal about final productivity ϵ such that :

$$s = \epsilon + u$$

where u is a mean zero noise term. The aggregate shock z affects the variance of u: in the good aggregate state u has low variance, in the bad aggregate state u has high variance.

There are two main frictions in the model: The entrepreneur is protected by limited liability and therefore tends to invest too much relative to the frictionless first best amount. The bank, when in control, can only extract a limited amount of the profits. This is a reduced form way of modeling a moral hazard problem. When the bank is in control the entrepreneur still needs to operate the firm, but might be less motivated to do so, because he is only working to repay his bank debt.

Having a friction on both the entrepreneur and the bank is crucial for an optimal income covenant. If either the entrepreneur or the bank invested the frictionless amount, it would be optimal to always give this agent the control right.

I assume t_1 investment to be non-contractible, for example because at t_0 it is not possible to describe next period's investment opportunities in sufficiently precise terms. The contract can specify a threshold value $\hat{s}$ allocating control rights between the entrepreneur and the bank in the intermediate period[1]. I will call $\hat{s}$ an income covenant. The repayments can also be dependent on who is in control. I do not consider other non-price contract terms such as collateral, other types of covenants and different maturity structures. Furthermore the bank is always honoring its commitment to the firm.

The repayment by the firm to the bank can be interpreted as a commitment fee. The bank charges this fee for making the credit line available to the firm, inependently of whether the firm uses it or not. The repayment by the bank to the firm can be interpreted a partial default of the firm.

The solution of the model is an optimal income covenant threshold $\hat{s}$, initial investment, intermediate period investment and final period repayment conditional on the agent being in control[2]. I start by the t_1 period problem for when either the entrepreneur or the bank is in control, then move to the period t_0 which consists in maximizing the entrepreneur's payoff subject to the bank's break even constraint and given the t_1 solution.

The entrepreneur's t_1 problem The entrepreneur maximises his expected payoff c_{2f} with respect to next period's capital stock k_2 and the amount drawn from the credit line ρ_1. Because of limitied liability he only takes into account states with positive payoff. At time t_1 the entrepreneur knows the realization of s and z.

$$\max_{\{k_2,\rho_1\}} Pr(c_{2f} > 0|s(z)) \mathop{\mathbb{E}}_{\epsilon} [c_{2f}|s(z), c_{2f} > 0]$$

The entrepreneur's ressources at t_1 consist of t_1 production, the remaining capital and the amount drawn from the credit line ρ_1 which are used to finance k_2. I assume the entrepreneur does not consume in t_1.

$$sf(k_1) + (1-\delta)k_1 + \rho_1 \geq k_2, \text{ with } k_2 \geq 0$$

[1]Because real world loan contracts are not conditional on the aggregate state I do not allow the contract to be conditional on z, I will relax this

[2]When the bank is in control I do not mean the bank employees are running the firm but rather the bank changes the credit limit in way that implements the bank's investment choice

In period t_2 output and the remaining capital net of the repayment of the initial loan w_b and the drawn portion of the credit line is split between the fixed payment to the bank $\tilde{c}_{2b}$ and the entrepreneur's payoff[3].

$$\epsilon f(k_2) + (1-\delta)k_2 - (1+r)^2 w_b - (1+r)\rho_1 \geq c_{2f} + \tilde{c}_{2b}$$

The bank's t_1 problem If the bank is in control in period t_1 it faces the same problem as the entrepreneur except that it only takes into account states where the payoff is below c_{max}. c_{max} is the maximal incentive compatible amount the bank can make the entrepreneur pay to the bank when the bank is in control.

$$\max_{\{k_2,\rho_1\}} Pr(c_{2b} < c_{max}|s) \mathop{\mathbb{E}}_{\epsilon} [c_{2b}|s(z), c_{2b} < c_{max}] + Pr(c_{2b} \geq c_{max}|s) c_{max}$$

The t_1 budget constraint is the same as for the entrepreneur in control. In period t_2 the net surplus is split between a fixed payment to the $\tilde{c}_{2f}$ entrepreneur and the bank's payoff c_{2f}. For simplicity I assume that if the bank's payoff exceeds the maximal amount c_{max}, the remainder is lost in court proceedings.

$$\epsilon f(k_2) + (1-\delta)k_2 - (1+r)^2 w_b - (1+r)\rho_1 \geq c_{2b} + \tilde{c}_{2f}$$

The t_0 problem In t_0 the entrepreneur and the bank write a contract which specifies the income covenant threshold $\hat{s}$, the initial loan w_b, the initial investment k_1 and the fixed repayments $\tilde{c}_{2b}$ and $\tilde{c}_{2f}$. Under the assumption of a competitive banking sector the contract terms are chosen to maximize the entrepreneur's expected payoff subject to the bank breaking even. The first term inludes all states where the entrepreneur is in control and his expected payoff is positive. The second term takes into account the fixed payment from the bank when the entrepreneur is not in control.

$$\max_{\{\hat{s},\tilde{c}_{2b},\tilde{c}_{2f},k_1,w_b\}} Pr(s \geq \hat{s} \cap c_{2f} > 0) \mathop{\mathbb{E}}_{\epsilon,s(z)} [c_{2f}|s \geq \hat{s} \cap c_{2f} > 0] + Pr(s < \hat{s})\tilde{c}_{2f}$$

The bank's break even constraint takes into account the losses the bank has to cover when the entrepreneur is in control (the first term) and the payoffs when being in control (the second term).

[3] This is quite realistic as banks typically charge firms a baseline rate plus a risk premium per credit line unit drawn and a fixed committment fee.

$$0 \leq Pr(s \geq \hat{s}) \left[Pr(c_{2f} < 0 | s \geq \hat{s}) \underset{\epsilon, s(z)}{\mathbb{E}} [c_{2f} | c_{2f} < 0 \cap s \geq \hat{s}] + \tilde{c}_{2b} \right] +$$
$$Pr(s < \hat{s}) \left[Pr(c_{2b} < c_{max} | s < \hat{s}) \underset{\epsilon, s(z)}{\mathbb{E}} [c_{2b} | s < \hat{s} \cap c_{2b} < c_{max}] + Pr(c_{2b} > c_{max} | s < \hat{s}) c_{max} \right]$$

The intial loan w_b and the entrepreneur's own funds w_f have make up for initial investment. Because of limited liability $\tilde{c}_{2f}$ has to be positive.

$$w_f + w_b \geq k_1 \qquad \tilde{c}_{2f} \geq 0$$

3.1 Solution

I solve the model numerically. Before discussing the numerical solution I will present the trade-offs the entrepreneur faces in period t_1 for a simple two state example and the trade-offs in t_0.

Mechanism at work in t_1 Here I assume that ϵ can only take two values: $\epsilon \in \{\underline{\epsilon}, \bar{\epsilon}\}$. The entrepreneur can then choose between two levels of investment: he can either invest such that he never defaults or he can invest such that he defaults only when the low productivity state is realized., i.e. $\epsilon = \underline{\epsilon}$. Equation 1 is the difference between the payoffs under no default and default in the low productivity state:

$$\underbrace{\pi_{\bar{\epsilon}|s} \bar{\epsilon} \left(f(k^*_{2,d}) - f(k^*_{2,n}) \right)}_{\text{gain in good state}} - \underbrace{\pi_{\underline{\epsilon}|s} \underline{\epsilon} f(k^*_{2,n})}_{\text{loss in payoff}} + \underbrace{(1 - \pi_{\bar{\epsilon}|s}) \Omega(s)}_{\text{less likely repayment}} + \underbrace{(r + \delta)(k^*_{2,n} - \pi_{\bar{\epsilon}|s} k^*_{2,d})}_{\text{less likely but higher}} > 0 \tag{1}$$

with $\Omega(s) = \tilde{c}_{2b} + (1 + r)^2 w_b - (1 + r)(s f(k_1) + (1 - \delta) k_1)$

If the entrepreneur decides to default in the low productivity state he increases his payoff in the high productivity state but foregoes any payoff in the low state. In addition when defaulting he will be less likely to repay the fixed amount but total repayment will increase as optimal investent is higher.

The entrepreneur will therefore be more likely to default if: the productivity difference $\Delta\epsilon$ is higher or when the fixed repayment $\Omega(s)$ is large. The latter effect is the well-known "gamling for resurrection" mechanism.

Mechansim at work in t_0 The income covenant $\hat{s}$ is chosen to minimize the distortion coming from both the entrepreneur's and the bank's friction when investing in t_1. The fixed repayments

$\tilde{c}_{2f}$ and $\tilde{c}_{2b}$ influence the bank's break even condition in t_0 and how likely the two frictions are binding in t_1. An increase $\tilde{c}_{2b}$, the payment from the firm to the bank, relaxes the bank's zero profit condition but increases the probability that the entrepreneur choses an investment plan with default in some states in the intermediate period. Conversely, a higher $\tilde{c}_{2f}$, the payment from the bank to the firm, tightens the bank's zero profit condition but decreases the probability of the bank choosing an investment plan where the maximal payout friction is binding. The initial loan size, w_b, increases both t_1 output but also t_2 repayment.

Numerical solution I solve the model by guessing values for $\hat{s}$, w_b, $\tilde{c}_{2b}$ and $\tilde{c}_{2f}$ to solve the t_1 problems. Given the t_1 solutions $\{k_2^{s*}\}$ and $\{\rho_1^{s*}\}$ I compute the entrepreneur's payoff and check whether the bank's break even constraint is satisified. The parameter values used are in the Appendix.

I find the that $\hat{s} = s_3$, $\tilde{c}_{2f} = 32$, $\tilde{c}_{2b} = 19$ and $w_b = 37$.

Proposition 1. *When the productivity distribution is dispersed enough there is an optimal income covenant threshold. For income realizations below the threshold the bank is in control, for realizations above the threshold the management is in control of the firm.*

The intuition is the following: Starting from a productivity distribution under which the optimal income covneant threshold is not at a corner, suppose the productivity distribution becomes less dispersed. If the decrease is large enough then $\tilde{c}_{2b}$, the payment from the firm to the bank, can be decreased such that the firm never defaults. Or $\tilde{c}_{2f}$ can be increased such that the friction on the bank side is never binding. Then it will be optimal to allocate the control rights to the agent whose friction never binds.

Under the more dispersed productivity distribution the income covneant minimizes the losses from both frictions. Over-(under-) investment matters less when final period productivity is likely to be good (bad).

Figure 4 illustrates the optimal t_1 investment for different control right allocations. In the upper left panel the firm is in control in ever s state and invests more than the frictionless amount. Giving the bank control rights when $s = s_1$ means the bank invests close to the frictionless amount when it is in control. But as the bank gets control rights for more s states its investment moves away from the frictionless amount. This is because $\tilde{c}_{2b}$ decreases and $\tilde{c}_{2f}$ increases, from the break even constraint, making both the firm's and the bank's more likely to bind.

The next step is to investigate the interaction between the optimal income covenant and the aggregate state z. How does the optimal income covenant affect the economy in a downturn?

Aggregate downturn An aggregate downturn $z = z_L$ increases the variance of u and therefore spreads out the s distribution and makes s less informative about ϵ. By assumption neither the mean of s nor ϵ change. Table 3 shows the change in aggregate variables. Relative to the good aggregate

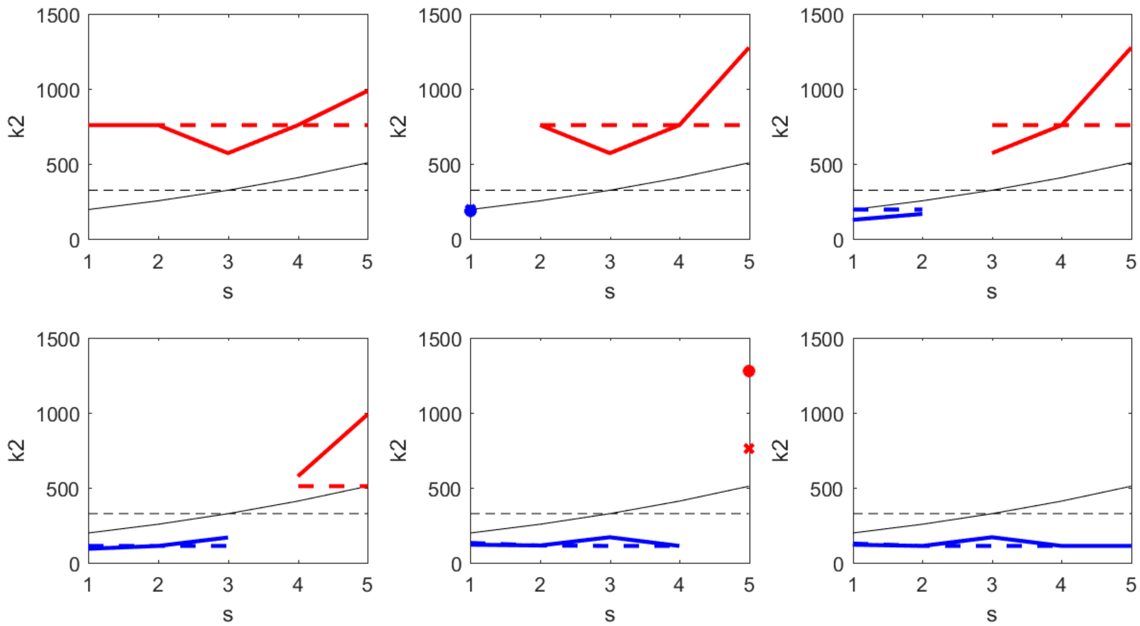

Figure 4: t_1 investment for different control right allocations, blue: firm in control, red: bank in control, black: frictionless investment, solid line: $z = z_H$, dashed line:$z = z_L$

	K	Y	C_{2f}	C_{2b}
t_1	100	100.1	-	-
t_2	94.5	94.3	106.5	-99.5

Table 3: Aggregate variables: $x(z_L)$ in % of $x(z_H)$

state more firms are pushed below the income covenant threshold and under the more conservative investment strategy of banks. This decreases aggregate investment in the intermediate period and output in the final period. There is, however, a second effect going in the opposite direction: because the signal is less informative during a recession firms decrease and banks increase their investment.

When the signal s is less informative about ϵ during the bad aggregate state an income covenant conditional on the aggregate state would improve the firm's payoff. In the extreme case of a completely uninformative signal shown in figure 4 it would be optimal to always give control in the bad aggregate state to the agent that invests closer to the frictionless amount, under this parametrization the bank.

4 Conclusion

Firms violating a financial covenant decrease their employment and investment. During aggregate downturns the contribution of all firms violating a covenant to the overall decline in employment and investment growth seems to be large. These stylized facts together with the fact that financial covenants are typically not conditioned on the aggregate state are the motivation for my model.

The model's main ingredients are limited liability and a moral hazard problem when the bank decides about the firm's investment problem. An optimal allocation of control rights between the firm and the bank emerges as long as the productivity distribution is sufficiently spread out. The optimal income covenant gives control to the firm in good states when limited liability matters less and conversely gives the bank control of the firm in bad states. Under the optimal income covenant a mean-preserving spread can cause an aggregate downturn. Conditioning covenants on the aggregate state would seem beneficial when the productivity signal is less informative during the bad aggregate state.

I plan to use plausibly exogenous variation in banks' health to identify the causal effect of covenant violations on firms. On the theory side I will add an intermediate liquidity constraint on banks, which might be the reason why banks do not want covenants to be conditional on the aggregate state.

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Appendix

I use the follwoing values for the parameters:

Table 4: Parameter values

$\alpha = 0.75$	$c_{max} = 7.5$	$\delta = 0.1$	$w_f = 10$	$r = 0.05$

There are two aggregate states and 5 idiosyncratic producitivity states.

- $\epsilon \in \{0.45, 0.65, 0.85, 1.05, 1.25\}$
- $s \in \{0.4, 0.475, 0.55, 0.625, 0.7\}$

The probabilities for the aggregate state are $\pi_{z=z_H} = \pi_{z=z_L} = \frac{1}{2}$. The probabilities for s conditional on z have been chosen such that:

$$\mathbb{E}(s|z = z_H) = \mathbb{E}(s|z = z_L) \quad \text{and} \quad v(s|z = z_H) < v(s|z = z_L)$$

$$\pi_{s|z=z_H} = \{0.13\ 0.23\ 0.39\ 0.17\ 0.08\ \}$$

$$\pi_{s|z=z_L} = \{0.27\ 0.23\ 0.1\ 0.17\ 0.23\ \}$$

The transition probabilities for ϵ conditional on s and z are as follows:

$$\pi_{\epsilon_i|s_j,z=z_L} = \begin{cases} 0.4 \text{ if i=j} \\ 0.15 \text{ else} \end{cases}$$

$$\pi_{\epsilon_i|s_j,z=z_L} = 0.2$$

Therefore the signal s is informative about ϵ in the high aggregate state but completely uninformative in the low aggregate state.