# Supplementary Appendix: Anatomy of Corporate Borrowing Constraints

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## IA1 Contracting Bases of Earnings-Based Covenants

Below we illustrate the contracting functions of earnings-based covenants in cash flow-based lending.

In the simplest case where the borrower's cash flows are completely exogenous, the lender can just determine debt capacity at issuance based on expected cash flows. The lender does not need to constantly monitor each period's cash flows/earnings and restrict debt capacity. To understand why creditors closely monitor cash flows/earnings in each period, we consider two types of frictions that can give rise to earnings-based covenants.

### IA1.1 Summary of Mechanisms

*Earnings-Based Covenant and Incentive Provision*

The first explanation is based on the role of financial covenants as an incentive scheme. We study a setting in the spirit of Innes (1990). In this setting, cash flows are verifiable and contractible, consistent with the institutional background of cash flow-based lending discussed above. However, the borrower needs to make an effort choice, and the effort is unobservable and not contractible. Effort is costly and the borrower may want to shirk (moral hazard), so financial contracts are designed to provide incentives for high effort.

In a standard debt contract, there is one breakpoint (default threshold) that serves two functions: satisfying the creditor's participation constraint (break-even condition) and incentivizing the borrower to exert effort (default is costly to the borrower). Adding a covenant allows the creditor to specify a separate threshold, covenant violation, for incentive provision. Covenant violation imposes costs to the borrower, such as punishment fees or significant non-monetary costs (time spent dealing with creditors, restrictions on corporate policies, management being replaced, etc.), and incentivizes the borrower to work hard to avoid violation. By allowing the contract to decouple the incentive effect from the breakeven condition, the covenant can decrease the cost of incentivizing the borrower (helps satisfy the borrower's incentive compatibility constraint). The formal model is shown below in Section IA1.2.

*Earnings-Based Covenant as Contingent Transfer of Control Rights*

The second explanation views covenant violation as a signal that default on debt payment may become possible, and the creditor should consider stepping in to take actions. Specifically, when earnings are above the threshold specified by the covenant, default is remote; creditors can rest assured and do not need to pay much attention. When earnings fall below the covenant threshold, there are warning signs that the borrower's ability to pay back the debt could be in question and creditors may suffer losses. In this case, creditors may want to step in and take some otherwise costly actions to improve firm performance. Because creditors enjoy most of the benefits from such actions (such actions only improve firm performance in bad states), the borrower/firm shareholders cannot commit to it. As a result, financial covenants are placed in debt contracts as an early warning sign, and they can trigger partial transfers of control rights to creditors. This view builds along the idea of contingent control rights (Aghion and Bolton, 1992) and the evidence on control right transfers following covenant violations (Chava and Roberts, 2008; Roberts and Sufi, 2009). The formal model is shown below in S IA1.3.

*Why Covenants based on Earnings/EBITDA?*

Finally, we discuss why financial covenants in cash flow-based lending emphasize current earnings as a key metric to serve the contracting functions discussed above (incentive provision or contingent transfer of control rights). The evaluation metric needs to have several properties. First, it needs to be informative about firm performance, which is central to both of the rationales we considered. Firm performance shows the manager's effort. It also signals the necessity for creditor interventions (the borrower's financial performance/cash flow value is especially important to creditor payoffs in cash flow-based lending). Second, the metric needs to be easy to observe and measure, so that it can be assessed on a frequent basis, and borrowers and lenders do not dispute its value.

In the US, with an accounting system that is reliable and well-designed to reflect the economic activities of the firm, earnings are informative and serve as a central measure of performance. Moreover, among various possible measures of earnings, creditors place most weight on EBITDA to reflect the performance and cash flow generation ability of the firm's core business.[1] Financial covenants also focus on current/recent earnings which are readily observable based on financial statements, rather than future earnings which are unobservable and not easily contractible.[2]

[1]For instance, taxes and interests are excluded because they can be affected by different capital structures different firms have. The exclusion makes EBITDA more comparable across firms.

[2]One may wonder whether financial covenants can use other measures. We discuss several alternatives and why they are not applied in cash flow-based lending. First, relative to earnings, the value of physical assets can be driven by many factors and is less informative about the borrower's performance. It can also be difficult to measure on a frequent basis, especially when assets are specialized and illiquid. Second, statistical measures of distance/probability to default can be relevant, but they are difficult to assess. Debtors and

## IA1.2 Model 1: Incentive Provision

Below we provide a model that illustrates the role of financial covenants for incentive provision.

The model has two stages, $t = 1, 2$. In stage $t = 1$, the risk neutral borrower needs to borrow $B > 0$ dollars from the risk neutral creditor to continue operations. If operations continue, the borrower needs to make an unobservable effort choice, $e \in \left\{e^L, e^H\right\}$, generating cost $g(e)$ to the borrower. In stage $t = 2$, the borrower generates observable and verifiable earnings/cash flows $R$ with p.d.f. $f_e(R)$ and c.d.f. $F_e(R)$, where $e \in \left\{e^L, e^H\right\}$, and needs to repay debt obligations. We assume a competitive lending market, so the optimal contract maximizes the borrower's payoff, subject to the creditor's participation constraint (IR-C) and the borrower's incentive compatibility constraint of not shirking (IC-B).[3] For simplicity, we assume the gross interest rate to be 1.

We focus on whether adding an earnings-based covenants to an otherwise standard debt contract[4] can improve the borrower's payoff. The face value of debt is denoted by $D > 0$. On top of it, an earnings-based covenants with threshold $C \geq D$ can be added. When the covenant is violated, the borrower faces a "technical default," and bears a non-monetary cost of $\bar{A} > 0$ (which may come from creditor interventions, time costs of dealing with creditors, career costs, etc.). When $C = D$, the contract degenerates to a standard debt contract, and the borrower only incurs the non-monetary cost if he misses debt payment.[5]

In this environment, the optimal debt contract (with covenants) solves the following constrained maximization problem:

$$U^* = \sup_{C,D} \int \left(\max\{R-D,0\} - \bar{A}1_{\{R<C\}}\right) f_{e^H}(R)\,dR - g\left(e^H\right) \equiv \sup_{C,D} U^B(C,D), \quad (1)$$

$$s.t.\ \ IC-B: \int \left(\max\{R-D,0\} - \bar{A}1_{\{R<C\}}\right) f_{e^H}(R)\,dR - g\left(e^H\right) \geq$$

$$\int \left(\max\{R-D,0\} - \bar{A}1_{\{R<C\}}\right) f_{e^L}(R)\,dR - g\left(e^L\right), \quad (2)$$

$$IR-C: \int \min\{R,D\} f_{e^H}(R)\,dR \geq B, \quad (3)$$

$$C \geq D, \quad (4)$$

creditors can dispute about the computation, making it harder to contract on. Finally, financial covenants also do not use metrics such as stock prices, which can fluctuate due to non-fundamental reasons. In addition, investors can deliberately influence stock prices to trigger or avoid covenant violations, which can significantly complicate the situation.

[3]We assume the cost of not continuing operations to the borrower is very high, so the borrower's participation constraint always holds.

[4]Innes (1990) shows that a debt-like contract is optimal in this environment, as it provides best incentives for the borrower to work. That is why we focus on debt contracts here. We discuss the relationship with the particular contract Innes (1990) considered in footnote 7.

[5]For simplicity, in the current environment, the non-monetary cost $\bar{A}$ to the borrower when the covenant is violated (i.e. $D \leq R < C$) and such cost when the borrower misses debt payment (i.e. $R < D$) is the same. The key result, Proposition A1, extends to settings where the non-monetary costs at these two events are different. Moreover, Proposition A1 also holds when there is additional monetary cost of the payment default (e.g. monetary cost associated with bankruptcy).

Condition (1) specifies the payoff to the borrower. It consists of three components. First, $max\{R - D, 0\}$ is the monetary payoff to the borrower when the realized earnings/cash flows is $R$. Second, the borrower incurs a non-monetary cost $\bar{A}$ when the covenant is violated or debt payment is missed. Third, the borrower incurs a cost of $g\left(e^H\right)$ by exerting high efforts. Condition (2) specifies the borrower's incentive compatibility constraint of not shirking (IC-B): the borrower's utility is higher under $e^H$ than $e^L$.[6] Condition (3) specifies the expected payoff to the creditor is weakly higher than the amount lent to the borrower, $B$, so the creditor has incentive to participate (IC-R). Condition (4) requires the covenant violation cutoff to to be weakly higher than the debt face value/payment default threshold.

Under the standard debt contract, $C = D$: the incentive effects provided by the non-monetary costs are determined by the face value of debt $D$ (under the standard debt contract, the utility difference between high and low levels of effort, which comes from from the non-monetary cost, is $\int -\bar{A}1_{\{R<D\}} f_{e^H}(R)\,dR - \left(\int -\bar{A}1_{\{R<D\}} f_{e^L}(R)\,dR\right) = \bar{A}\left(F_{e^H}(D) - F_{e^L}(D)\right)$). Adding an earnings-based covenant, $C > D$, allows the contract to decouple debt payment, $D$, and incentive effects (the utility difference between high and low efforts coming from the non-monetary cost is now given by $\int -\bar{A}1_{\{R<C\}} f_{e^H}(R)\,dR - \left(\int -\bar{A}1_{\{R<C\}} f_{e^L}(R)\,dR\right) = \bar{A}\left(F_{e^H}(C) - F_{e^L}(C)\right)$). The introduction of earnings based covenants helps to provide more effective incentives for the borrower to exert high effort, and helps to achieve the constrained optimum. We formalize this intuition in Proposition A1.[7] We state a few standard (technical) assumptions first.

**Assumption A1** (Full and Non-Moving Support)**.** *The p.d.f of $R$ satisfies:*

$$f_{e^L}(R), f_{e^H}(R) > 0,\ \forall R \in [R_{\min}, R_{\max}];$$

$$f_{e^L}(R) = f_{e^H}(R) = 0,\ \forall R \notin [R_{\min}, R_{\max}].$$

**Assumption A2** (Monotone Likelihood Ratio Property (MLRP))**.** *The likelihood ratio $L(R) = \frac{f_{e^H}(R)}{f_{e^L}(R)}$ is increasing in $R \in [R_{\min}, R_{\max}]$.*

Assumptions A1 and A2 are standard regularity assumptions to make the problem well behaved. By Assumption A2, there exists $\bar{R}$, such that

[6] This raises the question of why the optimal contract wants to implement high effort $e^H$, instead of shirking $e^L$. We assume $\int R f_{e^L}(R)\,dR < B$. As a result, the expected payoff generated by shirking is not enough to compensate the creditor. A contract implementing $e^L$ cannot satisfy creditor's participation constraint.

[7] Innes (1990) considers two types of contracts: a "live or die" contract and a standard debt contract. The "live or die" contract features a discrete jump in the borrower's payoff if he does not default on debt payment, similar to the effect of $\bar{A} > 0$ here. This is the optimal contract without any restriction on the contract space. However, a contract with discrete jumps may create incentives for the borrower to get a few extra dollars and avoid the jump. The debt contract Innes (1990) considers avoids such the discrete jump of the borrower's payoff (this requires $\bar{A} = 0$ in our notation), and provides a smooth payoff scheme. In our view, as widely documented in the empirical literature on debt covenants, the event of covenant violation indeed incurs significant costs to the borrower, and borrowers try to avoid such violations. However, this cost should not be a free variable that can be chosen by the contract as in the "live or death" contract. As a result, we choose a fixed cost $\bar{A} > 0$ and explores its implications for optimal contract design.

$$\begin{cases} L(R) = \frac{f_{e^H}(R)}{f_{e^L}(R)} < 1 & R < \bar{R} \\ L(R) = \frac{f_{e^H}(R)}{f_{e^L}(R)} \geq 1 & R \geq \bar{R}. \end{cases}$$

Now we state the assumption under which at least one contract will satisfy the constraints in conditions (2), (3) and (4), so the problem in (1) is well defined.

**Assumption A3.** *[Existence]*

*i) Under high efforts, the borrower generates enough output to repay the creditor:*

$$\int R f_{e^H}(R)\, dR > B.$$

*As a result, there exists a* $\bar{D} \in [0, R_{\max})$ *that uniquely pins down the creditor's break-even condition,*

$$\int \min\left\{R, \bar{D}\right\} f_{e^H}(R)\, dR = B, \tag{5}$$

*thus condition (3) holds with equality.*

*ii) Under contract* $(C, D) = \left(\max\left\{\bar{D}, \bar{R}\right\}, \bar{D}\right)$*, the borrower's IC condition gets satisfied:*[8]

$$\begin{aligned} &\int \left(\max\left\{R - \bar{D}, 0\right\} - \bar{A}1_{\left\{R<\max\{\bar{D},\bar{R}\}\right\}}\right) f_{e^H}(R)\, dR - g\left(e^H\right) \geq \\ &\int \left(\max\left\{R - \bar{D}, 0\right\} - \bar{A}1_{\left\{R<\max\{\bar{D},\bar{R}\}\right\}}\right) f_{e^L}(R)\, dR - g\left(e^L\right). \end{aligned} \tag{6}$$

We will now be able to formalize the previous intuition about why earnings-based covenants are helpful, and state Proposition A1.

**Proposition A1.** *Under Assumptions A1, A2 and A3, we establish:*

*(i) The set of contracts that satisfy all of the constraints (2) - (4) are non-empty. Moreover, there exists a contract* $(C^*, D^*)$ *that achieves the supremum* $U^*$ *defined in condition (1).*

*(ii) In any optimal contract, the face value of debt always pins down the creditor's break-even condition. That is,* $D^* = \bar{D}$*, where* $\bar{D}$ *is defined in (5).*

*(iii) Suppose that the borrower's IC constraint is not satisfied under a simple debt contract with face value* $\bar{D}$*,*

$$\begin{aligned} &\int \left(max\left\{R - \bar{D}, 0\right\} - \bar{A}1_{\left\{R<\bar{D}\right\}}\right) f_{e^H}(R)\, dR - g\left(e^H\right) < \\ &\int \left(max\left\{R - \bar{D}, 0\right\} - \bar{A}1_{\left\{R<\bar{D}\right\}}\right) f_{e^L}(R)\, dR - g\left(e^L\right). \end{aligned} \tag{7}$$

[8] In fact, we can prove that, if condition (6) is violated, the borrower's IC condition is not satisfied under any contract. In this sense, contract $(C, D) = \left(\max\left\{\bar{D}, \bar{R}\right\}, \bar{D}\right)$ is the "best" contract in terms of helping to achieve the borrower's IC constraint.

*In any optimal contract, the cutoff of covenant violation is strictly higher than the face value of debt.*

$$C^* > D^*. \tag{8}$$

Part (i) of the Proposition proves the existence of the optimum under the previous assumptions. Part (ii) shows that once the option of adding a financial covenant is available, the face value of debt is *always* pinned down by the creditor's break-even condition. In this sense, the introduction of financial covenant decouples the face value of debt/debt payment, $D$, and incentive effects. Part (iii) shows, as long as a simple debt contract with face value $D = \bar{D}$ is not enough to incentivize the borrower to put high efforts[9], the optimal contract *always* features a higher cutoff for covenant violation than the face value of debt.

The role of covenants as an incentive scheme also provides a rationale about why EBITDA is chosen as the key earnings measure used in practice. Among financial variables, it is among the most informative ones about firm performance (e.g. excluding windfalls etc.) and thus managers' efforts. Moreover, this metric is easy to observe and measure. It can be assessed on a frequent basis, and borrowers and lenders do not constantly dispute its value.

## IA1.3 Model 2: Contingent Transfer of Control Rights

Now we present a model formulating the role of financial covenants for contingent transfer of control rights.

The model has three stages, $t = 1, 1.5, 2$. The gross interest rate is normalized to be 1 throughout.

In stage $t = 1$, the risk neutral borrower needs to borrow $B > 0$ dollars from the risk neutral creditor to continue operations.[10] Different from the first explanation in Section IA1.2, there is no ex ante effort choice. We thus emphasize that the second explanation does not depend on the role of earnings-based covenants as an incentive scheme.[11] Instead, the earnings/cash flows generated at stage $t = 2$, $R(x)$, is a function of the exogenous state of the world, $x \in [x_{\min}, x_{\max}]$, in stage 2. Without loss of generality, we assumes $R(x)$ is increasing in $x$.[12]

In the intermediate stage $t = 1.5$, an observable state of nature $s \in [s_{\min}, s_{\max}]$ is revealed, which serves as a "signal" about $x$. When $s$ is low (high), it means low (high) $x$ is more likely. In particular, let $F_s(x)$ denote the distribution (c.d.f.) of $x$ conditional on

[9]This is what condition (7) means. If it does not hold, then the friction due to ex ante moral hazard does not matter for the contract design, and we go back to the first best (the problem is uninteresting in this case).

[10]Similar to the model above, we assume the cost of not continuing operations to the borrower is very high, so the borrower's participation constraint always holds.

[11]As we will see, the crucial friction in the first explanation is the borrower's unobservable ex ante efforts choice. The crucial friction in the second explanation is that the borrower cannot commit to some ex post actions that are beneficial in the bad states.

[12]We also assume $E[R(x)] > B$, so there is enough output to compensate the borrower.

$s$. We assume, if $s > s'$,

$$F_s(x) \text{ first order stochastic dominates } F_{s'}(x). \tag{9}$$

As a result,

$$E[R(x)|s] \text{ is increasing in s.}$$

In this intermediate stage, an additional action can be taken, which generates additional observable and verifiable earnings/cash flows $Y(x)$ in stage $t = 2$. Such actions are only efficient when $x$ is bad. In particular, $Y(x)$ is decreasing in $x$ (We still maintain that $Y(x) + R(x)$ is increasing in $x$.) Moreover, there is an cutoff $\bar{x} \in (x_{\min}, x_{\max})$, such that

$$\begin{cases} Y(x) > 0 & \text{if } x < \bar{x} \\ Y(x) \leq 0 & \text{if } x \geq \bar{x} \end{cases}. \tag{10}$$

Such an action can be thought as an "emergency plan" that is otherwise costly in the good states of the world.

In stage $t = 2$, the state of nature $x$, is revealed, and the borrower generates observable and verifiable earnings/cash flows $R(x)$. If the "emergency plan" project is taken, an additional observable and verifiable earnings/cash flows $Y(x)$ is generated. The borrower needs to repay his debt obligations, with face value $D$, in stage 2. As before, we assume a competitive lending market, so the optimal contract maximizes the borrower's payoff, subject to the creditor's participation constraint (IR-C).

Let us first consider the first best, where the "emergency plan" project is taken if and only if $s \leq \bar{s}$, where $\bar{s}$ is the cutoff such that[13]

$$\begin{cases} E[Y(x)|s] > 0 & \text{if } s < \bar{s} \\ E[Y(x)|s] \leq 0 & \textit{if } s \geq \bar{s} \end{cases}.$$

Under first best, the creditor's realized payoff is $\min\{D, R(x) + Y(x) 1_{s<\bar{s}}\}$. To satisfy the creditor's participation constraint (IR), it must be the case that $E[\min\{D, R(x) + Y(x) 1_{s<\bar{s}}\}] \geq B$. A competitive lending market then pins down $D = D^*$ by letting the previous condition hold with equality. The borrower's realized utility is then given by $\max\{R(x) + Y(x) 1_{s<\bar{s}} - D^*, 0\}$.

How can the first best can be implemented? A standard debt contract in which the borrower always has control rights in the intermediate stage $t = 1.5$ may not do the job. This is because the "emergency plan" is beneficial in bad states of the world, but is otherwise costly in good states of the world; the creditor enjoys the majority of benefits from such an action, and the borrower may not be able to commit to implementing it even when $s$ is revealed revealed in the intermediate stage.[14] For example, we have:

[13] The existence of such cutoff comes from conditions (9) and (10).

[14] Such frictions is akin to frictions studied in the "debt overhang" literature (Myers, 1977).

**Proposition A2.** *Assume $R(x_{\min}) \leq D \leq R(x_{\max})$, so there exists a unique $x_D$ such that $R(x_D) = D$.*[15] *As long as $Y(x_D) \leq 0$, for all $s$,*

$$E[max\{R(x) + Y(x) - D, 0\}|s] \leq E[max\{R(x) - D, 0\}|s]. \quad (11)$$

*Moreover, if for a given $s$, there is a positive measure of $x$ under $F_s$ such that*

$$\max\{R(x) + Y(x) - D, 0\} < \max\{R(x) - D, 0\},$$

The condition $Y(x_D) \leq 0$ means that, in the state of world where the borrower starts to receive payment, the "emergency plan" project is already inefficient.[16] In this case, the borrower weakly prefers not to implement the "emergency plan" in *any* state of the world in the intermediate stage. Moreover, if for a given intermediate state $s$, there is a positive measure of final states $x$ such that taking the "emergency plan" project is strictly worse off for the borrower, then the borrower will strictly prefer not to implement such "emergency plan" in state $s$. This explains why the optimal contract needs to feature a covenant that *transfers the control rights* to the creditor in certain states of the world.

Now we show that a financial contract specifying a contingent transfer of control rights from the borrower to the creditor when $s < \bar{s}$ in the intermediate state can implement the first best. To be concrete, we have:[17]

**Proposition A3.** *For all $D > 0$ and $s < \bar{s}$,*

$$E[\min\{D, R(x) + Y(x)\}|s] \geq E[\min\{D, R(x)\}|s]. \quad (12)$$

This means the creditor always has incentives to implement the "emergency plan" when $s < \bar{s}$. As a result, the first best can be implemented by a standard debt contract with face value $D^*$ and a covenant transferring the control rights to the creditor when $s < \bar{s}$.

As EBITDA is among the most informative financial variables about firm performance, it can serve as a helpful signal. In addition, this metric is easy to observe and measure, and can be assessed on a frequent basis. Accordingly, one can write a covenant that transfers control rights when EBITDA is too low, approximating the transfer of control rights in state $s < \bar{s}$ modeled in Proposition A3. Thus, earnings-based covenants can be thought as a mechanism for contingent transfers of control rights.

## IA1.4 Proofs

See Appendix IA6.

[15]Note that any debt face value $D \geq R(x_{\max})$ is equivalent to $D = R(x_{\max})$ in terms of payoffs, as $Y(x_{\max}) < 0$. So assume $D \leq R(x_{\max})$ is without loss of generality.

[16]Note that this does not mean there does not exist state $\bar{s}$ in the intermediate stage such that the "emergency plan" is efficient for $s \leq \bar{s}$.

[17]The proposition can also be extended to the case with costs of bankruptcy, but such costs are not required.

# IA2 Other Types of Financial Covenants

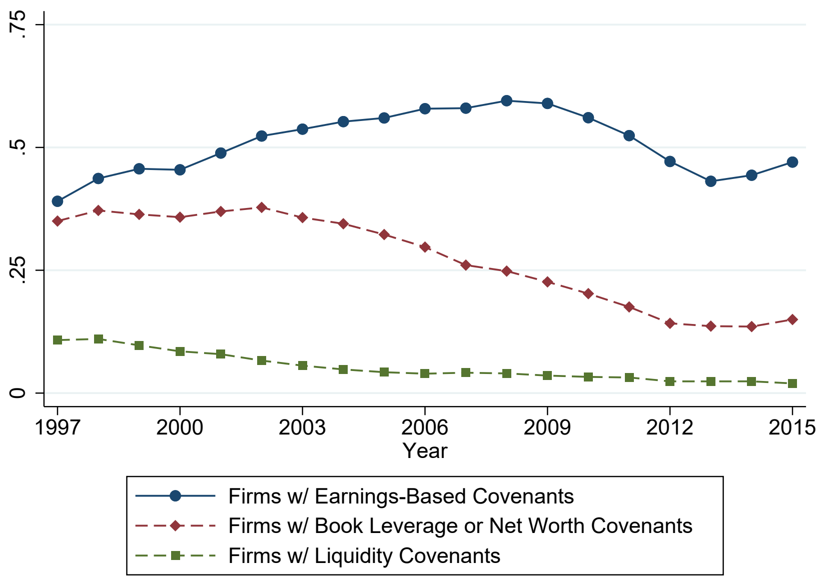
As mentioned in Section 3, other types of financial covenants have two main forms. One type specifies an upper bound on book leverage, or analogously a lower bound on book equity (book net worth). The popularity of this type of covenant has declined in the past twenty years for several reasons. Demerjian (2011) postulates the decline is affected by shifts in accounting standards that gave firms more discretion in estimating the value of assets and liabilities on their balance sheets. In addition, institutional investors have become increasingly more important in corporate loans, who place less emphasis on balance sheet-based metrics relative to earnings-based metrics. Currently the prevalence of the book leverage/net worth covenants is less than a third of the prevalence of earnings-based covenants, and violations are uncommon.

The other type of financial covenant focuses on liquidity conditions, and specifies limits on the ratio of current assets to current liabilities. The prevalence of this type of financial covenant is relatively low.

Figure IA1 plots the fraction of large firms with earnings-based covenants, book leverage/net worth covenants, and liquidity covenants, based on covenant information from DealScan loans.

Figure IA1: Other Forms of Financial Covenants

This figure shows the prevalence of different types of financial covenants among large US non-financial firms (assets above Compustat median). The solid line with circles shows the fraction of firms with earnings-based covenants. The dashed line with diamonds shows the fraction of firms with book leverage or book net wroth covenants. The dashed line with squares shows the fraction of firms with liquidity covenants (limits on current assets relative to current liabilities). The covenants data are based on DealScan loans.



# IA3 Additional Results

## IA3.1 Response of Debt Issuance and Investment to EBITDA

Table IA1: Issuance of Cash Flow-Based Debt and Unsecured Debt

Firm-level annual regressions of debt issuance:

$$Y_{it} = \alpha_i + \eta_t + \beta \text{EBITDA}_{it} + X'_{it}\gamma + \epsilon_{it}$$

In columns (1) and (2) $Y_{it}$ is changes in cash flow-based debt in year $t$, normalized by assets at the end of year $t-1$. In columns (3) to (4) $Y_{it}$ is changes in unsecured debt in year $t$. Control variables are the same as those in Table 4. Firm fixed effects and year fixed effects are included ($R^2$ does not include fixed effects). Sample period is 2003 to 2015 (when we have detailed data to classify cash flow-based debt). The sample is restricted to large US non-financial firms that have earnings-based covenants in year $t$. Standard errors are clustered by firm and time.

| | Δ Cash Flow-Based | | Δ Unsecured | |
|---|---|---|---|---|
| EBITDA | 0.258*** | 0.263*** | 0.218*** | 0.253*** |
| | (0.061) | (0.074) | (0.041) | (0.044) |
| OCF | | -0.012 | | -0.073** |
| | | (0.051) | | (0.029) |
| $Q$ | 0.013* | 0.013* | 0.008* | 0.009** |
| | (0.007) | (0.007) | (0.004) | (0.004) |
| Past 12m stock ret | -0.006 | -0.006 | 0.003 | 0.003 |
| | (0.004) | (0.004) | (0.003) | (0.003) |
| L.Cash holding | -0.103** | -0.103** | -0.136*** | -0.135*** |
| | (0.046) | (0.046) | (0.040) | (0.039) |
| Controls | Y | Y | Y | Y |
| Firm FE | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y |
| Obs | 9,589 | 9,589 | 9,850 | 9,850 |
| $R^2$ | 0.067 | 0.067 | 0.075 | 0.075 |

Standard errors in parentheses, clustered by firm and time

*** p<0.01, ** p<0.05, * p<0.1

Table IA2: Debt Issuance and Investment Activities:
Industry-Year Fixed Effects

Firm-level annual regressions of debt issuance and investment activities:

$$Y_{it} = \alpha_i + \eta_{kt} + \beta \text{EBITDA}_{it} + \kappa \text{OCF}_{it} + X'_{it}\gamma + \epsilon_{it}$$

The outcome variable $Y_{it}$ and the right hand side variables are the same as in Table 4 of the main text. Firm fixed effects ($\alpha_i$) and industry-year fixed effects ($\eta_{kt}$, using two-digit SIC industry classification) are included ($R^2$ does not include fixed effects). Sample period is 1996 to 2015. The sample is restricted to large US non-financial firms that have earnings-based covenants in year $t$. Standard errors are clustered by firm and time.

Panel A. Debt Issuance

| | Net Debt Iss. | | Δ LT Book Debt | | Δ Total Book Debt | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| EBITDA | 0.246*** | 0.306*** | 0.392*** | 0.424*** | 0.381*** | 0.451*** |
| | (0.032) | (0.037) | (0.042) | (0.049) | (0.040) | (0.045) |
| OCF | | -0.116*** | | -0.061 | | -0.137*** |
| | | (0.037) | | (0.043) | | (0.046) |
| $Q$ | 0.011** | 0.012** | 0.005 | 0.005 | 0.004 | 0.004 |
| | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) |
| Past 12m stock ret | -0.003 | -0.003 | -0.004 | -0.004 | 0.002 | 0.001 |
| | (0.003) | (0.003) | (0.004) | (0.004) | (0.003) | (0.003) |
| L.Cash holding | -0.033 | -0.033 | 0.034 | 0.035 | 0.040 | 0.041 |
| | (0.043) | (0.043) | (0.055) | (0.055) | (0.048) | (0.049) |
| Controls | Y | Y | Y | Y | Y | Y |
| Firm FE | Y | Y | Y | Y | Y | Y |
| Industry-Year FE | Y | Y | Y | Y | Y | Y |
| Obs | 15,642 | 15,642 | 15,537 | 15,537 | 15,576 | 15,576 |
| $R^2$ | 0.115 | 0.117 | 0.122 | 0.123 | 0.155 | 0.157 |

Standard errors in parentheses, clustered by firm and time
*** p<0.01, ** p<0.05, * p<0.1

Panel B. Investment Activities

| | CAPX | | R&D | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| EBITDA | 0.114*** | 0.089*** | 0.036*** | 0.040*** |
| | (0.012) | (0.012) | (0.013) | (0.014) |
| OCF | | 0.046*** | | -0.007 |
| | | (0.010) | | (0.013) |
| $Q$ | 0.010*** | 0.010*** | 0.004** | 0.004*** |
| | (0.002) | (0.002) | (0.002) | (0.002) |
| Past 12m stock ret | 0.002 | 0.002 | -0.003*** | -0.003*** |
| | (0.002) | (0.002) | (0.001) | (0.001) |
| L.Cash holding | 0.017 | 0.017 | -0.004 | -0.003 |
| | (0.011) | (0.011) | (0.013) | (0.013) |
| Controls | Y | Y | Y | Y |
| Firm FE | Y | Y | Y | Y |
| Industry-Year FE | Y | Y | Y | Y |
| Obs | 16,907 | 16,907 | 8,588 | 8,586 |
| $R^2$ | 0.135 | 0.138 | 0.106 | 0.107 |

Standard errors in parentheses, clustered by firm and time

Table IA3: Debt Issuance and Investment Activities:
Lagged Dependent Variable Specification

Firm-level annual regressions of debt issuance and investment activities:

$$Y_{it} = \eta_t + \beta \text{EBITDA}_{it} + \kappa \text{OCF}_{it} + X'_{it}\gamma + \xi Y_{it-1} + \epsilon_{it}$$

The outcome variable $Y_{it}$ and the right hand side variables are the same as in Table 4 of the main text. Lagged dependent variable $Y_{it-1}$ is included. Sample period is 1996 to 2015. The sample is restricted to large US non-financial firms that have earnings-based covenants in year $t$. Standard errors are clustered by firm and time.

Panel A. Debt Issuance

| | Net Debt Iss. | | Δ LT Book Debt | | Δ Total Book Debt | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| EBITDA | 0.145*** | 0.204*** | 0.298*** | 0.336*** | 0.271*** | 0.348*** |
| | (0.025) | (0.031) | (0.035) | (0.043) | (0.030) | (0.040) |
| OCF | | -0.108*** | | -0.069* | | -0.143*** |
| | | (0.036) | | (0.036) | | (0.041) |
| $Q$ | 0.010*** | 0.011*** | 0.003 | 0.004 | 0.006 | 0.007* |
| | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) |
| Past 12m stock ret | 0.009*** | 0.009*** | 0.014*** | 0.013*** | 0.018*** | 0.018*** |
| | (0.003) | (0.003) | (0.005) | (0.004) | (0.005) | (0.004) |
| L.Cash holding | 0.008 | 0.011 | 0.033* | 0.035* | 0.036** | 0.040** |
| | (0.013) | (0.014) | (0.019) | (0.019) | (0.018) | (0.018) |
| LDV | 0.027* | 0.026* | 0.011 | 0.010 | 0.041*** | 0.039*** |
| | (0.014) | (0.014) | (0.013) | (0.013) | (0.015) | (0.014) |
| Controls | Y | Y | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y | Y | Y |
| Obs | 15,425 | 15,425 | 15,950 | 15,950 | 16,044 | 16,044 |
| $R^2$ | 0.034 | 0.036 | 0.048 | 0.048 | 0.054 | 0.057 |

Standard errors in parentheses, clustered by firm and time
*** p<0.01, ** p<0.05, * p<0.1

Panel B. Investment Activities

| | CAPX | | R&D | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| EBITDA | 0.165*** | 0.119*** | 0.055*** | 0.051*** |
| | (0.013) | (0.013) | (0.021) | (0.019) |
| OCF | | 0.081*** | | 0.006 |
| | | (0.010) | | (0.013) |
| $Q$ | 0.001 | 0.000 | 0.005*** | 0.005*** |
| | (0.001) | (0.001) | (0.002) | (0.002) |
| Past 12m stock ret | 0.011*** | 0.011*** | -0.003*** | -0.003*** |
| | (0.002) | (0.002) | (0.001) | (0.001) |
| L.Cash holding | 0.006 | 0.005 | 0.045*** | 0.044*** |
| | (0.006) | (0.006) | (0.012) | (0.012) |
| LDV | 0.554*** | 0.547*** | 0.564*** | 0.564*** |
| | (0.034) | (0.033) | (0.084) | (0.084) |
| Controls | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y |
| Obs | 17,311 | 17,311 | 8,711 | 8,709 |
| $R^2$ | 0.638 | 0.642 | 0.640 | 0.640 |

Standard errors in parentheses, clustered by firm and time

Table IA4: Debt Issuance and Investment Activities: Post-1985 Sample

Firm-level annual regressions of debt issuance and investment activities:

$$Y_{it} = \alpha_i + \eta_t + \beta \text{EBITDA}_{it} + \kappa \text{OCF}_{it} + X'_{it}\gamma + \xi Y_{it-1} + \epsilon_{it}$$

In Panel A, $Y_{it}$ is net debt issuance; in Panel B, $Y_{it}$ is capital expenditures. The right hand side variables are the same as those in Table 4 of the main text. Firm groups are divided by size: large (assets above Compustat median) and small; profit margin: high (above Compustat median) and low; as well as airlines and utilities (two digit SIC 45 and 49). Firm fixed effects and year fixed effects are included ($R^2$ does not include fixed effects). Sample period is 1986 to 2015. Standard errors are clustered by firm and time.

Panel A. Net Debt Issuance

| | Size | | | | Margin | | | | Airlines | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Large** | | Small | | **High** | | Low | | & Utilities | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| EBITDA | 0.067*** | 0.156*** | -0.028*** | 0.007 | 0.067*** | 0.122*** | -0.029*** | 0.013 | -0.061 | -0.024 |
| | (0.015) | (0.017) | (0.006) | (0.008) | (0.014) | (0.013) | (0.006) | (0.009) | (0.041) | (0.056) |
| OCF | | -0.159*** | | -0.059*** | | -0.095*** | | -0.069*** | | -0.070 |
| | | (0.019) | | (0.011) | | (0.019) | | (0.012) | | (0.053) |
| $Q$ | 0.007*** | 0.007*** | 0.005*** | 0.004*** | 0.001 | 0.001 | 0.007*** | 0.006*** | 0.020* | 0.021* |
| | (0.002) | (0.002) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.012) | (0.012) |
| Past 12m stock ret | 0.004 | 0.003 | 0.003* | 0.002* | -0.001 | -0.001 | 0.004** | 0.004** | 0.010 | 0.010 |
| | (0.003) | (0.002) | (0.001) | (0.001) | (0.001) | (0.001) | (0.002) | (0.002) | (0.007) | (0.007) |
| L.Cash holding | -0.028** | -0.027* | -0.048*** | -0.052*** | -0.014 | -0.015 | -0.058*** | -0.062*** | -0.102* | -0.116** |
| | (0.013) | (0.014) | (0.011) | (0.012) | (0.014) | (0.015) | (0.013) | (0.013) | (0.053) | (0.057) |
| Controls | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Firm FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Obs | 41,750 | 41,662 | 32,915 | 32,753 | 36,700 | 36,596 | 36,698 | 36,555 | 4,787 | 4,781 |
| $R^2$ | 0.066 | 0.073 | 0.029 | 0.033 | 0.049 | 0.052 | 0.036 | 0.041 | 0.049 | 0.050 |

Standard errors in parentheses, clustered by firm and time
*** p<0.01, ** p<0.05, * p<0.1

Panel B. Capital Expenditures

| | Size | | | | Margin | | | | Airlines | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Large** | | Small | | **High** | | Low | | & Utilities | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| EBITDA | 0.107*** | 0.092*** | 0.009* | 0.010* | 0.097*** | 0.087*** | 0.006 | 0.003 | 0.099*** | 0.041 |
| | (0.009) | (0.010) | (0.006) | (0.006) | (0.007) | (0.009) | (0.004) | (0.005) | (0.029) | (0.028) |
| OCF | | 0.028*** | | -0.000 | | 0.020*** | | 0.005 | | 0.134*** |
| | | (0.007) | | (0.004) | | (0.006) | | (0.005) | | (0.026) |
| $Q$ | 0.007*** | 0.007*** | 0.006*** | 0.006*** | 0.005*** | 0.005*** | 0.007*** | 0.007*** | 0.025*** | 0.023*** |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.006) | (0.006) |
| Past 12m stock ret | 0.006*** | 0.007*** | 0.005*** | 0.005*** | 0.004*** | 0.004*** | 0.005*** | 0.005*** | 0.009* | 0.009* |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.005) | (0.005) |
| L.Cash holding | 0.021*** | 0.022*** | 0.007 | 0.008* | 0.006 | 0.005 | 0.016*** | 0.018*** | -0.028 | -0.011 |
| | (0.007) | (0.007) | (0.004) | (0.004) | (0.008) | (0.008) | (0.005) | (0.005) | (0.031) | (0.030) |
| Controls | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Firm FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Obs | 44,362 | 44,263 | 34,561 | 34,376 | 38,794 | 38,683 | 38,914 | 38,749 | 4,905 | 4,898 |
| $R^2$ | 0.143 | 0.144 | 0.043 | 0.043 | 0.101 | 0.101 | 0.045 | 0.045 | 0.122 | 0.136 |

Standard errors in parentheses, clustered by firm and time
*** p<0.01, ** p<0.05, * p<0.1

## Table IA5: Debt Issuance and Investment Activities: Controlling for Inventory Purchase

Firm-level annual regressions of debt issuance and investment activities:

$$Y_{it} = \alpha_i + \eta_t + \beta \text{EBITDA}_{it} + \kappa \text{OCF}_{it} + X'_{it}\gamma + \epsilon_{it}$$

The outcome variable $Y_{it}$ is net debt issuance in columns (1) and (2), and capital expenditures in columns (3) and (4). The right hand side variables are the same as in Table 4 of the main text. The additional control is inventory purchase in year $t$. Firm fixed effects and year fixed effects are included ($R^2$ does not include fixed effects). Sample period is 1996 to 2015. The sample is restricted to large US non-financial firms that have earnings-based covenants in year $t$. Standard errors are clustered by firm and time.

| | Net Debt Iss | | CAPX | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| EBITDA | 0.273*** | 0.212*** | 0.105*** | 0.105*** |
| | (0.034) | (0.039) | (0.020) | (0.023) |
| OCF | -0.111*** | -0.099*** | 0.055*** | 0.056*** |
| | (0.033) | (0.033) | (0.013) | (0.013) |
| $Q$ | 0.011** | 0.012*** | 0.010*** | 0.010*** |
| | (0.005) | (0.005) | (0.002) | (0.002) |
| Past 12m stock ret | -0.003 | -0.004 | 0.004* | 0.004* |
| | (0.003) | (0.003) | (0.002) | (0.002) |
| L.Cash holding | -0.033 | 0.004 | 0.012 | 0.013 |
| | (0.044) | (0.044) | (0.013) | (0.013) |
| Invt purchase | | 0.053*** | | -0.001 |
| | | (0.009) | | (0.003) |
| Controls | Y | Y | Y | Y |
| Firm FE | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y |
| Obs | 15,642 | 15,580 | 15,576 | 15,514 |
| $R^2$ | 0.116 | 0.127 | 0.159 | 0.159 |

Standard errors in parentheses, clustered by firm and time

*** p<0.01, ** p<0.05, * p<0.1

Table IA6: Debt Issuance and Investment Activities:
Controlling for Real Estate Collateral Value

Firm-level annual regressions of debt issuance and investment activities:

$$Y_{it} = \alpha_i + \eta_t + \beta \text{EBITDA}_{it} + \kappa \text{OCF}_{it} + X'_{it}\gamma + \epsilon_{it}$$

The outcome variable $Y_{it}$ is net debt issuance in columns (1) and (2), and capital expenditures in columns (3) and (4). The right hand side variables are the same as in Table 4 of the main text. The additional control is market value of firm real estate in year $t$ (estimated following Chaney, Sraer, and Thesmar (2012)). Firm fixed effects and year fixed effects are included ($R^2$ does not include fixed effects). Sample period is 1996 to 2015. The sample is restricted to large US non-financial firms that have earnings-based covenants in year $t$ and the real estate value estimate is available. Standard errors are clustered by firm and time.

| | Net Debt Iss | | CAPX | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| EBITDA | 0.325*** | 0.330*** | 0.077*** | 0.082*** |
| | (0.064) | (0.066) | (0.022) | (0.022) |
| OCF | -0.135*** | -0.134*** | 0.018 | 0.019 |
| | (0.037) | (0.037) | (0.015) | (0.015) |
| $Q$ | 0.006 | 0.007 | 0.013*** | 0.013*** |
| | (0.006) | (0.006) | (0.004) | (0.004) |
| Past 12m stock ret | -0.004 | -0.005 | 0.002 | 0.002 |
| | (0.006) | (0.006) | (0.002) | (0.002) |
| L.Cash holding | -0.036 | -0.037 | 0.016 | 0.015 |
| | (0.067) | (0.066) | (0.015) | (0.016) |
| RE | | 0.035* | | 0.036*** |
| | | (0.018) | | (0.009) |
| Controls | Y | Y | Y | Y |
| Firm FE | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y |
| Obs | 4,554 | 4,554 | 4,540 | 4,540 |
| $R^2$ | 0.116 | 0.116 | 0.186 | 0.194 |

Standard errors in parentheses, clustered by firm and time
*** p<0.01, ** p<0.05, * p<0.1

## IA3.2 Informativeness of EBITDA and $Q$

This section presents a list of checks about the informativeness of EBITDA and $Q$ across firm groups. We would like to test whether among large firms with EBCs, EBITDA is more informative or $Q$ is more mismeasured (less informative), in which case the EBITDA coefficient could have a larger upward bias in the baseline regressions of Tables 4 and 5.

Table IA7 shows statistics of several metrics for accounting quality. Net operating assets is calculated following Hirshleifer, Hou, Teoh, and Zhang (2004), which reflects accumulated accruals. High net operating assets indicates potentially high cumulative earnings management. Operating cycle and trade cycle are calculated following Dechow and Dichev (2002). Longer operating cycles and trade cycles are potentially associated with greater difficulty and less precision in earnings estimates. Larger variability of EBITDA, accrual, and residual accrual (calculated following Dechow and Dichev (2002), which captures accruals not explained by net cash receipts from year $t-1$ to year $t+1$) also reflect potential difficulty in earnings estimates. Finally, we also calculate measures of loss avoidance following the idea of Bhattacharya, Daouk, and Welker (2003), using the difference in the probability of small positive net income and that of small negative net income. Across all these meaures, it does not appear that earnings of large firms with EBCs have different properties than other large firms.

Furthermore, Table IA8 shows results predicting future EBITDA and net cash receipts (OCF) in year $t+1$ and $t+2$. These tests examine the informativeness of EBITDA and $Q$ in predicting future earnings and cash flows. The results show that relative to comparison groups, EBITDA of large firms with EBCs is *not more informative*, while their $Q$ if anything appears *less mismeasured*. Overall, it does not appear $Q$ mismeasurement may lead to a larger upward bias in the EBITDA coefficient among large firms with EBCs; indeed, the concern seems less severe among this group of firms.

Table IA7: Accounting Quality Statistics

Firm characteristics by group. Net operating assets is operating assets minus operating liabilities following Hirshleifer et al. (2004) (normalized by total assets), which captures the accumulated accruals. Operating cycles, trade cycles, and residual accruals are calculated following Dechow and Dichev (2002). Small positive net income is net income (normalized by lagged assets) between zero and 0.01; small negative net income is net income (normalized by lagged assets) between zero and -0.01.

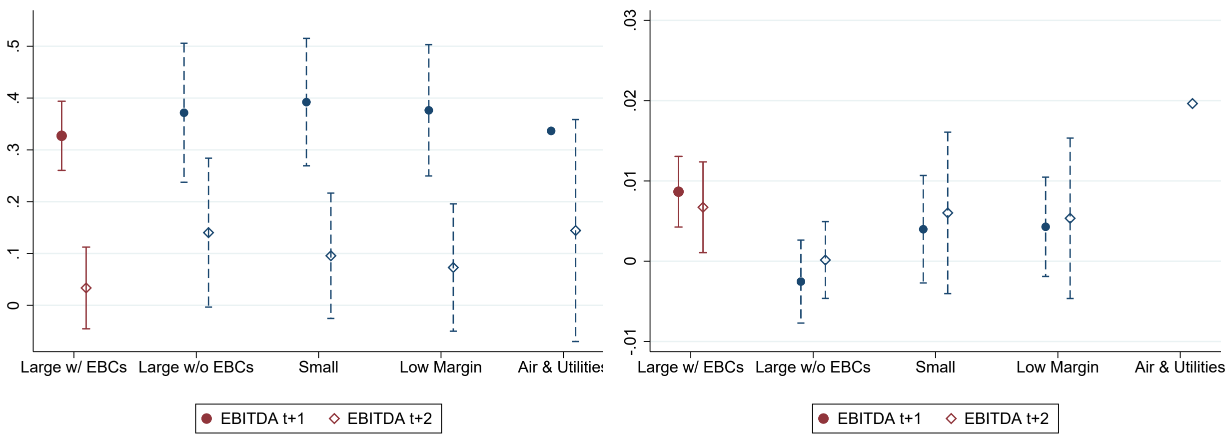
| | **Large w/ EBCs** | Large w/o EBCs | Small | Low Margin | Air & Utilities |
|---|---|---|---|---|---|
| | Group-Level Medians | | | | |
| Net operating assets | 0.651 | 0.552 | 0.522 | 0.553 | 0.652 |
| Operating cycle (days) | 93.5 | 101.2 | 114.5 | 101.8 | 68.8 |
| Trade cycle (days) | 55.6 | 56.5 | 67.6 | 56.1 | 26.4 |
| EBITDA SD | 0.042 | 0.040 | 0.087 | 0.051 | 0.025 |
| Accrual SD | 0.040 | 0.036 | 0.069 | 0.053 | 0.024 |
| Residual accrual SD | 0.039 | 0.035 | 0.066 | 0.052 | 0.023 |
| | Group-Level Means | | | | |
| Pr(small pos NI) - Pr(small neg NI) | 0.013 | 0.015 | 0.013 | 0.019 | 0.028 |

Figure IA2: Informativeness of EBITDA and $Q$ by Firm Group

This figure shows the coefficient $\beta$ on EBITDA, and the coefficient $\phi$ on beginning-of-year $Q$, from regressions predicting future EBITDA in year $t+1$ and $t+2$:

$$Y_{i,t+k} = \alpha_i + \eta_t + \beta \text{EBITDA}_{it} + \phi Q_{it} + X'_{it}\gamma + \epsilon_{it}$$

The outcome variable $Y_{i,t+k}$ is EBITDA in year $t+1$ and $t+2$ (normalized by lagged assets). The circles represent coefficients when $Y_{i,t+k}$ uses $k=1$; the diamonds represent coefficients when $Y_{i,t+k}$ uses $k=2$. The right-hand-side variables are the same as the main specification in Tables 4 and 5.




(a) Coefficients on Current EBITDA

(b) Coefficients on $Q$

Table IA8: Predicting Future EBITDA and Net Cash Receipts

Firm-level annual regressions of future EBITDA and net cash receipts (OCF):

$$Y_{it+k} = \alpha_i + \eta_t + \beta \text{EBITDA}_{it} + \kappa \text{OCF} + X'_{it}\gamma + \epsilon_{it}$$

The outcome variable $Y_{it+k}$ is EBITDA in Panel A, and net cash receipts (OCF) in Panel B. The right hand side variables are the same as in Table 4 of the main text. Firm groups are the same as in Table 4 and Table 5. Firm fixed effects and year fixed effects are included ($R^2$ does not include fixed effects). Sample period is 1996 to 2015. Standard errors are clustered by firm and time.

Panel A. Predicting Future EBITDA

| | **Large w/ EBCs** | | Large w/o EBCs | | Small | | Low Margin | | Air & Utilities | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t+k=$ | $t+1$ | $t+2$ | $t+1$ | $t+2$ | $t+1$ | $t+2$ | $t+1$ | $t+2$ | $t+1$ | $t+2$ |
| EBITDA | 0.327*** | 0.034 | 0.372*** | 0.140* | 0.392*** | 0.096 | 0.376*** | 0.073 | 0.337 | 0.144 |
| | (0.034) | (0.040) | (0.068) | (0.073) | (0.063) | (0.062) | (0.065) | (0.063) | (0.429) | (0.109) |
| OCF | 0.069*** | 0.028 | 0.162* | 0.065*** | 0.083** | 0.125** | 0.095** | 0.130** | 0.483 | 0.144 |
| | (0.024) | (0.021) | (0.092) | (0.023) | (0.042) | (0.057) | (0.041) | (0.060) | (0.589) | (0.110) |
| $Q$ | 0.009*** | 0.007** | -0.003 | 0.000 | 0.004 | 0.006 | 0.004 | 0.005 | -0.069*** | 0.020 |
| | (0.002) | (0.003) | (0.003) | (0.002) | (0.003) | (0.005) | (0.003) | (0.005) | (0.019) | (0.018) |
| Controls | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Firm FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Obs | 14,038 | 12,544 | 9,149 | 8,214 | 17,384 | 15,068 | 19,417 | 16,765 | 2,248 | 2,055 |
| $R^2$ | 0.195 | 0.058 | 0.116 | 0.028 | 0.140 | 0.019 | 0.116 | 0.019 | 0.379 | 0.042 |

Standard errors in parentheses, clustered by firm and time
*** p<0.01, ** p<0.05, * p<0.1

Panel B. Predicting Future Cash Receipts (OCF)

| | **Large w/ EBCs** | | Large w/o EBCs | | Small | | Low Margin | | Air & Utilities | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t+k=$ | $t+1$ | $t+2$ | $t+1$ | $t+2$ | $t+1$ | $t+2$ | $t+1$ | $t+2$ | $t+1$ | $t+2$ |
| EBITDA | 0.254*** | 0.072** | 0.305*** | 0.207*** | 0.339*** | 0.120*** | 0.340*** | 0.105*** | 0.022 | 0.186 |
| | (0.028) | (0.029) | (0.049) | (0.057) | (0.043) | (0.034) | (0.045) | (0.039) | (0.535) | (0.115) |
| OCF | -0.044 | -0.045 | 0.093 | -0.037 | -0.020 | -0.005 | -0.009 | 0.002 | 0.482 | 0.059 |
| | (0.031) | (0.031) | (0.098) | (0.033) | (0.029) | (0.042) | (0.029) | (0.048) | (0.647) | (0.140) |
| $Q$ | 0.006*** | 0.007*** | -0.003 | 0.000 | 0.004 | 0.005 | 0.005 | 0.008** | -0.037** | 0.022 |
| | (0.002) | (0.002) | (0.003) | (0.002) | (0.003) | (0.004) | (0.004) | (0.004) | (0.017) | (0.018) |
| Controls | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Firm FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Obs | 14,043 | 12,548 | 9,160 | 8,228 | 17,388 | 15,071 | 19,415 | 16,754 | 2,249 | 2,057 |
| $R^2$ | 0.097 | 0.035 | 0.081 | 0.026 | 0.117 | 0.020 | 0.100 | 0.018 | 0.230 | 0.039 |

Standard errors in parentheses, clustered by firm and time
*** p<0.01, ** p<0.05, * p<0.1

## IA3.3 Accounting Natural Experiment: Placebo Tests

Table IA9 below presents results of placebo tests using alternative timing. In Table 6, outcome variables are measured in 2006, while EBITDA in 2006 is instrumented using average option compensation expenses in 2002 to 2004. In Table IA9 we shift the same timing backwards, and perform both the first stage and the reduced form tests. For instance, in column (1) option compensation expenses are measured from 1998 to 2000, while outcome variables are measured in 2002.

Table IA9: Placebo Tests

Cross-sectional placebo regressions, for years $t$ from 2002 to 2006:

$$Y_{it} = \alpha + \beta \overline{\text{OptComp}}_{i,t-4,t-2} + X'_{it}\gamma + \epsilon_{it}$$

where $\overline{\text{OptComp}}$ is average option compensation expense in fiscal year $t-4$ to $t-2$. In Panel A, $Y$ is EBITDA in year $t$ (placebo first stage). In Panel B, $Y$ is net debt issuance in year $t$ (placebo reduced form). In Panel C, $Y$ is capital expenditures in year $t$ (placebo reduced form). Control variables are the same as those in Table 6. Industry (Fama-French 12 industries) fixed effects are included; $R^2$ does not include fixed effects. The sample is restricted to large firms with EBCs in year $t$. Robust standard errors in parentheses.

Panel A. $Y_i$ = EBITDA

| Year $t$ = | 2002 | 2003 | 2004 | 2005 | **2006** |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Avg. option comp expense | -0.245 | -0.053 | 0.469** | -0.163 | -0.857*** |
| $t-4$ to $t-2$ | (0.287) | (0.300) | (0.203) | (0.171) | (0.206) |
| Obs | 573 | 639 | 689 | 673 | 686 |
| $R^2$ | 0.770 | 0.735 | 0.727 | 0.748 | 0.746 |

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Panel B. $Y_i$ = Net Debt Issuance

| Year $t$ = | 2002 | 2003 | 2004 | 2005 | **2006** |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Avg. option comp expense | -0.333 | 0.104 | -0.205 | -0.316 | -0.745** |
| | (0.509) | (0.619) | (0.480) | (0.322) | (0.360) |
| Obs | 575 | 640 | 689 | 673 | 686 |
| $R^2$ | 0.115 | 0.044 | 0.104 | 0.082 | 0.103 |

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Panel C. $Y_i$ = Capital Expenditures

| Year $t$ = | 2002 | 2003 | 2004 | 2005 | **2006** |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Avg. option comp expense | -0.224 | -0.033 | -0.108 | -0.251* | -0.387*** |
| | (0.321) | (0.175) | (0.113) | (0.143) | (0.143) |
| Obs | 565 | 623 | 672 | 660 | 682 |
| $R^2$ | 0.448 | 0.541 | 0.512 | 0.610 | 0.598 |

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

## IA3.4 Great Recession

Table IA10: Firm Outcomes and Changes in Real Estate Value in the Great Recession

Cross-sectional regression of firm outcomes in the Great Recession and value of firm real estate:

$$\Delta Y_i^{07-09} = \alpha + \lambda \Delta \text{RE}_{i,06}^{07-09} + \eta \text{RE}_i^{06} + \phi \Delta P_i^{07-09} + X_i' \gamma + u_i$$

$Y_i^{07-09}$ is firm-level outcome from 2007 to 2009: in Panel A $\Delta Y_i^{07-09}$ is the change in net debt issuance, in Panel B $Y_i^{07-09}$ is the change in CAPX, normalized by assets by the end of 2006. The main independent variable $\Delta \text{RE}_i^{07-09}$ is the estimated gain/loss on firm $i$'s 2006 real estate holdings during the Great Recession, normalized by assets at the end of 2006. $\text{RE}_i^{06}$ is the estimated market value of firm $i$'s real estate at the end of 2006, normalized by assets at the end of 2006. $\Delta P_i^{07-09}$ is the percentage change in property value in firm $i$'s location. The market value of firms' real estate is estimated using two different methods (labeled in the columns), as described in Section 4.2 and Appendix D. Controls include changes in EBITDA and OCF from 2007 to 2009 (normalized by assets by the end of 2006), pre-crisis $Q$ and change in $Q$ from 2007 to 2009, cash holdings, book leverage (debt/assets), inventory, receivables, and size by the end of 2006. Industry (Fama-French 12 industries) fixed effects are included; $R^2$ does not include fixed effects. Estimates using both OLS and LAD are presented. Robust standard errors in parentheses.

Panel A. Net Debt Issuance

| | Method 1 | | Method 2 | |
|---|---|---|---|---|
| $\Delta$Net Debt Iss$^{07-09}$ | OLS | LAD | OLS | LAD |
| $\Delta \text{RE}_{06}^{07-09}$ | -0.121 | -0.086 | -0.135 | -0.028 |
| | (0.362) | (0.239) | (0.241) | (0.079) |
| $\text{RE}_{06}$ | -0.042 | -0.004 | -0.009 | -0.007 |
| | (0.030) | (0.024) | (0.032) | (0.013) |
| $\Delta P^{07-09}$ | 0.076 | 0.024 | -0.020 | 0.003 |
| | (0.082) | (0.045) | (0.059) | (0.023) |
| $\Delta \text{EBITDA}^{07-09}$ | 0.189** | 0.160** | 0.109* | 0.044 |
| | (0.085) | (0.066) | (0.065) | (0.028) |
| $\Delta \text{OCF}^{07-09}$ | -0.189*** | -0.168*** | -0.218*** | -0.070** |
| | (0.073) | (0.047) | (0.055) | (0.033) |
| $\Delta Q^{07-09}$ | 0.019** | 0.005 | 0.013** | 0.004 |
| | (0.007) | (0.007) | (0.006) | (0.004) |
| $Q_{06}$ | -0.001 | -0.005 | 0.006 | 0.002 |
| | (0.008) | (0.005) | (0.004) | (0.006) |
| $\text{Cash}_{06}$ | -0.018 | 0.006 | 0.041 | 0.012 |
| | (0.053) | (0.043) | (0.037) | (0.022) |
| Obs | 384 | 384 | 466 | 466 |

Standard errors in parentheses

Panel B. Capital Expenditures

| | Method 1 | | Method 2 | |
|---|---|---|---|---|
| $\Delta \text{CAPX}^{07-09}$ | OLS | LAD | OLS | LAD |
| $\Delta \text{RE}_{06}^{07-09}$ | 0.086 | -0.008 | 0.078 | 0.030 |
| | (0.120) | (0.104) | (0.075) | (0.062) |
| $\text{RE}_{06}$ | 0.005 | -0.003 | 0.012 | 0.013 |
| | (0.012) | (0.012) | (0.012) | (0.010) |
| $\Delta P^{07-09}$ | 0.037 | 0.018 | 0.001 | 0.009 |
| | (0.025) | (0.020) | (0.017) | (0.009) |
| $\Delta \text{EBITDA}^{07-09}$ | 0.101*** | 0.098*** | 0.064** | 0.061*** |
| | (0.024) | (0.018) | (0.025) | (0.015) |
| $\Delta \text{OCF}^{07-09}$ | -0.032 | -0.028* | -0.041** | -0.027** |
| | (0.021) | (0.015) | (0.019) | (0.013) |
| $\Delta Q^{07-09}$ | 0.014*** | 0.008*** | 0.010*** | 0.007*** |
| | (0.003) | (0.002) | (0.002) | (0.002) |
| $Q_{06}$ | 0.003 | 0.002 | 0.002 | 0.002 |
| | (0.002) | (0.002) | (0.001) | (0.002) |
| $\text{Cash}_{06}$ | -0.021 | -0.016 | 0.002 | 0.013* |
| | (0.016) | (0.014) | (0.013) | (0.008) |
| Obs | 380 | 380 | 464 | 464 |

Standard errors in parentheses

Table IA11: The Great Recession: Unpacking the Property Price Effects (Tradables Only)

Cross-sectional regression of firm outcomes in the Great Recession and value of firm real estate:

$$\Delta Y_i^{07-09} = \alpha + \lambda \Delta \mathrm{RE}_{i,06}^{07-09} + \eta \mathrm{RE}_i^{06} + \phi \Delta P_i^{07-09} + X_i' \gamma + u_i$$

The regressions are the same as those in Table IA10, but restricted to tradable firms only (tradable classification follows Mian and Sufi (2014)). In Panel A $\Delta Y_i^{07-09}$ is the change in net debt issuance between 2007 and 2009, in Panel B $Y_i^{07-09}$ is the change in CAPX between 2007 and 2009, normalized by assets by the end of 2006. The main independent variable $\Delta \mathrm{RE}_i^{07-09}$ is the estimated gain/loss on firm $i$'s 2006 real estate holdings during the Great Recession, normalized by assets at the end of 2006. $\mathrm{RE}_i^{06}$ is the estimated market value of firm $i$'s real estate at the end of 2006, normalized by assets at the end of 2006. $\Delta P_i^{07-09}$ is the percentage change in property value in firm $i$'s location. Industry (Fama-French 12 industries) fixed effects are included; $R^2$ does not include fixed effects. Estimates using both OLS and LAD are presented. Robust standard errors in parentheses.

Panel A. Net Debt Issuance

| | Method 1 | | Method 2 | |
|---|---|---|---|---|
| $\Delta$Net Debt Iss$^{07-09}$ | OLS | LAD | OLS | LAD |
| $\Delta \mathrm{RE}_{06}^{07-09}$ | -0.198 | -0.204 | 0.088 | 0.052 |
| | (0.538) | (0.320) | (0.419) | (0.129) |
| $\mathrm{RE}_{06}$ | -0.059 | -0.022 | 0.022 | 0.015 |
| | (0.047) | (0.036) | (0.040) | (0.027) |
| $\Delta P^{07-09}$ | 0.104 | 0.052 | -0.015 | -0.026 |
| | (0.112) | (0.064) | (0.090) | (0.033) |
| $\Delta$EBITDA$^{07-09}$ | 0.135 | 0.086 | 0.184** | 0.065* |
| | (0.098) | (0.064) | (0.087) | (0.035) |
| $\Delta$OCF$^{07-09}$ | -0.080 | -0.077 | -0.258*** | -0.096 |
| | (0.072) | (0.054) | (0.067) | (0.062) |
| $\Delta Q^{07-09}$ | 0.009 | 0.004 | 0.009 | 0.004 |
| | (0.008) | (0.005) | (0.007) | (0.006) |
| $Q_{06}$ | -0.009 | -0.001 | 0.006 | 0.003 |
| | (0.008) | (0.004) | (0.004) | (0.006) |
| | (0.016) | (0.013) | (0.016) | (0.008) |
| Obs | 264 | 264 | 300 | 300 |
| $R^2$ | 0.140 | - | 0.200 | - |

Standard errors in parentheses

Panel B. Capital Expenditures

| | Method 1 | | Method 2 | |
|---|---|---|---|---|
| $\Delta$CAPX$^{07-09}$ | OLS | LAD | OLS | LAD |
| $\Delta \mathrm{RE}_{06}^{07-09}$ | -0.013 | -0.071 | 0.001 | -0.050 |
| | (0.157) | (0.107) | (0.095) | (0.057) |
| $\mathrm{RE}_{06}$ | -0.007 | -0.011 | 0.012 | 0.013 |
| | (0.018) | (0.010) | (0.014) | (0.009) |
| $\Delta P^{07-09}$ | 0.021 | 0.014 | 0.007 | 0.012 |
| | (0.025) | (0.021) | (0.016) | (0.012) |
| $\Delta$EBITDA$^{07-09}$ | 0.071** | 0.066*** | 0.080*** | 0.063*** |
| | (0.028) | (0.020) | (0.030) | (0.016) |
| $\Delta$OCF$^{07-09}$ | -0.025 | -0.010 | -0.065** | -0.031** |
| | (0.027) | (0.018) | (0.026) | (0.014) |
| $\Delta Q^{07-09}$ | 0.010*** | 0.006** | 0.004** | 0.002 |
| | (0.003) | (0.003) | (0.002) | (0.002) |
| $Q_{06}$ | -0.001 | -0.001 | -0.001 | 0.000 |
| | (0.002) | (0.001) | (0.002) | (0.002) |
| Obs | 263 | 263 | 307 | 307 |
| $R^2$ | 0.222 | - | 0.213 | - |

Standard errors in parentheses

# IA4 Effects of Cash Flows in Classic Models of Corporate Borrowing

In this appendix, we further discuss several strands of literature on costly external financing, and their predictions about how cash flows influence corporate borrowing and investment. We clarify the differences between predictions based on EBCs and predictions in these models. As discussed in Section **??**, in these other models, cash flows only affect corporate borrowing through the impact on internal funds; EBITDA does not have an independent role after controlling for internal funds. We summarize the detailed predictions below.

1. This paper
   - Determinant of cost/capacity for external borrowing: Operating earnings.
   - How cash flows influence borrowing and investment: Cash flows in the form of EBITDA relax borrowing constraints/decrease cost of external borrowing, and crowd in borrowing and investment. Holding EBITDA constant, cash receipts increase internal funds, but do not relax borrowing constraints/decrease cost of external borrowing. They boost investment but substitute out external borrowing.
   - EBITDA plays an independent role controlling for internal funds.

2. Froot, Scharfstein, and Stein (1993), Kaplan and Zingales (1997)
   - Determinant of cost/capacity for external borrowing: Exogenous (not dependent on financial variables).
   - How cash flows influence borrowing and investment: Cash flows increase internal funds, but do not relax borrowing constraints/decrease cost of external borrowing. They boost investment but substitute out external borrowing.
   - EBITDA does not play an independent role controlling for internal funds.

3. Kiyotaki and Moore (1997), Bernanke, Gertler, and Gilchrist (1999)
   - Determinant of cost/capacity for external borrowing: Liquidation value of physical assets.
   - Formulation: $C(b, qk)$. $k$ is the amount of physical capital the firm owns, $q$ is the liquidation value per unit of capital measured at the time of debt repayment.
   - How cash flows influence borrowing and investment: Borrowing constraints/cost of external borrowing do not directly depend on cash flows. Higher cash flows may increase borrowing indirectly as they increase firms' internal funds ("net worth"), allow firms to acquire more physical assets, and relax firms' borrowing constraints/decreases cost of external financing.
   - EBITDA does not play an independent role controlling for internal funds.

4. Holmstrom and Tirole (1997)

- Determinant of cost/capacity for external borrowing: Pledgeable income.
- How cash flows influence borrowing and investment: Borrowing constraints/cost of external borrowing do not directly depend on cash flows. Higher cash flows may increase borrowing indirectly as they increase firms' internal funds ("net worth"), allow firms to acquire more projects, and therefore generate more pledgeable income and relax firms' borrowing constraints/decreases its cost of external financing.
- EBITDA does not play an independent role controlling for internal funds.

5. Net worth channel

- The concept "net worth channel" is used in both the third case and the fourth case. "Net worth" is defined as the firm's maximum amount of funds available that can be used to acquire new assets and projects (Bernanke, Gertler, and Gilchrist, 1999). This is equivalent to internal funds $w$ in our framework.
- In the case of Kiyotaki and Moore (1997) and Bernanke, Gertler, and Gilchrist (1999), the net worth channel means that an increase in internal funds $w$ allows firms to acquire more physical assets and relax its borrowing constraints. In the case of Holmstrom and Tirole (1997), the net worth channel means that an increase in internal funds $w$ allows firms to acquire more projects, generate more pledgeable income and relax its borrowing constraints. The concept "net worth channel" can be consistent with both asset-based lending and cash flow-based lending.
- In the models above, the net worth channel is focused on the role of internal funds. All components of internal funds have the same positive impact on borrowing; EBITDA does not play an independent role after controlling for internal funds.

# IA5 Accounting

## IA5.1 EBITDA and OCF

### Definition and Construction

1. EBITDA

- Compustat variable: EBITDA (equivalently OIBDP)
- EBITDA is a measure of operating earnings
- EBITDA = revenue - operating expenses = sales (SALE) - cost of goods sold (COGS) - selling, general and administrative expense (XSGA)
- EBITDA does not include capital expenditures (CAPX), which is separately accounted as cash flows from investment activities. EBITDA does include R&D expenses, which count towards operating expenses (included in COGS and XSGA); R&D spending is required to be immediately expensed.

2. OCF

- Compustat variable: OANCF + XINT
  - XINT: Interest Expenses. The Compustat variable OANCF subtracts interest expenses. We add them back to avoid mechanical correlations with debt issuance.
- OCF is a measure of the net cash receipts (inflows minus outflows) a firm gets from operating activities (as opposed to investing activities or financing activities).
- OCF is typically calculated via the indirect method, i.e. starting with earnings and add back/subtract non-cash components. Based on Compustat variable definitions, the following relation holds:

$$\begin{aligned} \text{OCF} = \ & \text{EBITDA} \underbrace{+(\text{NOPI} + \text{SPI}) + \text{SPPE}}_{\text{non-operating \& other income}} \underbrace{-(\text{TAX} - \text{DTAX} - \Delta\text{ATAX})}_{\text{cash taxes paid}} \\ & \underbrace{+\Delta\text{AP} - \Delta\text{AR} - \Delta\text{INV}}_{\Delta\text{NWC}} + \underbrace{\Delta\text{UR} - \Delta\text{PX}}_{\substack{\text{cash income/cost} \\ \text{not in earnings}}} + \text{OCFO} \end{aligned} \tag{13}$$

  - NOPI: Nonoperating Income (e.g. dividend, interest, rental, royalty income).
  - SPI: Special Item (e.g. windfalls, natural disaster damages, earnings from discontinued operations, litigation reserves). Based on the Compustat definition, variables XIDOC (cash flows from extraordinary items & discontinued operations) and MII (noncontrolling interest) are also added back.
  - SPPE: Sale of Property, Plant and Equipment.
  - TXT: Total Income Taxes; TXD: Deferred Taxes; $\Delta$TXA: Changes in Accrued Taxes. TXT − TXD − $\Delta$TXA is cash payment of taxes.
  - $\Delta$AP: Changes in Accounts Payable.
  - $\Delta$AR: Changes in Accounts Receivable.
  - $\Delta$INV: Changes in Inventory.
  - $\Delta$UR: Changes in unearned revenue. For instance, if a firm receives cash for purchases of goods and services to be delivered in the future (e.g. membership, subscription, gift card), it does not record any earnings but gets more cash. This leads to an increase in unearned revenue. $\Delta$PX: Changes in prepaid expenses. Similarly, if a firm pays for goods or services to be delivered to it in the future (e.g. insurance), it does not record an expense but has less cash. This leads to an increase in prepaid expenses. OCFO: other miscellaneous cash flows from operations. See Compustat definitions of OANCF.
- OCF does not include capital expenditures (CAPX), which is separately accounted in cash flows from investment activities. OCF does include R&D expenses, which count towards operating expenses (included in COGS and XSGA); R&D spending is required to be immediately expensed. OCF does not include the effect of payouts and securities issuance, which are separately accounted in cash flows from financing activities.

3. Difference between EBITDA and OCF

- There are two main differences between the EBITDA and OCF variables.

First, OCF takes into account the cash receipts due to non-operating income, asset sales, windfalls, minority interests, etc., which are items not included in EBITDA.

Second, due to accounting principles, earnings recognition and cash payments may not happen concurrently. Cash payments may occur before, at the same time, or after earnings recognition. For instance, it is customary for companies to make sales and receive payments from customers later. Companies may also receive payments first before delivering goods and services (e.g. customers purchase gift cards and only use them later, or customers purchase membership/subscription that they use later).

## Discussion

In the baseline regression of Section 4.1.1, we have a specification that controls for OCF to address the potential impact of cash receipts on firms' borrowing and investment:

$$Y_{it} = \alpha_i + \eta_t + \beta \text{EBITDA}_{it} + \kappa \text{OCF}_{it} + X_{it}'\gamma + \epsilon_{it}$$

In this specification with both EBITDA and OCF, we would like to make sure that the coefficient on EBITDA ($\beta$) reflects the impact of the EBC channel, and the coefficient on OCF ($\kappa$) reflect the impact of the internal funds channel.

**Coefficients on EBITDA.** Based on the definition of EBITDA above, variations in EBITDA come from either sales or operating expenses. Whether cash associated with sales/expenses comes in advance, concurrently, or later does not affect EBITDA per se.

For the coefficient on EBITDA $\beta$, consider two firms that end up with the same OCF, but have different EBITDA. From Equation (13), we know the variations in EBITDA are accompanied by differences in the second to last terms of Equation (13).

- For example, consider firm A with EBITDA 20, NOPI 0, and OCF 20, and firm B with EBITDA 10, NOPI 10, and OCF 20. They happen to have the same OCF and different EBITDA. There are accompanying differences in NOPI (10).

To make sure the coefficient on EBITDA reflects the impact of the EBC channel, we need to make sure the accompanying differences themselves do not influence borrowing and investment (through mechanisms other than the EBC channel) and cause omitted variable problems. In the NOPI case above, this issue does not seem obvious: holding OCF constant, it is not obvious why having less NOPI (firm A) would lead to more borrowing and investment. The issue could be more relevant in several other cases, which we discuss below.

- Can changes in accounts receivables directly affect borrowing and investment and be an OVB?

  We first consider changes in accounts receivable $\Delta$AR. To illustrate, suppose firm A has EBITDA 20, $\Delta$AR 0 (all the earnings are concurrently received in cash), and OCF 20, while firm B has EBITDA 30, $\Delta$AR 10 (20 of the EBITDA is received in cash, while 10 is booked as receivable), and OCF 20.

  One concern is that firm B expects to receive 10 in the next period, and can pledge the receivable as collateral to borrow more. Even in the absence of EBCs, if firms borrow by pledging receivable, we may see firm B borrow more than firm A.[18] Such borrowing based on receivable is generally short-term debt, while our results hold primarily for long-term debt. In addition, such borrowing is also asset-based debt, while our results also hold among cash flow-based debt.

- Can changes in inventory directly affect borrowing and investment and be an OVB?

  Another case worth considering is changes in inventory. Changes in inventory $\Delta \mathrm{INV}$ has several components: $\Delta \mathrm{INV} = \mathrm{INVP}_{\mathrm{t}}^{\mathrm{t+1}} - \mathrm{INVP}_{\mathrm{t-1}}^{\mathrm{t}}$.

  - $\mathrm{INVP}_{\mathrm{t-1}}^{\mathrm{t}}$ denotes inventory purchased before period $t$ used in period $t$ production. $\mathrm{INVP}_{\mathrm{t-1}}^{\mathrm{t}}$ affects EBITDA of period $t$ (counts toward cost of goods sold in period $t$), but does not affect OCF in period $t$.
  - $\mathrm{INVP}_{\mathrm{t}}^{\mathrm{t+1}}$ denotes inventory purchased in period $t$ for future production. $\mathrm{INVP}_{\mathrm{t}}^{\mathrm{t+1}}$ affects OCF in period $t$ but does not affect EBITDA in period $t$.

  As shown above, changes in the inventory balance can come from two sources: 1) usage of old inventory, and 2) purchase of inventory for future production. There are two corresponding situations to consider.

  The first situation focuses on usage of old inventory. To illustrate, suppose firm A has sales 20 and $\Delta \mathrm{INV} = \mathrm{INVP}_{\mathrm{t}}^{\mathrm{t+1}} - \mathrm{INVP}_{\mathrm{t-1}}^{\mathrm{t}} = 0 - 0 = 0$, so its EBITDA is 20 and OCF is 20. Firm B has sales of 20 and $\Delta \mathrm{INV} = \mathrm{INVP}_{\mathrm{t}}^{\mathrm{t+1}} - \mathrm{INVP}_{\mathrm{t-1}}^{\mathrm{t}} = 0 - 10 = -10$, so its EBITDA is 10 and OCF is 20. The difference between firm A and firm B is that firm A does not use old inventory ($\mathrm{INVP}_{\mathrm{t-1}}^{\mathrm{t}} = 0$), while firm B uses old inventory ($\mathrm{INVP}_{\mathrm{t-1}}^{\mathrm{t}} = 10$). In this situation, firm A and firm B have the same OCF and different EBITDA; the difference in EBITDA is accompanied by firm A using less old material. It is not obvious why such differences will directly affect borrowing and investment, except we need to be careful about the investment opportunity issue which is addressed extensively in Section 4.1.1.

  The second situation focuses on purchases of new inventory. To illustrate, suppose firm A has sales of 20 and $\Delta \mathrm{INV} = \mathrm{INVP}_{\mathrm{t}}^{\mathrm{t+1}} - \mathrm{INVP}_{\mathrm{t-1}}^{\mathrm{t}} = 0 - 0 = 0$, so its EBITDA is 20 and OCF is 20. Firm B has sales of 30 and $\Delta \mathrm{INV} = \mathrm{INVP}_{\mathrm{t}}^{\mathrm{t+1}} - \mathrm{INVP}_{\mathrm{t-1}}^{\mathrm{t}} = 10 - 0 = 10$, so its EBITDA is 20 and OCF is 10. The difference between firm A and firm B is that firm A does not purchases additional inventory for future production ($\mathrm{INVP}_{\mathrm{t}}^{\mathrm{t+1}} = 0$), while firm B purchases additional inventory for future production ($\mathrm{INVP}_{\mathrm{t}}^{\mathrm{t+1}} = 10$). In this situation, firm A and firm B have the same OCF and different EBITDA; the difference in EBITDA is accompanied by purchases of inventory for future production. To the extent that investment opportunities are well measured, holding OCF fixed, inventory purchases would not add additional information about borrowing and investment decisions; the investment opportunity issue is addressed extensively in Section 4.1.1.

**Coefficients on OCF.** Based on the definition of OCF above, variations in OCF are affected by the timing of payments and by payments associated with other forms of earnings not included in EBITDA.

For the coefficient on OCF $\kappa$, consider two firms that have the same EBITDA, but different OCF. From Equation (13), we know the differences in OCF are accompanied by differences in the second to last terms of Equation (13).

[18] This issue with accounts receivable could exist even when we do not control for OCF. Consider a limiting case where all sales are paid by receivable rather then cash. Then variations in sales are entirely variations in receivable.

- For example, suppose firm A and firm B both have EBITDA 20, while firm A has NOPI 10 and firm B has NOPI 0, then firm A will have OCF 30 and firm B will have OCF 20.

To make sure the coefficient on OCF reflects the impact of the internal funds channel, we need to make sure the accompanying differences themselves do not influence borrowing and investment (through mechanisms other than the internal funds channel) and cause omitted variable problems. In the NOPI case above, this issue does not seem obvious: holding EBITDA constant, it is not obvious why having more NOPI (firm A) would lead to less borrowing and more investment other than through the internal funds channel. The issue could be more relevant in several other cases, which we discuss below.

- Can changes in accounts receivable directly affect borrowing and investment and be an OVB?

  To illustrate, consider a case about accounts receivable: suppose firm A and firm B have the same EBITDA, and firm A receives cash while firm B gets receivables. Firm B may pledge the receivables as collateral to borrow more. However, as discussed above, such borrowing based on receivables is generally short-term debt, while our results primarily hold for long-term debt. In addition, such borrowing is also asset-based debt, while our results also hold among cash flow-based debt.

- Can changes in accounts payable directly affect borrowing and investment and be an OVB?

  To illustrate, suppose firm A and firm B have the same EBITDA, but firm A decides to pay its suppliers more slowly. In this case, firm A will have an increase in $\Delta$AP and more OCF.

  In this case, firm A now has more internal funds and may raise less money from capital markets. To the extent that borrowing from suppliers (i.e. increasing payable) is less costly than external financing in capital markets, stretching accounts payable is one way of generating internal funds. This is the same as the internal funds channel discussed above. Holding EBITDA constant, it is not obvious why having more accounts payable would lead to less borrowing and more investment other than through the channel of increasing internal funds.

- Can changes in inventory directly affect borrowing and investment and be an OVB?

  To illustrate, suppose firm A and firm B have the same EBITDA, but firm A purchases more inventory for future production ($\mathrm{INVP}_t^{t+1}$), then firm A will have lower OCF.

  In this case, firm A now has less internal funds and may raise more money from capital markets to finance the inventory purchases. This is the same as the internal funds channel discussed above. Holding EBITDA constant, it is not obvious why having more inventory purchase would lead to more borrowing and less investment other than through the channel of increasing internal funds. To further confirm, we also perform checks controlling for inventory purchases in Supplementary Appendix Table IA5. The OCF coefficients stay similar as before.

## IA5.2 Earnings Management

In the baseline regressions in Section 4.1.1, one driver of variations in EBITDA could be earnings management. For example, when EBCs become binding, firms may recognize earnings more aggressively (e.g. under-estimate operating expenses, or over-estimate sales or accounts receivable) so they can keep more debt. The survey of managers by Graham, Harvey, and Rajgopal (2005) suggests such earnings management can happen when firms are close to violating debt covenants.

How does the possibility of earnings management affect the interpretation of the baseline regressions in Section 4.1.1? The objective in these tests is to study the sensitivity of external borrowing to accounting EBITDA. Whether the EBITDA comes from "true" operating earnings or from earnings management, both affect accounting EBITDA and can help us estimate the sensitivity of borrowing to accounting EBITDA.

The earnings management motive also speaks directly to the impact of accounting earnings on borrowing. Due to EBCs, current EBITDA plays a key role in firm's ability to borrow. Thus managers sometimes resort to earnings management to boost EBIDA and debt capacity.

# IA6 Proofs

## IA6.1 Proofs for Appendix E

**Characterization of the equilibrium dynamics under collateral-based constraints.** From conditions (A3) and (A10), we have, for all $t$,

$$\hat{q}_t = \frac{1}{\eta}\frac{\left(\frac{R}{1-\delta}\right)-1}{\left(\frac{R}{1-\delta}\right)}\frac{1}{1-\left(1+\frac{1}{\eta}\right)^{-1}\left(\frac{R}{1-\delta}\right)^{-1}}\hat{K}_t = \frac{\left(1+\frac{1}{\eta}\right)\left[\frac{R}{1-\delta}-1\right]}{\eta\left[\left(1+\frac{1}{\eta}\right)\left(\frac{R}{1-\delta}\right)-1\right]}\hat{K}_t,$$

Substitute in period 0 farmers' land demand curve (condition (A8)), we have

$$\begin{aligned}
\left(1+\frac{1}{\eta}\right)\hat{K}_0 &= \Delta + \frac{1-\delta}{1-\frac{1}{R}(1-\delta)}\left(\frac{\left(1+\frac{1}{\eta}\right)\left[\frac{R}{1-\delta}-1\right]}{\eta\left[\left(1+\frac{1}{\eta}\right)\left(\frac{R}{1-\delta}\right)-1\right]}\hat{K}_0\right), \\
\hat{K}_0 &= \frac{1}{1+\frac{1}{\eta}}\left(1+\frac{\frac{R}{1-\delta}}{\frac{R}{1-\delta}-1}\frac{1}{\eta}\right)\frac{\eta}{\eta+\frac{\delta}{1-\frac{1-\delta}{R}}}\Delta, \\
\hat{q}_0 &= \frac{1}{\eta+\frac{\delta}{1-\frac{1-\delta}{R}}}\Delta.
\end{aligned}$$

Using conditions (A10), we then have

$$\hat{K}_t = \left(1+\frac{1}{\eta}\right)^{-t}\hat{K}_0 \quad \text{and} \quad \hat{q}_t = \left(1+\frac{1}{\eta}\right)^{-t}\hat{q}_0.$$

**Characterization of the steady state under earnings-based constraints.** From conditions (A13) and (A14), the steady state can be characterized by

$$q^*\delta K^* + RB^* = aK^* + B^*,$$
$$RB^* = \theta a K^*,$$
$$q^* = u(K^*)$$

As a result,

$$q^* = a\frac{\left(1+\frac{\theta}{R}-\theta\right)}{\delta} \quad , \frac{B^*}{K^*} = \frac{\theta a}{R} \quad \text{and} \quad K^* = u^{-1}\left(a\frac{\left(1+\frac{\theta}{R}-\theta\right)}{\delta}\right).$$

When $\theta = \frac{1-\delta}{1-\frac{1}{R}(1-\delta)}$, the steady state will then be the same as the one under collateral-based constraints.

**Characterization of the equilibrium under earnings-based constraints.** $\lambda = \frac{\left(\frac{R}{1-\delta}\left(1+\frac{\delta}{\eta}\right)+1\right)-\sqrt{\left(\frac{R}{1-\delta}\left(1+\frac{\delta}{\eta}\right)+1\right)-4\frac{R}{1-\delta}}}{2} \in (0,1)$ is the only eigenvalue of $\begin{pmatrix} \frac{R}{1-\delta} & -\frac{1}{\eta}\left(\frac{R}{1-\delta}-1\right) \\ -\delta\frac{\frac{R}{1-\delta}}{1-\frac{1-\delta}{R}} & 1+\frac{\delta}{\eta}\frac{R}{1-\delta} \end{pmatrix}$ that is within the unit circle. Together with the fact that $\hat{q}_t$ is bounded, we have $\hat{q}_0 = \alpha\hat{K}_0$, $\hat{q}_t = \lambda^t\hat{q}_0$ and $\hat{K}_t = \lambda^t\hat{K}_0$, where $\alpha = \frac{q_\lambda}{k_\lambda} = \frac{\frac{1}{\eta}\left(\frac{R}{1-\delta}-1\right)}{\frac{R}{1-\delta}-\lambda} > 0$ and $(q_\lambda, k_\lambda)$ is the eigenvector corresponding to $\lambda$. Using the farmers' capital holding at 0 in condition (A16), we arrive at condition (A20).

**Proof of Lemma 1.** From conditions (A11) and (A20), for the part of the Lemma about farmers' land holding ($\frac{d\hat{K}_0}{d\Delta}|_{KM} > \frac{d\hat{K}_0}{d\Delta}|_{EBC}$), we only need to prove that

$$\frac{1}{1+\frac{1}{\eta}}\left(1+\frac{\frac{R}{1-\delta}}{\frac{R}{1-\delta}-1}\frac{1}{\eta}\right)\frac{\eta}{\eta+\frac{\delta}{1-\frac{1-\delta}{R}}} > \frac{1}{1+\frac{\delta}{1-\frac{1}{R}(1-\delta)}\alpha}. \tag{14}$$

Let us first prove that

$$\frac{1}{1+\frac{1}{\eta}}\left(1+\frac{\frac{R}{1-\delta}}{\frac{R}{1-\delta}-1}\frac{1}{\eta}\right)\frac{\eta}{\eta+\frac{\delta}{1-\frac{1-\delta}{R}}} > \frac{1}{1+\frac{\delta}{\eta}}. \tag{15}$$

This is equivalent to proving that

$$\frac{\frac{\frac{R}{1-\delta}-1}{\frac{R}{1-\delta}}+\frac{1}{\eta}}{\frac{\frac{R}{1-\delta}-1}{\frac{R}{1-\delta}}+\frac{\delta}{\eta}} = \left(1+\frac{\frac{R}{1-\delta}}{\frac{R}{1-\delta}-1}\frac{1}{\eta}\right)\frac{\eta}{\eta+\frac{\delta}{1-\frac{1-\delta}{R}}} > \frac{1+\frac{1}{\eta}}{1+\frac{\delta}{\eta}},$$

which is true as $\frac{\frac{R}{1-\delta}-1}{\frac{R}{1-\delta}} > 1$ and $\delta < 1$.

We then prove that

$$\frac{1}{1+\frac{\delta}{1-\frac{1}{R}(1-\delta)}\alpha} < \frac{1}{1+\frac{\delta}{\eta}}. \tag{16}$$

Note that from the formula of $\lambda$ above, we have

$$\lambda = \frac{\left(\frac{R}{1-\delta}\left(1+\frac{\delta}{\eta}\right)+1\right) - \sqrt{\left(\frac{R}{1-\delta}\left(1+\frac{\delta}{\eta}\right)+1\right) - 4\frac{R}{1-\delta}}}{2}$$

$$= \frac{2\frac{R}{1-\delta}}{\frac{R}{1-\delta}\left(1+\frac{\delta}{\eta}\right)+1+\sqrt{\left(\frac{R}{1-\delta}\left(1+\frac{\delta}{\eta}\right)+1\right) - 4\frac{R}{1-\delta}}} > \frac{\frac{R}{1-\delta}}{\frac{R}{1-\delta}\left(1+\frac{\delta}{\eta}\right)+1}$$

$$\alpha = \frac{\frac{1}{\eta}\left(\frac{R}{1-\delta}-1\right)}{\frac{R}{1-\delta}-\lambda} > \frac{\frac{1}{\eta}\left(\frac{R}{1-\delta}-1\right)}{\frac{R}{1-\delta}-\frac{\frac{R}{1-\delta}}{\frac{R}{1-\delta}\left(1+\frac{\delta}{\eta}\right)+1}} = \frac{\frac{1}{\eta}\left(\frac{R}{1-\delta}-1\right)}{\left(\frac{R}{1-\delta}\right)^2\frac{\left(1+\frac{\delta}{\eta}\right)}{\frac{R}{1-\delta}\left(1+\frac{\delta}{\eta}\right)+1}}.$$

We then have

$$\frac{1}{1+\frac{\delta}{1-\frac{1}{R}(1-\delta)}\alpha} < \frac{1}{1+\frac{\delta}{1-\frac{1}{R}(1-\delta)}\frac{\frac{1}{\eta}\left(\frac{R}{1-\delta}-1\right)}{\left(\frac{R}{1-\delta}\right)^2\frac{\left(1+\frac{\delta}{\eta}\right)}{\frac{R}{1-\delta}\left(1+\frac{\delta}{\eta}\right)+1}}} = \frac{1}{1+\frac{\frac{1}{\eta}\delta}{\frac{\frac{R}{1-\delta}\left(1+\frac{\delta}{\eta}\right)}{\frac{R}{1-\delta}\left(1+\frac{\delta}{\eta}\right)+1}}} < \frac{1}{1+\frac{\delta}{\eta}}.$$

Together, we prove condition (14). Finally, note that the aggregate output from period $t$ land holding (which gets produced in period $t+1$) is

$$\hat{Y}_t = \frac{a+c-Ra}{a+c}\frac{(a+c)\,K^*}{Y^*}\hat{K}_t,$$

where $\frac{a+c-Ra}{a+c}$ reflects the difference between the farmers' productivity (equal to $a+c$) and the gatherers' productivity (equal to $Ra$ in the steady state) and the ratio $\frac{(a+c)K^*}{Y^*}$ is the share of farmers' output. In other words, $\hat{Y}_t$ is just a multiple $\hat{K}_t$. The above result about $\frac{d\hat{K}_0}{d\Delta}$ then also applies to $\frac{d\hat{Y}_0}{d\Delta}$.

## IA6.2 Proofs for Appendix IA1

**Proof of Proposition A1.**

i) Consider contract $(C,D) = \left(\max\left\{\bar{D},\bar{R}\right\},\bar{D}\right)$. From condition (6), we know that the borrower's IC constraint, condition (2), is satisfied. From condition (5), we know that the creditor's IR constraint, condition (3), is satisfied. As a result, the set of contracts that satisfy all of constraints (2) - (4) is non-empty.

Moreover, by working with continuous random variables (we assume p.d.f. exists for $f_{e^L}(R)$ and $f_{e^H}(R)$), we know the borrower's utility as a function of $C$ and $D$ in condition 1 is continuous and bounded, and the set of $(C,D)$ that satisfies constraints (2) - (4) is closed. As a result, the optimum of the following maximization problem exists. There exists a contract $(C^*,D^*)$ that achieves the supreme $U^*$ defined in condition 1.

ii) We will proceed by contradiction. Consider a constrained optimal contract $(C^*,D^*)$ such that $U^* = U(C^*,D^*)$ and $D^* > \bar{D}$, where $\bar{D} \in [0,R_{\max})$ is defined in condition (5). We can construct an alternative contract $(C',D') = \left(C^*,\bar{D}\right)$. Under this new contract, $U^B(C',D') > U^B(C^*,D^*)$. Let us consider whether the borrower's IC constraint is still satisfied under $(C',D')$. Let $h(D) \equiv \int \max\{R-D,0\}\left(f_{e^H}(R)-f_{e^L}(R)\right)dR = \int_D^{R_{\max}}(R-D)\left(f_{e^H}(R)-f_{e^L}(R)\right)dR$. We have

$$\begin{cases} h'(D) = \left(\int_D^{R_{\max}} -\left(f_{e^H}(R) - f_{e^L}(R)\right)\right) dR = F_{e^H}(R) - F_{e^L}(R) \leq 0 & \text{if } D \in [0, R_{\max}) \\ h'(D) = 0 & \text{if } D > R_{\max}. \end{cases}$$

where we use the fact that under Assumption 5, $F_{e^H}$ first order stochastically dominates $F_{e^L}$. As a result, we have $h(D^*) \leq h(\bar{D}) = h(D')$. This makes sure that the borrower's IC constraint is still satisfied under $(C', D')$. Moreover, conditions (3) and (4) are also satisfied under $(C', D')$. As a result, $(C^*, D^*)$ achieves constrained optimum.

iii) Consider a constrained optimal contract $(C^*, D^*)$. From part (ii) of the Proposition, we know $D^* = \bar{D}$. From condition 7, we know if $C^* = D^* = \bar{D}$, the borrower's IC constraint will be violated. This proves $C^* > D^*$.

**Proof of Proposition A3.**

We prove Proposition A3 first, and then prove Proposition A2 next. As discussed in footnote 15, without loss of generality, we can assume $D \leq R(x_{\max})$. If $D \geq R(x_{\min})$, there exists a unique $x_D$ such that $R(x_D) = D$. Consider two sub-cases:

a) $Y(x_D) \geq 0$. Because $Y$ is decreasing, we have, for all $x \leq x_D$, $Y(x) \geq 0$. As a result,

$$\min\{D, R(x) + Y(x)\} \geq \min\{D, R(x)\} \quad \forall x \leq x_D. \tag{17}$$

For $x > x_D$, we assumed both $R(x)$ and $R(x) + Y(x)$ are increasing in $x$. As a result, $R(x) \geq R(x_D) = D$. $R(x) + Y(x) \geq R(x_D) + Y(x_D) \geq D$. Together, we have,

$$\min\{D, R(x) + Y(x)\} = \min\{D, R(x)\} = D \quad \forall x > x_D.$$

Together with condition (17), we prove $E[\min\{D, R(x) + Y(x)\} | s] \geq E[\min\{D, R(x)\} | s]$ for *any* $s$.

b) $Y(x_D) \leq 0$. Because $Y$ is decreasing, for all $x > x_D$, we have $Y(x) \leq 0$. As a result,

$$\max\{R(x) + Y(x) - D, 0\} \leq max\{R(x) - D, 0\} \quad \forall x > x_D.$$

For $x \leq x_D$, because both $R(x)$ and $R(x)+Y(x)$ are increasing in $x$, we have $R(x)+Y(x) \leq R(x_D) + Y(x_D) < D$. As a result,

$$\max\{R(x) + Y(x) - D, 0\} = \max\{R(x) - D, 0\} = 0 \quad \forall x \leq x_D.$$

Together, we have, for *any* $s$,

$$E[\max\{R(x) + Y(x) - D, 0\} | s] \leq E[\max\{R(x) - D, 0\} | s]. \tag{18}$$

Note that, for $s < \bar{s}$, $E[Y(x) | s] = E[R(x) + Y(x) - D | s] - E[R(x) - D | s] > 0$. Moreover, $\max\{R(x) - D, 0\} + \min\{D, R(x)\} = R(x)$ and $\max\{R(x) + Y(x) - D, 0\} + \min\{D, R(x) + Y(x)\}$ $= R(x) + Y(x)$. Together with condition (18), we have, for any $s < \bar{s}$,

$$E[\min\{D, R(x) + Y(x)\} | s] \geq E[\min\{D, R(x)\} | s].$$

Finally, we consider the case $D \leq R(x_{\min})$. Then, for all $x$, we have

$$\min\{D, R(x)\} = D \quad \text{and} \quad \min\{D, R(x) + Y(x)\} \geq D.$$

As a result, we have, for *any* $s$,

$$E[\min\{D, R(x) + Y(x)\} | s] \geq E[\min\{D, R(x)\} | s].$$

This finishes the proof of Proposition A3.

**Proof of Proposition A2.**

As in the proof of Proposition A3, we have,

$$\max\{R(x) + Y(x) - D, 0\} \leq \max\{R(x) - D, 0\} \quad \forall x,$$

$$E[\max\{R(x) + Y(x) - D, 0\} | s] \leq E[\max\{R(x) - D, 0\} | s] \quad \forall s.$$

If for a given $s$, there is a positive measure of $x$ under $F_s$ such that

$$\max\{R(x) + Y(x) - D, 0\} < \max\{R(x) - D, 0\},$$

we have

$$E[\max\{R(x) + Y(x) - D, 0\} | s] < E[\max\{R(x) - D, 0\} | s].$$

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