Anatomy of Corporate Borrowing Constraints*

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Abstract

Macro-finance analyses commonly link firms' borrowing constraints to the liquidation value of physical assets. For US non-financial firms, we show that 20% of debt by value is based on such assets ("asset-based lending" in creditor parlance), whereas 80% is based predominantly on cash flows from firms' operations ("cash flow-based lending"). A standard borrowing constraint restricts total debt as a function of cash flows measured using operating earnings ("earnings-based borrowing constraints"). These features shape firm outcomes on the margin: first, cash flows in the form of operating earnings can directly relax borrowing constraints; second, firms are less vulnerable to collateral damage from asset price declines, and fire sale amplification may be mitigated. Taken together, our findings point to new venues for modeling firms' borrowing constraints in macro-finance studies.

JEL: E22, E32, G31, G33.
Key words: Cash flow-based lending; Earnings-based borrowing constraints; Macro-finance mechanisms.

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1 Introduction

Borrowing constraints of firms play a critical role in macroeconomic analyses with financial frictions. What determines these borrowing constraints? In some work, borrowing capacity depends on cash flows from firms' operations (Stiglitz and Weiss, 1981; Holmstrom and Tirole, 1997). More recently, however, the spotlight has fallen on the liquidation value of physical assets that firms can pledge as collateral (Hart and Moore, 1994; Kiyotaki and Moore, 1997; Bernanke, Gertler, and Gilchrist, 1999).

The type of borrowing constraints can have an important impact on macro-finance mechanisms. For example, classic financial acceleration through asset price feedback builds on borrowing constraints tied to the liquidation value of physical assets (Kiyotaki and Moore, 1997; Bernanke, Gertler, and Gilchrist, 1999; Mendoza, 2010). Furthermore, different forms of constraints also have different implications for credit allocation and efficiency, responses to monetary policy, economic recovery, and the rise of intangible capital, among others (Lorenzoni, 2008; Bernanke and Gertler, 1995; Diamond, Hu, and Rajan, 2018; Crouzet and Eberly, 2018). As the Great Recession inspires growing interest in macro-finance modeling, a key question is what types of constraints apply and in which settings?

In this paper, we collect detailed data on US non-financial corporate debt to empirically investigate this question. We document the central role of firms' cash flows (not necessarily physical collateral value) for corporate borrowing in the US, using a newly constructed dataset that integrates a number of data sources and hand-collected data. The dataset features two components. One is a classification of debt based on the primary determinants of debt value, which covers both the aggregate non-financial corporate sector and individual debt at the firm level; the analysis includes all forms of debt (not restricted to a particular debt category such as bank loans or corporate bonds). The other is debt limit requirements and enforcement of these restrictions. This data on debt contracts allows us to analyze the prevalence of different types of debt and the constraints creditors impose. We then document how the characteristics of corporate borrowing affect firm outcomes on the margin. We also study the implications of our findings for the applicability of macro-finance mechanisms.

We begin by presenting two main facts about corporate borrowing in the US. First, borrowing against cash flows accounts for the majority of US non-financial corporate debt. We find that 20% of corporate debt is based on specific assets (i.e., assets that can be repossessed and evaluated on a standalone basis, including physical assets like real estate, equipment, inventory, as well as receivables, patents, etc.), both in terms of aggregate dollar amount outstanding and for a typical large non-financial firm (book assets above Compustat median). Creditors commonly refer to this type of debt as asset-based lending. The debt is generally secured by these specific assets, whose liquidation value is the key determinant of creditors' payoffs in bankruptcy. Asset-based debt corresponds to borrowing against "land"

in Kiyotaki and Moore (1997). Meanwhile, 80% of corporate debt is not tied to specific assets, and is instead based on the value of cash flows from firms' continuing operations. Creditors commonly refer to this type of debt as cash flow-based lending. As we discuss in Section 2, cash flow-based lending can be either secured (by the corporate entity) or unsecured, and the key determinant of creditors' payoffs in US Chapter 11 bankruptcy is the going-concern cash flow value of the restructured firm. Cash flow-based debt corresponds to borrowing against "fruits" in Kiyotaki and Moore (1997). In the data, we verify that the amount of cash flow-based debt a firm has does not have indirect positive dependence on physical asset value. Overall, the composition of corporate debt suggests that the liquidation value of physical assets may not be the defining constraint for major US non-financial firms.

Second, with the prevalence of cash flow-based lending, borrowing constraints commonly rely on a specific measure of cash flows. They stipulate that a firm's total debt or interest payments cannot exceed a multiple of EBITDA (earnings before interest, taxes, depreciation and amortization) in the past twelve months. We refer to these constraints as earnings-based borrowing constraints (EBCs). EBCs restrict total debt at the firm level, rather than the size of a particular debt contract. EBCs are often enforced through legally binding financial covenants in cash flow-based loans and bonds. Those in loans monitor compliance on a quarterly basis, so the constraint is relevant not just for issuing new debt, but also for maintaining existing debt. Among large non-financial firms, around 60% have earnings-based covenants explicitly written in their debt contracts. Given contracting constraints, creditors focus on current EBITDA as a principal metric of cash flow value, which is informative as well as observable and verifiable.

Corporate borrowing based on cash flows is not always the norm. Its feasibility and practicality rely on legal infrastructure (e.g., accounting, bankruptcy laws, court enforcement) that enhances cash flow verifiability and contractibility, and on firms generating sufficient cash flows. Once these conditions are met, cash flow-based lending can be more appealing than pledging specific assets, since many corporate assets are specialized and illiquid, as observed by previous work on firm-specific capital (Altig, Christiano, Eichenbaum, and Linde, 2011). These factors shape several variations across firm groups in the prevalence of cash flow-based lending (and correspondingly the prevalence of EBCs). First, cash flow-based lending is less common among small firms (with median share less than 10%), given low or negative earnings and higher likelihood of liquidation. The same applies to low profit margin firms. Second, while cash flow-based lending dominates in value in most industries, there are exceptions such as airlines where firms have a substantial amount of standardized transferable assets. Finally, the prevailing form of corporate borrowing can vary across countries given differences in institutional environments. We find a higher prevalence of cash flow-based lending in countries with Chapter 11-type corporate bankruptcy systems that facilitate reorganization. Later we present a detailed illustration of the impact of different forms of corporate borrowing

by contrasting the US with Japan.

After documenting the prevalence of cash flow-based lending and EBCs based on debt contracts, we investigate how they affect firm outcomes on the margin. With cash flow-based lending and EBCs, cash flows in the form of operating earnings (EBITDA) can directly relax borrowing constraints, and enable firms to borrow and invest more. We first analyze the sensitivity of debt issuance to EBITDA, starting with firms where cash flow-based lending and EBCs are most relevant, such as large firms with earnings-based covenants. We find that a one dollar increase in EBITDA is on average associated with about 27 cents increase in net debt issuance. This finding does not exist, however, among other firm groups not bound by EBCs, such as unconstrained firms and firms that primarily use asset-based lending (e.g., small firms, low margin firms, airlines and utilities, Japanese firms). The set of results across different firm groups is not easy to account for based on standard empirical concerns (e.g., Q mismeasurement), which we discuss in detail.

We then study a natural experiment that contributes to exogenous variations in operating earnings (EBITDA), due to changes in an accounting rule (SFAS 123(r)). Before the adoption of this rule, firms' option compensation expenses did not count towards operating earnings, while the new rule requires their inclusion. Thus the rule affects the calculation of operating earnings, but does not directly affect firms' cash positions or economic fundamentals. As previous research demonstrates, changes in accounting rules are not easy to neutralize, and they can have a significant impact through debt covenants (Moser, Newberry, and Puckett, 2011; Shroff, 2017). We instrument operating earnings after the adoption of SFAS 123(r), using average option compensation expenses in the three years prior to the rule announcement. We find significant first-stage results among all firms. We find significant second-stage results of operating earnings on borrowing only among firms bound by EBCs.

While the prevalence of cash flow-based lending in the US contributes to the sensitivity of corporate borrowing to cash flows in the form of operating earnings, it may diminish the sensitivity to the value of physical assets such as real estate (borrowing against real estate accounts for only 7% of corporate debt by value). Using both traditional estimates of firm real estate value and hand-collected property-level data from company filings, we find that US large non-financial firms' borrowing has relatively small sensitivity to real estate value, concentrated in asset-based debt. For cash flow-based debt, the sensitivity is absent, if not negative and offsets the response of asset-based debt. Overall, borrowing increases by 3 to 4 cents on average for a one dollar increase in firm real estate value, consistent with findings by Chaney, Sraer, and Thesmar (2012). In this case, a 20% decline in property price would be associated with a minor decline in borrowing (0.12% of book assets) for the median firm with real estate.

These observations can also shed further light on the transmission of shocks during the Great Recession. For the decline in property prices, we do not find that collateral damage

to firms' real estate asset value had a powerful impact on corporate borrowing and investment. Meanwhile, the decline in earnings did have a significant impact through EBCs, which accounted for roughly 10% of the drop in debt issuance and capital expenditures. The magnitude is meaningful but not catastrophic. The results are in line with the view that the US Great Recession was a crisis centered around the balance sheet impairment of households and banks, rather than that of major non-financial firms.

The story in the US finds its antithesis in Japan. Unlike the US where cash flow-based lending prevails, Japan historically lacked legal infrastructure for such lending practices, and instead developed a corporate lending tradition focused on physical assets, especially real estate. We show that Japanese firms do not display sensitivity of debt issuance to operating earnings. Japanese firms are, however, highly sensitive to declines in the value of real estate assets, as shown by the Japanese property price collapse in the early 1990s (Gan, 2007). As different legal institutions shape different corporate borrowing practices across countries, distinct macro-finance mechanisms may apply.

Finally, we lay out further implications of the prevalence of cash flow-based lending and EBCs for macro-finance analyses. Based on the standard model of Kiyotaki and Moore (1997), we study financial acceleration in general equilibrium with different borrowing constraints (traditional collateral constraints versus EBCs). With cash flow-based lending and EBCs, we find that asset price feedback through firms' balance sheets can diminish significantly. We also examine the implications for credit access and allocation, monetary policy transmission, and investment cash flow sensitivity. We end by delineating how our empirical findings translate into specifying firms' borrowing constraints in macro-finance models.

The domain of our analysis is *non-financial corporations*. For financial institutions, assets are generally standardized and liquid, and borrowing constraints often tie closely to the liquidation value of securities pledged as collateral. The ensuing fire sale amplification has been thoroughly analyzed (Shleifer and Vishny, 1997; Coval and Stafford, 2007; Garleanu and Pedersen, 2011), which attests to models of asset price feedback (Kiyotaki and Moore, 1997; Bernanke, Gertler, and Gilchrist, 1999; Brunnermeier and Sannikov, 2014). For households, mortgages also emphasize "loan-to-value" constraints. Greenwald (2019b) investigates the role of "payment-to-income" constraints, a form of constraint similar to the earnings-based constraints we study among firms.[1] Overall, in the US setting, financial fragility and fire sale amplification may have primary impact through financial institutions and households, while these traditional mechanisms may not prevail among major non-financial firms.

[1] As Greenwald (2019b) shows, in residential mortgages "payment-to-income" (PTI) constraints coexist with "loan-to-value" (LTV) constraints. In this setting, creditors' claims are primarily tied to the value of the property, and LTV is the primary constraint. However, seizing and liquidating the property is not frictionless, so PTI can be a secondary constraint to reduce costly foreclosures (when assets are very liquid and seizing assets is close to costless, e.g., margin loans in financial markets, traditional collateral constraints are first-order and cash flow-based constraints are absent).

1.1 Related Literature

Our paper relates to several strands of research. First, our study is motivated by the importance of firms' borrowing constraints in macro-finance models (Hart and Moore, 1994, 1998; Shleifer and Vishny, 1992; Kiyotaki and Moore, 1997; Bernanke, Gertler, and Gilchrist, 1999; Christiano, Motto, and Rostagno, 2014; Dávila and Korinek, 2017).[2] The traditional focus has been the liquidation value of physical assets. We perform detailed empirical analyses to connect model assumptions with the data: we show the prevalent form of corporate borrowing (cash flow-based lending) and key borrowing constraints (EBCs) among US non-financial firms. The findings suggest new venues for specifying firms' borrowing constraints in macro-finance analyses. We also show that different forms of corporate borrowing apply in different environments, and can lead to distinct implications.

Second, our findings inform several related papers on financial frictions and the macroeconomy. Greenwald (2019a) analyzes how interest coverage ratio constraints, a particular form of EBCs, affect the transmission of monetary policy. Drechsel (2019) builds a business cycle model to study the impact of investment opportunity shocks under traditional collateral constraints versus earnings-based constraints. Cloyne, Ferreira, Froemel, and Surico (2018) find that young firms, which rely more heavily on asset-based lending, experience more financial acceleration in response to monetary policy shocks.

Third, our work connects research on corporate debt with questions in macro-finance. Our paper is related to studies of corporate debt heterogeneity and its impact. We analyze one key aspect of debt heterogeneity, i.e., asset-based versus cash flow-based lending: we investigate their characteristics, prevalence, contracting foundations, and implications for macro-finance mechanisms. Recent work by Ivashina, Laeven, and Moral-Benito (2019) also highlights the importance of this distinction, and studies how asset-based lending and cash flow-based lending play different roles in the bank lending channel. Other work has analyzed heterogeneity in debt types, sources, and priority (Rauh and Sufi, 2010; De Fiore and Uhlig, 2011; Crouzet, 2017; Benmelech, Kumar, and Rajan, 2019; Donaldson, Gromb, and Piacentino, 2019a). We also build on studies of financial covenants (Sufi, 2009; Roberts and Sufi, 2009; Nini, Smith, and Sufi, 2012; Chodorow-Reich and Falato, 2019; Acharya, Almeida, Ippolito, and Perez-Orive, 2019). We show that earnings-based constraints are often implemented through financial covenants, and such restrictions are tied to the prevalence of cash flow-based lending.

[2]For more analyses, see also Mendoza (2010) and Bianchi (2011) in international macro; Midrigan and Xu (2014), Buera and Moll (2015), and Catherine, Chaney, Huang, Sraer, and Thesmar (2018) in studies of productivity and misallocation; Bernanke and Gertler (1989), Carlstrom and Fuerst (1997), Liu, Wang, and Zha (2013), Azariadis, Kaas, and Wen (2015), and Ottonello and Winberry (2018) in analyses of business cycles and monetary policies; Rampini and Viswanathan (2010, 2013) and Donaldson, Gromb, and Piacentino (2019b) in corporate finance; Crouzet and Mehrotra (2018) and Dinlersoz, Hyatt, Kalemli-Ozcan, and Penciakova (2018) in studies of financial constraints and firm dynamics, among many others.

Finally, corporate borrowing practices develop based on legal infrastructure (La Porta, Lopez-de Silanes, Shleifer, and Vishny, 1997, 1998; Djankov, Hart, McLiesh, and Shleifer, 2008). Correspondingly, legal institutions may have a significant impact on lending practices and the applicability of macro-finance mechanisms. In the context of trade finance, Antras and Foley (2015) also point out that legal institutions affect financing contracts and the impact of crises.

The rest of the paper is organized as follows. Section 2 documents the prevalence of cash flow-based lending among US non-financial firms. Section 3 documents the prevalence of earnings-based borrowing constraints. Section 4 studies how the characteristics of corporate borrowing shape the way different financial variables affect firm outcomes on the margin. Section 5 discusses additional implications for macro-finance analyses. Section 6 concludes.

2 Prevalence of Cash Flow-Based Lending

In this section, we document the prevalence of cash flow-based lending among US non-financial firms. In Section 2.1, we describe the definition and classification procedure of asset-based debt and cash flow-based debt, and report the classification results. In Section 2.2, we show the key properties of asset-based and cash flow-based debt. In Section 2.3, we explain the institutional foundations of cash flow-based lending, and delineate heterogeneity in debt composition among different firm groups.

2.1 Asset-Based Lending and Cash Flow-Based Lending

The gist of asset-based versus cash flow-based lending is debt that is primarily against the liquidation value of specific assets versus against the cash flow value of the business. These concepts are central in credit markets in practice, and they map closely into classic models (e.g., Kiyotaki and Moore (1997)). Since these concepts and classifications have not been commonly used in existing empirical work, we discuss the definitions in detail below. We explain the difference with the traditional distinction of secured versus unsecured debt in Section 2.2.

Definition

We describe asset-based lending and cash flow-based lending from three aspects: 1) general definition, 2) debt structure and default resolution, and 3) typical examples. In the data, as in theory, the differentiation is shaped by the default resolution of different types of debt based on bankruptcy laws. We focus on the case of Chapter 11 restructuring-based bankruptcy, which accounts for over 90% of corporate bankruptcy filings in the US by value.[3]

[3]The alternative to Chapter 11 is Chapter 7, which is focused on liquidation. In Chapter 7, asset-based debt receives the liquidation value of the specific assets pledged to them as collateral; cash flow-based debt

Asset-based lending:

- General definition: In asset-based lending, the debt is based on the liquidation value of specific assets (including physical assets such as real estate, equipment, inventory, as well as other standalone, separable assets such as receivables, patents): creditors' payoffs (in default) are driven by the liquidation value of these assets. Asset-based debt corresponds to debt against "land" in Kiyotaki and Moore (1997).
- Debt structure and default resolution: For asset-based debt, creditors have claims against the liquidation value of specific assets, and typically make such claims clear by taking explicit security interests in these assets. In particular, in bankruptcy creditors have a secured (i.e., high priority) claim up to the liquidation value of the specific assets that serve as the collateral of their debt. If this value falls short of the debt claim, then creditors have a secured claim up to the collateral value, plus an unsecured (i.e., low priority) general claim ("deficiency claim") based on the size of the remaining under-collateralized portion of their debt (Gilson, 2010). Given that deficiency claims have low recovery rates, the primary determinant of payoffs in default is the liquidation value of the collateral. In the US, bankruptcy laws prohibit creditors from actually seizing assets to disrupt firm operations or pose additional threat ("automatic stay").[4]
- Common examples: Examples of asset-based lending include commercial mortgages (backed by commercial real estate) and other asset-based loans (backed by inventory, receivable, machinery and equipment, oil and gas reserves, etc.). Each debt typically has a size limit based on the liquidation value of the particular assets pledged as collateral for that debt. The limit is enforced throughout the duration of the debt in some cases (e.g., revolving credit lines based on working capital), and enforced mainly at issuance in others (e.g., commercial mortgages).

Cash flow-based lending:

- General definition: In cash flow-based lending, the debt is based on the value of cash flows from the firm's continuing operations: creditors' payoffs (in default) are driven by the going-concern cash flow value of the restructured firm. Cash flow-based debt corresponds to debt against "fruits" in Kiyotaki and Moore (1997).
- Debt structure and default resolution: For cash flow-based debt, creditors have claims whose value in bankruptcy depends primarily on the going-concern cash flow value of the reorganized firm (Gilson, 2010). Specifically, in Chapter 11, the restructuring process produces an evaluation of the going-concern value of the firm approved by

receives additional liquidation value, if any, which tends to be minimal.

[4]Accordingly, this default resolution procedure differs from the setting in some models like Hart and Moore (1994) where creditors can use seizing physical assets as a key threat for bargaining.

the court; this value (minus the liquidation value of specific assets pledged to asset-based debt) then pins down the payoffs of cash flow-based debt. Cash flow-based debt can be secured by the corporate entity ("substantially all assets" in legal parlance, and sometimes less formally referred to as a "blanket lien," excluding specific assets pledged to asset-based debt), or unsecured. Under US bankruptcy law, the key function of *secured* cash flow-based debt is to establish priority in bankruptcy (secured claims have priority over unsecured claims), not to enforce payments against the liquidation value of specific assets; indeed, the essence of taking security against the corporate entity is to allow creditors to have high priority claims against the going-concern value of the firm as a whole.[5]

- Common examples: Examples of cash flow-based lending include the majority of corporate bonds and a significant share of corporate loans such as most syndicated loans. For debt limits, creditors do not focus on the liquidation value of specific assets; they focus instead on assessing and monitoring firms' cash flows from operations, which we discuss further in Section 3.

In summary, in asset-based lending the debt is based on the liquidation value of specific assets (the value to *alternative users* if a given asset is *separated* from the firm), while in cash flow-based lending the debt is based on the going-concern cash flow value of the business (the value generated by the firm's *own operations*).[6] These two sets of values can diverge for a number of reasons. First, the structure of the firm can create value, so the boundary of the firm is meaningful and the whole is more than the sum of the pieces (Williamson, 1975; Grossman and Hart, 1986; Kaplan, Sensoy, and Strömberg, 2009). Second, the firm may derive value from human capital (Kiyotaki and Moore, 1997). Third, many assets of non-financial firms can be highly specialized and firm-specific, and have limited alternative use (Shleifer and Vishny, 1992; Ramey and Shapiro, 2001): once installed, capital has little value unless used in production (Bertola and Caballero, 1994).

As suggested above, the Chapter 11 bankruptcy system plays a key role for facilitating cash flow-based lending. Its provisions help preserve the structure and human capital of the firm (unlike standard assumptions in models that firm structure and human capital are lost, and creditors seize and liquidate physical assets if a firm defaults). Furthermore, its payment determination directly ties total creditor payoffs to the going-concern cash flow value of the firm. Accordingly, creditors can enforce debt claims against going-concern cash flow value (not just the liquidation value of physical assets).

[5]Secured cash flow-based debt is not effectively junior to secured asset-based debt. In particular, secured asset-based debt is close to being non-recourse: it has high priority with respect to the liquidation value of its collateral, but not in general. Secured cash flow-based debt, on the other hand, has high priority with respect to the going-concern cash flow value of the business (minus the liquidation value of specific assets pledged to asset-based debt).

[6]By "own operations," we mean operations where the structure, organizational capital, and human capital of the firm are preserved. Exactly who owns the firm's equity stake is less relevant.

Classification Procedures

We perform the classification both in the aggregate (for the overall non-financial corporate sector, including public and private firms), and at the firm-level (for the majority of Compustat non-financial firms, namely firms with SIC codes outside of 6000 to 6999). We summarize the classification procedures below, and explain the details in Appendix A.1 and A.2. We then present the results, and test the properties of asset-based versus cash flow-based debt afterwards.

Aggregate Composition. For aggregate estimates, we first analyze the composition of each of the major debt classes, such as mortgages (all asset-based), corporate bonds (primarily cash flow-based), and commercial loans (combination of asset-based and cash flow-based). We use data from the Flow of Funds, bond aggregates from Fixed Income Securities Database (FISD), large commercial loan aggregates from Shard National Credit (SNC), DealScan, ABL Advisor, small business loan aggregates from Small Business Administration (SBA), capital lease estimates from Compustat, among others. We then sum up the outstanding amount of asset-based and cash flow-based debt across the major debt classes to get the total estimates.

Firm-Level Composition. For firm-level composition, we collect debt-level data on debt attributes, collateral structure, and amount outstanding, among others. The primary data source is debt descriptions from CapitalIQ, supplemented with bond data from FISD, loan data from DealScan, and additional information from SDC Platinum.

We first classify asset-based debt, if one of the following criteria is met: a) we directly observe the key features of asset-based lending (e.g., secured by specific assets or have borrowing limits tied to them); b) the debt belongs to a debt class that is usually asset-based (e.g., secured revolving lines of credit, finance company loans, capital leases, small business loans, etc.), or it is labeled as asset-based. We then classify cash flow-based debt, if one of the following criteria is met: a) the debt is secured by the corporate entity or unsecured, and does not have any features of asset-based lending; b) the debt belongs to a debt class that is primarily cash flow-based (e.g., corporate bonds other than asset-backed bonds and industrial revenue bonds, term loans in syndicated loans) and is not classified as asset-based, or it is labeled as cash flow-based. Finally, we include all unclassified secured debt in asset-based debt to be conservative (i.e., we may over-estimate rather than under-estimate the amount of asset-based lending).

We put personal loans (from individuals, directors, and related parties) and government loans into a miscellaneous category (neither asset-based nor cash flow-based); their share is less than one percent in aggregate, but can be more significant among certain small firms.

Results

Table 1 summarizes the main classification results. For the aggregate non-financial corporate sector (including both public and private firms), asset-based lending accounts for roughly 20% of total debt outstanding by value, of which 7% are mortgages (backed by real estate)

and 13% are other asset-based loans (backed by equipment, inventory, receivable, etc.).[7] Meanwhile, cash flow-based lending accounts for about 80% of debt by value, of which 57% are corporate bonds and 23% are cash flow-based loans. The aggregate composition is the same among firms in Compustat, which account for about 80% of debt in the entire US non-financial corporate sector.

For individual firms, the composition is similar in large non-financial firms. Among the larger half of Compustat firms (by book assets), the median share of asset-based lending is 12%, while that of cash flow-based lending is 83%. Among rated firms, the median share of asset-based lending is 8%, while that of cash flow-based lending is 89%.[8] Figure 1 Panel A shows that the median share of asset-based and cash flow-based lending among large non-financial firms is generally less than 20% and slightly over 80%, respectively, in recent years. These large firms account for more than 96% of debt outstanding in Compustat, and they shape the total debt composition in Compustat. On the other hand, among small Compustat firms, the median share of asset-based lending is 61% and the median share of cash flow-based lending is about 7%. We further analyze heterogeneity among firm groups in Section 2.3.

For individual private firms outside of Compustat, we have very limited information about their balance sheets and debt structures. These firms account for roughly 20% of total non-financial corporate debt by value, or $1.8 trillion out of $8.1 trillion in 2015. We make three observations. First, in the US, there are a number of large private firms. Their debt composition is generally similar to that of large public firms, which we verify through several examples including Dell, Neiman Marcus, Berkshire Hathaway, Petco, Univision, and Dex Media. Second and relatedly, many private firms in the US are results of buyouts by private equity investors (Kaplan and Strömberg, 2009). These private equity owned firms have a substantial amount of debt, most of which is cash flow-based. Indeed, annual cash flow-based loan issuance due to private equities' buyouts and other activities is about $200 billion based on S&P LCD data (accordingly, the total amount outstanding could be up to $1 trillion). Thus, cash flow-based debt of firms owned by private equities may account for a substantial portion of the total debt of private companies. Third, for small private firms, it is likely that most debt is asset-based. However, given the highly skewed distribution of

[7] To be conservative, we classify debt against inventory and receivable as asset-based, as in the OCC Comptroller's Handbook on Asset-Based Lending. Other work (e.g., Ivashina, Laeven, and Moral-Benito (2019)) may use a more restrictive definition of asset-based debt, focusing primarily on debt against prototypical hard assets like real estate and machinery. We also apply the concept and classification of asset-based and cash flow-based debt to all major debt classes, not just senior secured loans which Ivashina, Laeven, and Moral-Benito (2019) focus on.

[8] Rated firms account for about a quarter of all Compustat firms. They are primarily in the top 25% of Compustat firms by size. Rauh and Sufi (2010) study the debt structure of 305 rated firms, and provide firm-level data for debt outstanding by debt class (e.g., public bonds, revolvers, mortgages). With assumptions about whether each debt class is asset-based or cash flow-based (e.g., public bonds are cash flow-based, mortgages are asset-based, revolvers are a mix), we can get another estimate of debt composition. This alternative estimate and our firm-level calculations match closely; the median level matches one for one for firm-years in both samples.

firm size, their impact on aggregate debt composition can be limited. In particular, our decomposition for the aggregate non-financial corporate sector above covers loans to small businesses (which we classify as all asset-based to be conservative).

2.2 Properties

We discuss two key properties of asset-based debt and cash flow-based debt. First, we verify that cash flow-based debt does not have indirect positive dependence on the liquidation value of specific assets. Second, we clarify the difference between the distinction of asset-based versus cash flow-based debt and the distinction of secured versus unsecured debt.

Does cash flow-based debt rely on the liquidation value of specific assets?

One question is whether firms' ability to borrow what is classified as cash flow-based debt may have indirect positive dependence on the value of specific assets. In theory, given that creditors of asset-based debt have claims over these assets while creditors of cash flow-based debt do not, a higher value of specific assets may increase the bargaining power of creditors of asset-based debt. This, if anything, can decrease the bargaining power of creditors of cash flow-based debt and limit firms' ability to borrow cash flow-based debt. In the data, we confirm that the amount of asset-based debt a firm has is positively correlated with the amount of physical assets, whereas the amount of cash flow-based debt is not (if anything the correlation is often negative), as shown in Table 2.

Difference with Secured vs. Unsecured Debt

The notion of asset-based debt versus cash flow-based debt is conceptually and empirically different from the notion of secured debt versus unsecured debt. Under US law, secured versus unsecured debt is about *priority* in bankruptcy (Baird and Jackson, 1984), not necessarily the economic variables that determine creditors' payoffs. Asset-based debt can be secured and take priority over the liquidation value of specific assets. Cash flow-based debt can also be secured and take priority over the going-concern cash flow value of the firm (minus what is pledged to asset-based debt), as mentioned above.[9] On the other hand, our distinction between asset-based and cash flow-based debt focuses on the economic bases of creditors' claims and payoffs (i.e., liquidation value of specific assets versus going-concern cash flow value of the firm).

In the data, we find that about one third of total secured debt is cash flow-based, among Compustat non-financial firms. Moreover, Table 2 Panel B shows that secured cash flow-

[9]Can asset-based debt be unsecured? Because unsecured debt is the lowest-priority marginal claimant, its payoffs in default depend effectively on what determines total distributions to creditors. If a firm is always liquidated, then payoffs of all debt are primarily driven by the liquidation value of the capital stock; unsecured debt is effectively low-priority asset-based debt. On the other hand, in Chapter 11, total distributions of creditors are driven by the going-concern value of the firm, as explained above; in this case, unsecured debt would be low-priority cash flow-based debt. Accordingly, in our data of US firms, given that Chapter 11 is the primary form of default resolution, unsecured debt is typically cash flow-based not asset-based.

based debt behaves similarly to cash flow-based debt in general, and quite differently from asset-based debt. Secured cash flow-based debt is negatively correlated with the amount of physical assets a firm has, which is the opposite of asset-based debt. The results are in line with Ivashina, Laeven, and Moral-Benito (2019), who also find that a substantial portion of secured debt is cash flow-based.

While classifications of secured versus unsecured debt in the data are generally given by contracts and the legal framework, some previous research has used different interpretations of "secured" and "unsecured" debt. For example, Azariadis, Kaas, and Wen (2015) interpret secured debt as debt based on the liquidation value of physical assets (e.g., mortgages), and unsecured debt as debt based on reputation value (courts cannot enforce these claims, which are sustainable in equilibrium only because of reputation concerns). In the data, as we show above, not all secured debt is tied to the liquidation value of physical assets. Meanwhile, unsecured debt can be enforced by courts and receive payments in default, rather than relying only on reputation-based self-enforcement.

Taken together, our focus is to understand the determinants of borrowing constraints and the corresponding macro-finance implications; for our purpose, the most relevant distinction in the data is asset-based versus cash flow-based debt (i.e., debt against liquidation value of specific assets versus going-concern cash flow value of the firm), instead of secured versus unsecured debt (i.e., debt with high versus low priority in bankruptcy).

2.3 Institutional Foundations and Heterogeneity

The prevalence of cash flow-based lending relies on institutional and economic foundations. Correspondingly, it can display heterogeneity by firm size and age, industry, and across countries, which we summarize in this section.

The variations in cash flow-based lending are driven by three key factors. First, legal infrastructure is important for debt claims based on cash flows: reliable financial accounting and auditing facilitate the verifiability of cash flows; bankruptcy laws and court systems affect the enforceability of debt payments based on firms' cash flow value. With weak accounting, liquidation-based bankruptcy systems, or weak courts, cash flow-based lending can be harder to pursue. Second, firms need to be able to generate high cash flow value for cash flow-based lending to be practical. Third, debt based on cash flow value is especially relevant when firms' asset specificity is high. Non-financial firms often have a limited amount of standardized, transferable assets that support low-cost asset-based lending, while the majority of assets are specialized, illiquid, or intangible (Ramey and Shapiro, 2001).

Small, Young, and Low Profit Firms. Cash flow-based lending is less common among small firms, young firms, and low profit firms, which generate limited cash flows if not

sustained losses.[10] In addition, financial distress of these firms is more likely to be resolved through liquidations (Bris, Welch, and Zhu, 2006; Bernstein, Colonnelli, and Iverson, 2018), given fixed costs of restructuring (e.g., legal and financial personnel) and uncertain prospects. Accordingly, it is difficult for creditors to count on cash flow value from continuing operations.

In the data, among small firms (assets below Compustat median), the median share of cash flow-based lending in total debt is about 7%, while that of asset-based lending is 61% (the rest are personal loans and other miscellaneous borrowings). This compares to median shares of 83% and 12% among large firms. Among young firms (less than 15 years since incorporation date), the median share of cash flow-based lending is 38%, while that of asset-based lending is 47%. This compares to median shares of 61% and 15% among old firms. Among low margin firms (profit margin in the bottom half of Compustat), the median shares of cash flow-based lending and asset-based lending are 41% and 39% respectively, while among high margin firms the median shares are 74% and 19% respectively.

Airlines and Utilities. The prevalence of cash flow-based lending can differ across industries given differences in asset specificity. Figures 2 Panel A shows the median share across industries, focusing on rated firms so they are comparable in capital market access. Rated firms in most industries display a predominance of cash flow-based lending. Airlines are an exception, where the median share is less than 30%. The prevalence of asset-based lending in airlines is in line with Benmelech and Bergman (2009, 2011), who thoroughly analyze the collateral channel and fire sale amplification in this industry. Utilities also have a lower share of cash flow-based lending compared to other Fama-French 12 industries. While most non-financial firms have high asset specificity, these industries are special cases where firms have a large amount of standardized, transferable assets (aircraft for airlines and power generators for utilities) that facilitate asset-based lending.

Cross-Country Variation. While our main analysis focuses on the US, lending practices may also vary across countries given different legal infrastructure (La Porta et al., 1997, 1998). In developing countries, high quality accounting information may not be available. Moreover, across countries there can be major differences in bankruptcy laws and practices, which can shape variations in the nature of debt (Gennaioli and Rossi, 2013).

As mentioned above, in the US, Chapter 11's tenet is to prevent liquidation and facilitate restructuring to preserve firms' cash flow value from continuing operations. It also directly ties creditors' payoffs in default to firms' going-concern cash flow value certified by the court. In continental Europe, liquidations are more common and having claims over specific assets is more important in default resolution (Smith and Strömberg, 2004). In Japan, legal infrastructure and lending practices also present a sharp contrast with those in the US. In particular, Japanese bankruptcy courts were largely dysfunctional before a major reform

[10]For instance, the median EBITDA to assets ratio among small Compustat firms is -0.01 (while that among large Compustat firms is 0.13).

around 2000, and court-based default resolution was rare, which posed challenges to the contractibility of firms' cash flow value. In addition, there were no stays that would prevent creditors from seizing collateral and disrupting efforts for reorganization. Thus, corporate lending in Japan historically focused on physical assets, and real estate was especially popular (Rajan and Zingales, 1995; Peek and Rosengren, 2000; Tan, 2004; Gan, 2007). In Section 4.4, we contrast our findings in the US with results in Japan, which further illustrates the impact of different forms of corporate borrowing constraints on economic outcomes.

More generally, we can construct rough estimates of the fraction of asset-based versus cash flow-based debt for Compustat non-financial firms in around 50 countries, and we find a positive relationship between the prevalence of cash flow-based debt and having corporate bankruptcy regimes that facilitate reorganization. Specifically, we can use CapitalIQ data to categorize each outstanding debt of a given firm (just like our firm-level analysis in the US), although we sometimes have less detailed information among foreign firms. We measure bankruptcy regimes using data collected by Djankov et al. (2008), which record whether viable firms are likely to be reorganized or liquidated in bankruptcy. We discuss the details of data construction and present the results in Appendix B.

In summary, we find that cash flow-based lending accounts for the majority of non-financial corporate debt in the US, in the aggregate and among large firms. In the following, we document a central form of borrowing constraints in this setting.

3 Prevalence of Earnings-Based Borrowing Constraints

In this section, we present a standard form of borrowing constraints in the context of cash flow-based lending. These constraints stipulate limits on a firm's total debt based on a specific measure of cash flows, namely operating earnings. We refer to such constraints as earnings-based borrowing constraints (EBCs). In Section 3.1, we explain the definition and enforcement of EBCs. In Section 3.2, we show their prevalence, tightness, and connections with cash flow-based lending. In Section 3.3, we show variations in the prevalence of EBCs among different firm groups.

3.1 Earnings-Based Borrowing Constraints

The earnings-based borrowing constraints follow two main specifications. The first imposes a maximum ratio of a firm's debt to its operating earnings:

$$b_t \leq \phi \pi_t, \tag{1}$$

where b_t is the firm's debt, π_t is the firm's annual operating earnings, and ϕ is the maximum debt-to-earnings ratio.[11] The second imposes a minimum ratio of a firm's earnings relative to its interest payments (equivalently, maximum interest payments to earnings):

$$b_t \leq \frac{\theta \pi_t}{r_t}, \tag{2}$$

where $r_t b_t$ is the firm's annual interest payments, π_t is the firm's annual operating earnings, and θ is the minimum interest coverage ratio.

EBCs have several features. First, the constraint applies at the firm level: both earnings π_t and the amount of debt b_t (or interest payments $r_t b_t$) are those of the borrowing firm. In other words, the constraint restricts the total debt of the firm. This is different from, for instance, the "loan-to-value" constraint of a mortgage that applies only to the size of that particular loan. At a given point in time, a firm may face earnings-based borrowing constraints from different sources, as we discuss shortly. Each of these constraints has a parameter ϕ or θ, and the tightest one binds first. Second, the commonly used measure for π_t is EBITDA (earnings before interest, taxes, depreciation and amortization), over the past twelve months. It mainly captures sales revenue minus operating costs. As the name indicates, EBITDA excludes taxes and interest expenses. It also excludes non-operating income and special items (e.g., windfalls, natural disaster losses, earnings from discontinued operations). As a measure of the firm's operating earnings, EBITDA is affected by the human capital, technology, business model and structure of the firm, and is not simply a function of the liquidation value of specific assets like physical capital (EBITDA does not include gains or losses in the liquidation value of capital, which would belong to non-operating income if relevant). Third, EBCs apply not just when firms issue new debt; they can also affect the maintenance of existing debt. Even if a firm is not issuing new debt, if its earnings decline significantly, it may need to reduce debt to comply with these constraints imposed by existing debt (e.g., through legally binding covenants, as further explained below).

Enforcement

Earnings-Based Covenants. An important way to impose earnings-based borrowing constraints is through financial covenants in debt contracts, which are legally binding provisions that specify restrictions on borrowers' financial conditions, assessed based on financial statements. A common type of financial covenants specifies debt limits as a function of operating earnings, which we refer to as earnings-based covenants.[12] They follow the forms in

[11] The debt-to-earnings ratio is a central concept to creditors: in credit agreements, lenders typically use the term "leverage ratio" to refer to the debt-to-earnings ratio (rather than the debt-to-assets ratio).

[12] Debt contracts can also specify other types of financial and non-financial covenants to restrict borrowers' behavior for a variety of purposes (e.g., maintaining creditors' priority). For other types of financial covenants, there are two main forms, which are less prevalent as we discuss in Internet Appendix Section IA2. One type specifies an upper bound on book leverage, or relatedly a lower bound on book equity. Currently the prevalence of the book leverage covenants is less than a third of the prevalence of earnings-based covenants,

Equations (1) and (2), and share the three features discussed above. First, the debt limits are at the firm level (so a firm is subject to the constraint if one of its debt contracts contains such covenants) and apply to total debt. Second, earnings are measured based on EBITDA. Third, compliance is assessed regularly based on firms' financial statements. Those in loans generally monitor compliance on a quarterly basis ("maintenance tests"); thus continuous compliance is relevant for both the maintenance of existing loans and the issuance of new debt. Those in bonds monitor compliance only when borrowers take certain actions such as issuing debt ("incurrence tests"), and are relevant for new debt issuance.

Violations of covenants trigger "technical defaults," in which case creditors have legal power to make the debt due immediately. While such actions are infrequent, creditors use them as threats to implement their requests, such as restricting financial and investment decisions, replacing management teams, among others (Chava and Roberts, 2008; Roberts and Sufi, 2009; Nini, Smith, and Sufi, 2009, 2012). In other words, while covenant violations are generally followed by renegotiation rather than bankruptcy, the renegotiation is an important occasion to enforce creditors' demand and restrictions on borrowers' activities.

In our setting, the key is to verify that earnings-based covenants impose effective borrowing limits. Here we focus on earnings-based covenants in loans, for which we have information about covenant specifications and thresholds. We obtain covenant information from DealScan, a comprehensive dataset on commercial loans, and merge it with firm information in Compustat. Table A3 in Appendix C.1 provides detailed information on covenant specifications in DealScan data and the corresponding accounting variables compiled by Demerjian and Owens (2016). Figure 3 plots firm-level debt growth in year $t+1$ against distance to the covenant threshold at the end of year t.[13] Debt growth is on average positive when firms are in compliance with earnings-based covenants (to the right of the dashed line). Once firms break one of these covenants (to the left of the dashed line), however, their debt growth becomes negative on average, suggesting that borrowing capacity is limited by these restrictions.[14]

Other Earnings-Based Borrowing Constraints. The earnings-based borrowing constraints a firm faces are not limited to financial covenants. The corporate credit market has

and violations are uncommon. The second type specifies limits on the ratio of current assets to current liabilities, which also has relatively low prevalence.

[13] As shown in Appendix C.1 Table A3, earnings-based covenants have several variants. Firms sometimes have more than one type of these covenants; different firms may also have different types. For a uniform measure of distance, we first compute the minimum amount of earnings ($\underline{\pi}_{it}$) required such that the firm is in compliance with all of its earnings-based covenants (given the current level of debt). We then compute the difference between the minimum earnings required ($\underline{\pi}_{it}$) and the actual earnings (π_{it}), scaled by lagged book assets. We normalize this distance by the standard deviation of ROA in the firm's two-digit SIC industry.

[14] DealScan's data allows us to observe the threshold set by the initial credit agreement (at loan issuance). Firms may subsequently renegotiate with lenders to amend credit agreements and relax covenants, and these amendments may not be fully captured by DealScan's data. Contracts may also contain exceptions that can increase the maximum allowed debt amount relative to EBITDA (Ivashina and Vallee, 2018). On the other hand, some contracts specify covenant thresholds that become tighter than the initial thresholds over time. For these reasons, the distance to covenant thresholds can be measured with noise. Nevertheless, we already observe a pause in debt growth on average once the initial threshold is reached.

important norms about debt relative to earnings: when a firm wants to issue debt, it can be hard to surpass a reference level of debt-to-EBITDA ratio lenders use. This limit can be tighter than covenants in existing debt or in the new debt (the covenants of the new debt, if there are any, are typically set in a way that they will not be violated immediately). We document the impact of these additional constraints in Appendix C.3 using proxies for the reference debt-to-EBITDA level in the leveraged loan market. We find that firms' actual debt-to-EBITDA ratios are sensitive to variations in this reference level, in settings where this constraint applies. The sensitivity is especially high for firms just below the investment grade cut-off, which borrow more from the leveraged loan market where the reference ratio is emphasized the most. We also find that the sensitivity is large and significant for firms that primarily use cash flow-based debt (e.g., share of cash flow-based lending greater than 50%), and close to zero for firms that do not.

In the rest of the paper, our analyses of EBCs focus on earnings-based covenants, given they are directly observable and legally binding. We assemble data on earnings-based covenants from three sources: DealScan for commercial loans, FISD for corporate bonds, and scraped and hand-collected data from annual reports (10-K filings) to check the comprehensiveness of data from DealScan and FISD. As we further explain below, we find that information on earnings-based covenants from DealScan and FISD is reasonably comprehensive. Analyses using covenant information cover US non-financial firms in Compustat from 1996 to 2015, as covenant data is sparse before 1996.

3.2 Properties

Prevalence and Tightness

Figure 1 Panel B shows that earnings-based covenants are prevalent among large non-financial firms. Of all large Compustat non-financial firms, about 50% to 60% have earnings-based covenants explicitly written in their debt contracts.[15] To make sure DealScan and FISD data does not miss covenant information, we also scrape mentions of financial covenants from 10-K filings. If we add mentions of earnings-based covenants from scraped data, the share of large firms with earnings-based covenants increases by another 5% per year (but the scraped data could contain false positives). Some large firms do not have earnings-based covenants written in their debt contracts because they currently have little debt and are far from the constraints (e.g., Apple nowadays). Nonetheless, the constraint still exists and they are likely to have explicit debt covenants if the debt level is higher (e.g., Apple fifteen years ago).

For the tightness of earnings-based covenants, the median value of ϕ in the debt-to-

[15]Examples include AAR Corp, AT&T, Barnes & Noble, Best Buy, Caterpillar, CBS Corp, Comcast, Costco, Disney, FedEx, GE, General Mills, Hershey's, HP, IBM, Kohl's, Lear Corp, Macy's, Marriott, Merck, Northrop Grumman, Pfizer, Qualcomm, Rite Aid, Safeway, Sears, Sprint, Staples, Starbucks, Starwood Hotels, Target, Time Warner, US Steel, Verizon, Whole Foods, Yum Brands, among many others.

earnings constraint in Equation (1) is about 3.5 (interquartile range roughly 3 to 4.5); the median value of θ in the interest coverage ratio constraint in Equation (2) is about 1/2.5 (interquartile range roughly 1/2 to 1/3). Every year around 10% of large firms with DealScan loans break the covenant thresholds; another 10% to 15% are within 0.5 standard deviations of the thresholds. These statistics are in line with prior work (Dichev and Skinner, 2002; Nini, Smith, and Sufi, 2012). In Appendix C Figure A1, we also find that firms' distances to the earnings-based covenant thresholds bunch just above zero, indicating that the restrictions bind for a number of firms and they try to avoid violation. Overall, the data suggests that these constraints are tight and relevant.[16]

Relationship with Cash Flow-Based Lending

We verify that earnings-based covenants primarily come from cash flow-based debt. To get a comprehensive picture that can include earnings-based covenants from all types of debt (not just commercial loans and bonds where data on financial covenants are directly available from DealScan and FISD), we read 10-K filings for a random sample of firms in 2005 (1,092 firms and 2,125 individual debt with earnings-based covenants). Among earnings-based covenants mentioned in 10-K filings, more than 80% come from debt that belongs to cash flow-based lending (or is packaged with cash flow-based debt),[17] such as cash flow-based commercial loans and corporate bonds. Few come from other types of debt (e.g., mortgages, equipment loans, etc.). Taken together, this analysis shows a close link between earnings-based restrictions and cash flow-based debt. In addition, it also verifies the validity of using covenant information on commercial loans and bonds (from DealScan and FISD) for systematic analyses of earnings-based covenants.

3.3 Contractual Foundations and Heterogeneity

To motivate the use of earnings-based borrowing constraints, one can follow a similar logic as the use of conventional borrowing constraints based on the liquidation value of physical assets in Kiyotaki and Moore (1997). In Kiyotaki and Moore (1997), if the borrower defaults, creditors can only seize and liquidate physical assets; correspondingly, this liquidation value determines their total payoffs in default and the ex ante debt limits. As we discuss in Section 2, in the US setting, if a borrower defaults, then in Chapter 11 the cash flow value of the restructured firm determines creditors' total payoffs; correspondingly, ex ante total debt limits of the firm are tied to operating earnings as a verifiable and contractible proxy for

[16]The fraction of firms violating covenants or are close to violation does not show strong cyclical patterns. First, earnings of major US non-financial firms do not have substantial cyclical swings. Second, firms are not passive; they adjust the debt level and control their distance to violation.

[17]Commercial loans are typically organized in a package that shares the same covenants: the package commonly contains a revolving credit line, which can be asset-based (secured by inventory and receivable), and cash flow-based term loans. Thus the revolving lines are also associated with earnings-based covenants although we categorize them into asset-based lending.

cash flow value.[18] In particular, contracts use current EBITDA as a key metric to strike a balance between being informative about firm performance, and importantly being easily observable and verifiable.[19] EBITDA excludes windfalls to focus on cash flow generation by core businesses; it excludes interest expenses and taxes to avoid mechanical influences from capital structure (e.g., tax advantages of debt). Moreover, it is available regularly based on financial statements.

Variations in the prevalence of EBCs mirror those of cash flow-based lending discussed in Section 2.3. When firms have low verifiable cash flows, are more likely to be liquidated in bankruptcy, or have high liquidation value from standardized and transferable physical assets, cash flow-based lending and EBCs are less relevant. In the data, we observe that EBCs are less common in firm groups where cash flow-based lending is less common. For small firms, 12% have earnings-based covenants, compared to 53% of large firms. For young firms, 27% have earnings-based covenants, compared to 36% of old firms. For low profit margin firms, 27% have earnings-based covenants, compared to 40% of high margin firms. These patterns hold despite that small, young, and low profit firms in principle should face more restrictions. For airlines and utilities, which are industries with low prevalence of cash flow-based lending, Figure 2 Panel B shows that earnings-based covenants are also less common.

In sum, earnings-based borrowing constraints play an important role in US corporate credit markets, and tie closely to the prevalence of cash flow-based lending. These constraints are commonly enforced through legally binding financial covenants in debt contracts.

4 Corporate Borrowing Sensitivity on the Margin

In the above, we document the prevalence of cash flow-based lending and EBCs among US non-financial firms, based on debt contract data. In this section, we further examine how these features of corporate borrowing affect firm outcomes on the margin. Section 4.1 studies how they shape the role of cash flows for corporate borrowing and investment. Section 4.2 studies the mirror image: how they affect the sensitivity of firm outcomes to the value of physical assets, in particular real estate. The results attest to the contract-level evidence. For US non-financial firms, with the prevalence of cash flow-based lending, cash flows in the form of operating earnings can be important for borrowing constraints and firm outcomes,

[18] One can also provide additional rationales for earnings-based constraints, especially in the form of legally binding debt covenants in cash flow-based debt, using incentive provision (Innes, 1990) or contingent transfer of control rights (Aghion and Bolton, 1992), and we present formal models in Internet Appendix Section IA1.

[19] One may wonder whether contracts can use other measures of firms' cash flow values. We discuss why several alternatives are not used. First, the value of physical assets is not necessarily informative about firms' cash flow values. It does not necessarily capture the value created by labor, human capital, management quality, and other inputs; it can also be affected by the specialized and illiquid nature of many assets. Second, metrics such as stock prices can fluctuate due to non-fundamental reasons. In addition, investors may deliberately influence stock prices to trigger or avoid violations. Third, assessment and estimates of future cash flows can be difficult to verify and easily disputable.

while the value of physical assets has a mild influence. Section 4.3 shows the reflections of these findings in the Great Recession. Finally, Section 4.4 contrasts the US with Japan, where asset-based lending plays a prominent role in corporate debt.

4.1 The Role of Cash Flows

With the prevalence of cash flow-based lending and EBCs, cash flows in the form of operating earnings (EBITDA) can directly relax borrowing constraints, and enable firms to borrow and invest more.[20] In contrast, this mechanism is not present among firms not bound by EBCs, such as unconstrained firms and firm groups with low presence of cash flow-based lending (e.g., small firms, low margin firms, airlines, Japanese firms). In the following, we first present the borrowing sensitivity to operating earnings across firm groups. We then supplement the baseline tests by studying exogenous variations in operating earnings due to changes in accounting rules. The results indicate the impact of EBCs on the margin, and shed further light on the way cash flows affect firm outcomes.

4.1.1 Borrowing Sensitivity to Operating Earnings: Baseline Tests

We begin by documenting the sensitivity of corporate borrowing to cash flows in the form of operating earnings (EBITDA). The mechanism of interest is the role of operating earnings in relaxing EBCs. This mechanism is distinct from the perspective in previous studies of investment sensitivity to cash flows (Fazzari, Hubbard, and Petersen, 1988; Froot, Scharfstein, and Stein, 1993; Kaplan and Zingales, 1997; Rauh, 2006). In that literature, the main function of cash flows is to increase *internal funds*. Following the pecking order view (Myers and Majluf, 1984), higher internal funds facilitate investment but *substitute out* external financing as long as investment has diminishing marginal returns. Indeed, to the extent that cash flows increase internal funds, they would decrease borrowing in this setting. With EBCs, however, cash flows in the form of operating earnings (EBITDA) can relax borrowing constraints, and help firms borrow more. Below we show that internal funds generally have a negative relationship with borrowing, while operating earnings increase borrowing when EBCs are relevant.

[20] As a concrete example, US non-financial firms routinely discuss their primary financing constraints in filings. These discussions indicate that major US non-financial firms still face borrowing constraints, but the primary constraint could be different from the traditional collateral constraint and instead focus on earnings. For instance, in its 2012 10-K filing, Coty Inc (a leading global beauty product producer) writes:

> "We remain dependent upon others for our financing needs, and our debt agreements contain restrictive covenants...[F]inancial covenants may restrict our current and future operations and limit our flexibility and ability to respond to changes or take certain actions...Financial covenants...require us to maintain, at the end of each fiscal quarter, a consolidated leverage ratio of consolidated total debt to consolidated EBITDA."

Our baseline results use standard annual firm-level regressions as in Fazzari, Hubbard, and Petersen (1988) and Kaplan and Zingales (1997):

$$Y_{it} = \alpha_i + \eta_t + \beta \text{EBITDA}_{it} + X'_{it}\gamma + \epsilon_{it}. \tag{3}$$

Outcome Variables. The main outcome variable is net debt issuance from the statement of cash flows, normalized by lagged book assets. Later we also present additional results on other measures of borrowing and on investment activities. The construction of main firm-level variables is explained in detail in Appendix D. We focus on outcome variables in flows (i.e., debt issuance and capital expenditures), which line up most closely with each other and with prior research. As explained below, since we always control for lagged debt (b^{old}), using debt issuance (b) on the left hand side is equivalent to using total debt ($b + b^{old}$), in terms of coefficients on the independent variables (except the coefficient on b^{old} changes by one).

Independent Variables. The main independent variable of interest is operating earnings (EBITDA), which directly affect EBCs, normalized by lagged book assets.[21] To isolate the impact of EBITDA through borrowing constraints, we then control for measures of internal funds. As discussed above, without controlling for internal funds, the impact of EBITDA on borrowing can be understated: to the extent that higher EBITDA is associated with higher internal funds, the traditional pecking order channel will lead to decreases in borrowing. To tease out the pecking order effect, we can further control for net cash receipts (OCF), which capture the actual amount of cash a firm gets from its operations (it does not include cash receipts/outlays due to financing or investment activities). For a firm over time, EBITDA and OCF are about 0.6 correlated. These two variables are different for several reasons. First, there are timing differences between earnings recognition (when goods/services are provided to customers) and cash payments (which can be before, during, or after earnings recognition). Second, OCF includes net cash receipts due to non-operating income, taxes, etc., which do not count towards EBITDA. Internet Appendix Section IA5 provides a detailed discussion of the definitions of EBITDA and OCF and their relationships. We also control for cash holdings at the beginning of year t.

Other control variables include Q and past twelve months stock returns that some work has found to be a useful empirical proxy for Q (Barro, 1990; Lamont, 2000). We also control for book leverage (total debt over assets) and other balance sheet characteristics (e.g., tangible assets such as PPE and inventory), measured at the beginning of year t. Finally, we control for size (log book assets) and lagged EBITDA to focus on the impact of current EBITDA. We use firm fixed effects and year fixed effects in our baseline specifications. Results are similar with industry-year fixed effects or using lagged dependent variables instead of firm

[21] We use the Compustat variable EBITDA, defined as sales minus operating expenses (cost of goods sold plus selling, general & administrative expenses). The specific definitions of EBITDA may vary slightly in different debt contracts, but share the core component captured by the Compustat variable.

fixed effects, as shown in Internet Appendix Tables IA1 and IA2.

Results When EBCs Relevant. We start with firms where EBCs are most relevant. We first examine large firms with earnings-based covenants, which have a high prevalence of cash flow-based lending and clear indications of the presence of earnings-based constraints. Other work such as Greenwald (2019a) also finds the effect of earnings-based constraints to be strongest among such firms. We use covenant information from DealScan and FISD, as described in Section 3. We present results separately for each firm group (instead of using interactions of the firm group dummy with the EBITDA variable) because we study five firm groups in the US and an additional group in Japan (later in Section 4.4) and the presentation of interactions becomes unwieldy. Moreover, we would like to allow coefficients on control variables to vary among different groups, which the sample split permits. Our main sample period is 1996 to 2015, since data on financial covenants was sparse prior to 1996. Internet Appendix Table IA3 provides additional results using a longer sample period since 1985 for robustness checks.

Table 3 Panel A provides summary statistics of these firms. They have high earnings, with a median EBITDA to assets ratio of 0.13, and primarily use cash flow-based lending (median share is 88%). They also have a reasonable amount of debt, so the constraint becomes relevant (and explicitly written into legally binding covenants): the median debt-to-EBITDA ratio is 2.2 (typical maximum debt/EBITDA allowed is around 3 to 4), and the median debt-to-assets ratio is 0.3.

Table 4 reports the results. Panel A column (1) shows that for a one dollar increase in EBITDA (without controlling for net cash receipts OCF), net debt issuance increases by 21 cents on average. As explained above, the EBITDA coefficient here may include two components: EBITDA's impact through relaxing EBCs and EBITDA's correlation with changes in internal funds. To the extent that higher internal funds may substitute out external borrowing, this coefficient would *understate* EBITDA's impact through relaxing EBCs. In column (2), we then control for net cash receipts (OCF). In this case, for a one dollar increase in EBITDA, net debt issuance increases by 27 cents on average. Accordingly, a one standard deviation change in EBITDA would be associated with a 0.16 standard deviation change in net debt issuance on average. The sensitivity of 27 cents on a dollar is still lower than a typical maximum debt-to-earnings constraint of around 4, since most firms are not exactly at the constraint and earnings are not very persistent. In such cases the average sensitivity would be less than what is specified by the constraint.

Table 4 Panel A columns (3) to (6) show that results are similar using other measures of debt issuance. The response to EBITDA is 39 cents when the outcome variable is the change in long-term book debt, and 41 cents when the outcome variable is the change in total book debt (holding constant OCF). We also study specific types of borrowing, such as secured (high priority) debt and unsecured (low priority) debt, asset-based debt and cash flow-based

debt. Since EBCs apply at the firm level and govern the *total* amount of debt of the firm, we find that all types of debt are affected by this constraint. In addition, Panel A shows that holding EBITDA constant, higher net cash receipts OCF are associated with less borrowing. In other words, holding fixed the tightness of EBCs, more internal funds do substitute out external borrowing as in the traditional pecking order theory.

Table 4 Panel B turns to investment activities. We find a coefficient of capital expenditures on EBITDA of 10 cents on average (and the coefficient on OCF is about 5 cents on average). Among firms bound by EBCs, the effect of the borrowing constraint channel appears as important as that of the internal funds channel, if not larger. In addition, we also find a positive relation between EBITDA and R&D expenditures.[22]

Results When EBCs Not Relevant. We then examine several firm groups where EBCs are less relevant. First, we analyze large firms without earnings-based covenants. These firms generally use cash flow-based lending (median share is 88%), but have a low level of debt and are far from the constraint. Second, we analyze a number of firm groups that rely on asset-based lending, where earnings are not key determinants of borrowing constraints. As explained in Sections 2.3 and 3.3, several distinct factors affect the prevalence of cash flow-based lending and EBCs, including size, profitability, asset specificity, and the legal environment. Correspondingly, we study small firms, low margin firms, airlines and utilities, and Japanese firms (later in Section 4.4), where asset-based lending dominates. Table 3 Panel B presents summary statistics of the comparison groups. These firms display rich heterogeneity in characteristics. Overall it appears hard to account for the different impact of EBITDA across all these groups based on common alternative explanations.

Table 5 Panel A shows that, across all these comparison groups, EBITDA does not have a positive impact on debt issuance. For all groups, the coefficient on EBITDA is about zero after controlling for net cash receipts OCF (and significantly *negative* without controlling for OCF). This contrasts sharply with the results among firms bound by EBCs shown in Table 4. Figure 4 visualizes the different impact of EBITDA on debt issuance across different firm groups. Table 5 Panel B shows that EBITDA also does not have an independent positive impact on capital expenditures once we control for OCF.

Checks for Alternative Explanations. A common concern in studying responses to cash flow variables is they may proxy for Q: the coefficients may be biased upward if these variables are positively correlated with Q and Q is imperfectly measured. We do not find this concern easily accounts for our results. In particular, the positive relationship between EBITDA and borrowing does not exist among various groups of firms that are not bound

[22] R&D expenses, unlike CAPX, are required to be included in operating expenses, which would produce an automatic negative link between R&D and EBITDA (and similarly a negative link between R&D and net cash receipts OCF). Even so, in this sample of firms bound by EBCs, increases in EBITDA can crowd in R&D spending (and these expenditures do not fully offset the initial increase in EBITDA). This pattern is unique to firms bound by EBCs. We also analyze the response of other firm outcomes: on average acquisitions expenditures increase by 15 cents, payout increases by 4 cents, and cash holdings increase by 1 cent.

by EBCs. For mismeasurement of Q to explain these findings, it needs to be that Q is *less mismeasured*, or EBITDA is *less informative*, across all these comparison groups. This does not appear to be the case in the data, as we show through detailed tests in Internet Appendix Section IA3.2 (including tests of earnings quality and predictive regressions of future profitability). To the contrary, among the comparison groups, EBITDA is equally or more informative (e.g., more predictive of future profitability and cash receipts), and Q sometimes more mismeasured (e.g., less predictive of future profitability and cash receipts).

We also check that the sensitivity of borrowing to EBITDA is not driven by omitted variable problems such as EBITDA being correlated with the value of physical collateral. For instance, we can look at the issuance of cash flow-based debt, which is unlikely to be affected by the value of physical collateral (as we confirm in Table 2). As explained in Section 2, we only have firm-level categorization of cash flow-based debt starting in 2003, so we report results for this shorter sample in Internet Appendix Table IA4. We can also directly control for measures of physical collateral value, such as the value of real estate assets, which does not affect the coefficient on EBITDA, as shown in Internet Appendix Table IA5. In sum, the evidence suggests that EBITDA has an important impact on corporate borrowing that is separate from the physical collateral value channel.

Finally, another possible concern is that the earnings-based covenants are not randomly assigned, which can be relevant for sample comparison analyses. This issue matters if the presence of earnings-based covenants is *correlated with* the severity of omitted variable problems. As discussed above, for mismeasurement of Q, we do not find that the problem is more severe among firms with earnings-based covenants. For physical collateral value, in the above we do not find it to be an important omitted variable problem in any firm group.

4.1.2 Exogenous Variations in Operating Earnings: An Accounting Natural Experiment

We supplement the results above using a natural experiment due to an accounting rule change. The accounting rule modifies the calculation of earnings, and contributes to changes in EBITDA that are not related to changes in economic fundamentals or internal funds. This helps us further isolate the impact of EBITDA due to EBCs.

The accounting rule change we study is SFAS 123(r) issued by the Financial Accounting Standard Board (FASB) regarding the accounting of stock-based compensation. Before the adoption of this rule, firms' option compensation expenses did not formally count towards operating expenses, a component of operating earnings. Instead, firms made footnote disclosures at the end of their financial statements. The new rule requires firms to include option compensation expenses in operating expenses, thus they would affect operating earnings. As a result, the new rule can decrease EBITDA for firms that use option compensation, but does

not have a direct impact on cash positions or company fundamentals. A number of studies show that contracting frictions make it hard to neutralize changes in accounting rules, and they tend to have a significant impact on firms' financial and real decisions due to debt covenants (Brown and Lee, 2007; Frankel, Lee, and McLaughlin, 2010; Moser, Newberry, and Puckett, 2011; Shroff, 2017).[23] SFAS 123(r) is most relevant to our study, as it directly relates to the calculation of operating earnings. The rule was issued in December 2004; it became effective for public companies for fiscal periods that began after June 15, 2005, and fiscal 2006 was the first fiscal year affected by the new rule.

We study the impact of the rule change in Table 6. We instrument EBITDA in 2006 (post-adoption) with the average option compensation expenses in the three years prior to the issuance of SFAS 123(r) in 2004, controlling for lags of EBITDA, lags of the dependent variable, as well as a set of firm characteristics (including the same controls as in Tables 4, book-to-market ratio, longer lags of firm stock returns, and sales and net cash receipts which are not affected by the accounting rule change):

$$\mathrm{Y}_i^{2006} = \alpha + \beta \widehat{\mathrm{EBITDA}}_i^{2006} + X_i'\gamma + \epsilon_i. \tag{4}$$

We study both debt issuance and capital expenditures as the outcome variable, and present results for large firms bound by EBCs, large firms not bound by EBCs, and small firms.

Table 6 Panel A shows strong first-stage responses among all firms. Panel B shows the second stage: debt issuance and investment are significantly affected among firms bound by EBCs, but not among other firm groups. The results are in line with our findings in the baseline tests above, and attest to the impact of operating earnings through EBCs. In Table 6, the second-stage coefficients on EBITDA among firms bound by EBCs are higher than the baseline results in Table 4. The estimates here are local average treatment effect (LATE), and it appears that firms which are most intensively treated (those that use a significant amount of option compensation) are more responsive. In addition, the accounting rule change induces a nearly permanent shock to earnings (the new rule permanently eliminates one way of compensating employees without booking an operating expense) while the average persistence of innovations in EBITDA in the baseline tests is about 0.3, which would make

[23] There are two issues about EBITDA definitions in debt contracts that we need to examine. The first issue is whether covenants calculate EBITDA using fixed accounting methods ("fixed GAAP," in which case accounting changes do not affect covenant tightness), or latest accounting methods ("floating GAAP," in which case accounting changes do matter). Reviews of sample contracts show that "floating GAAP" is common (Moser, Newberry, and Puckett, 2011; Shroff, 2017), given transaction costs for applying "fixed GAAP" (firms' official financial statements comply with latest accounting methods, so to implement "fixed GAAP" the borrower needs to prepare an additional set of financial statements); thus the accounting rule change would directly affect constraint tightness. The second issue is certain debt contracts allow borrowers to exclude all expenses with no cash impact ("non-cash charges," such as depreciation, amortization, stock-based compensation, etc.) from the calculation of EBITDA, in which case SFAS 123(r) may not affect covenant tightness (since stock-based compensation is excluded). We read a set of publicly available debt contracts during this period, and do not find such exclusions to be pervasive.

the effect size larger. In the Internet Appendix Section IA3.3, we perform placebo tests using other years, and verify that there are no first-stage and reduced form results in these cases.[24] Overall, in order to account for the results using alternative explanations, it has to be that there are certain links between prior option compensation and subsequent changes in borrowing and investment which are *unique to firms bound by EBCs*, but are not related to EBCs. In addition, such links need to be especially pronounced around this period. We do not find a strong reason for such channels.

4.2 The Role of Physical Asset Values

In this section, we study the mirror image of Section 4.1: when cash flow-based lending and EBCs prevail, how the value of physical assets, in particular the value of real estate, influences firm outcomes on the margin. Below we first investigate the general sensitivity of corporate borrowing to real estate value. We then turn to the case of the Great Recession in Section 4.3. We focus on real estate value because it is the main type of asset where market value estimates are available for a wide set of firms, and because real estate values often experience large fluctuations that have important macroeconomic effects.

Empirical Specification

Our main tests follow the standard empirical specification in prior research (Chaney, Sraer, and Thesmar, 2012; Cvijanović, 2014):

$$Y_{it} = \alpha_i + \eta_t + \beta \text{RE}_{it} + X'_{it}\gamma + \epsilon_{it}. \tag{5}$$

For the outcome variable, we study both net debt issuance as in previous work, and the issuance of different types of debt, in particular cash flow-based versus asset-based debt (measured using the change in amount outstanding). Since we only have detailed firm-level categorization of cash flow-based and asset-based debt starting in 2003, we focus on the sample period of 2003 to 2015. In addition, our real estate value estimates are also more widely available for the post-2000 period, as explained below.

The main independent variable RE_{it} is the market value of real estate assets, measured at the beginning of year t using two procedures described in detail below. We control for firms' operating earnings (EBITDA), net cash receipts (OCF), cash holdings, Q, and additional balance sheet characteristics such as book leverage, size (log book assets), and other specific assets (measured at the beginning of year t).

A standard empirical concern in testing responses to property value is that property prices might be correlated with local demand in firms' locations. To address this problem,

[24] A special case is fiscal year 2005, which is after the rule issuance but before its implementation. In this year, we find some impact on debt issuance and a modestly significant impact on investment among firms bound by EBCs. This could result from preemptive adjustments smoothing out the impact of the new rule.

we draw on Mian and Sufi (2014)'s observation that tradable firms' demand is generally national (or global), instead of local. Accordingly, we present additional results for tradable firms only to further tease out potential impact of local demand. Another approach is to instrument property prices with land supply elasticity, as in Chaney, Sraer, and Thesmar (2012). However, as Mian and Sufi (2014) demonstrate, land supply elasticity is a strong instrument for households' housing net worth and correspondingly local household demand. As a result, this instrument may not satisfy the exclusion restriction in our setting.

Measuring Firms' Real Estate Value

Firms' financial statements report the book value of real estate (based on historical cost) rather than the market value. We estimate the market value in two ways. All firms in this analysis own a non-zero amount of real estate, as indicated by the net book value.

Method 1: Traditional Estimates. Chaney, Sraer, and Thesmar (2012) provide a standard procedure to estimate the market value of real estate using accounting data. The estimate is calculated based on the book value of real estate, accumulated depreciation, and historical property value in the firm's headquarters location. Because accumulated depreciation on real estate assets is no longer reported after 1993, this procedure requires firms to exist in Compustat since 1993, which restricts the sample size. The key assumption in this estimate is that most of the real estate assets firms own are located near their headquarters, which is plausible as we discuss in more detail below (most firms' owned properties, such as offices and main production facilities, tend to concentrate in the headquarters region). Appendix E explains the construction of the estimates by step.

Method 2: Property Ownership Information from 10-K Filings. US firms are required to discuss their properties in annual reports (10-K filings). About one third of firms with real estate provide a detailed list of owned properties, including location, type, and square footage. We hand collect these data from 2006 filings to get more refined information about firms' real estate holdings. For the panel analysis in this section, we assume firms own a fixed set of properties as shown by 2006 filings, estimate the market value of each property in each year, and sum up to the firm level. We also read filings in 2002, which produce similar results (estimates using locations in 2002 and 2006 filings are about 0.85 correlated). We restrict to owned real estate located in the US, and keep firms that have information for substantially all owned properties in the US. Appendix E provides examples of property holding information from 10-K filings, and detailed explanations of variable construction.

Table 7 presents the characteristics of firms in the sample with real estate value estimates. Given the data requirements, the samples tilt towards large firms. The median share of cash flow-based debt in total debt is above 65%, and the majority of these firms have earnings-based covenants. The median market value of real estate is about 15% to 20% of book assets for these firms, similar to Chaney, Sraer, and Thesmar (2012). Table 7 also shows the characteristics of all Compustat firms that own real estate (around 66% of Compustat),

measured during the same period. Overall, firms covered by the samples of Method 1 and Method 2 are similar to the typical firm with real estate.

Finally, real estate values measured using Method 1 and Method 2 are 0.7 correlated. The levels also match up. The similarity is high because most firms' owned properties do concentrate in the headquarters location, so the assumptions in Method 1 largely hold (e.g., as of 2006 Starbucks only owns headquarters office space and four roasting facilities).

Results

Table 8 presents the results, for all firms where real estate value measures are available (Panel A), as well as the subsample with tradable firms only (Panel B) which shows similar results. A one dollar increase in the real estate value is on average associated with an increase in net debt issuance of about three cents. The positive response is concentrated in asset-based debt, while it is absent among cash flow-based debt. These patterns are consistent with the properties of asset-based and cash flow-based debt shown in Table 2. The response of investment activities is also relatively limited.

Taken together, the results suggest that a substantial portion of large non-financial firms' debt (cash flow-based debt) does not rely on real estate value. With these alternative venues for borrowing, the overall sensitivity of borrowing to property prices appears limited. For instance, for a firm with a median level of real estate holdings (real estate value is 0.2 times book assets), a 20% decline in property price would decrease its real estate value by about 0.04 of book assets, and reduce its borrowing by about 0.0012 of book assets (0.04×0.03).[25]

The results above are focused on a sample of primarily large US non-financial firms where cash flow-based lending prevails. One may wonder about results among firm groups where asset-based lending prevails. For small public firms, it turns out that many do not own real estate but lease instead. For small private firms, they can be similar to households, and several papers document that they borrow against residential real estate and are exposed to property value fluctuations (Adelino, Schoar, and Severino, 2015; Schmalz, Sraer, and Thesmar, 2017). For airlines where borrowing against the collateral value of aircraft is central, previous work shows that fluctuations in collateral value have significant consequences (Benmelech and Bergman, 2009, 2011). Finally, in Section 4.4, we also contrast our findings in the US with findings from Japan, a country where corporate lending traditionally emphasized physical collateral and real estate.

4.3 The Great Recession

Sections 4.1 and 4.2 focus on the general sensitivity of corporate borrowing to cash flows in the form of operating earnings and to the value of real estate. In this section, we show

[25] Chaney, Sraer, and Thesmar (2012) find the same sensitivity has large explanatory power for borrowing and investment across firms, due to substantial *cross-sectional* differences in firms' real estate holdings.

how these findings help shed light on the Great Recession. Overall, we find that the decline in earnings can account for some declines in corporate borrowing and investment, due to EBCs. We do not find that major non-financial firms were significantly affected by falling real estate values, due to collateral damage.

Earnings Drop and Firm Outcomes in the Great Recession

We first perform a simple assessment of the impact of EBCs during the Great Recession. From 2007 to 2009, total earnings of large Compustat firms with earnings-based covenants fell by $123 billion. Based on the results in Table 4, this would be associated with a $33.5 billion decline in net debt issuance due to EBCs, which accounts for 10.6% of the issuance decline among all Compustat firms. It would be associated with a $14 billion reduction in CAPX due to EBCs, which accounts for 8.7% of CAPX declines among Compustat firms. If we augment the baseline regression with two dummy variables indicating covenant violation and within 0.5 standard deviations of violation to allow for discontinuity in outcome variables due to violations, the total impact increases slightly to 14.4% of declines in net debt issuance and 9.5% of declines in CAPX. Results are also similar if we estimate a cross-sectional regression for firms with earnings-based covenants focusing on the Great Recession period (EBCs account for 10.7% of declines in net debt issuance and 9% of declines in CAPX).[26]

Taken together, the impact due to EBCs is meaningful but not catastrophic. As Figure 5 shows, while corporate earnings have cyclical fluctuations, the variations are relatively mild. Overall, the findings are consistent with structural estimates of the impact of firm-side credit frictions in the Great Recession in Mehrotra and Sergeyev (2018) and reduced-form estimates in Chodorow-Reich and Falato (2019).

Unpacking the Property Price Effect

We then assess the impact of property price declines on firms through collateral damage. Since the Great Recession, a vibrant strand of research investigates the impact of the property price collapse through damages to household balance sheets and corresponding contractions in aggregate demand, following Mian and Sufi (2014). Property price declines, however, may also transmit through collateral damage to firms. Less is known about the role of this second channel in the Great Recession. Indeed, collateral damage to firms plays a critical role both in theories of financial acceleration, and in some international experiences such as Japan in

[26]For Estimate 1, we use the regression in Table 4, and calculate the change in the outcome variable predicted by the change in EBITDA. We renormalize the outcome to dollar amounts and sum across all large firms with earnings-based covenants. For Estimate 2, the procedure is the same, except we add two dummies to capture potential non-linear effects when firms violate earnings-based covenants or are close to violation. For Estimate 3, we instead use cross-sectional regressions restricted to the Great Recession period. We run a regression among large non-financial firms with earnings-based covenants: $\Delta Y_i^{07-09} = \alpha + \beta \Delta \text{EBITDA}_i^{07-09} + \kappa \Delta \text{OCF}_i^{07-09} + X_i'\gamma + u_i$, where ΔY_i^{07-09} is firm i's change in net debt issuance (or CAPX) from 2007 to 2009, $\Delta \text{EBITDA}_i^{07-09}$ is its change in EBITDA; controls include changes in Q and pre-crisis Q, as well as cash holdings, book leverage, PPE, size, among other firm characteristics measured at the end of 2006. We then calculate changes in the outcome variable predicted by changes in EBITDA. Finally, we sum up the firm-level impact across all large firms with earnings-based covenants.

the early 1990s (Peek and Rosengren, 2000; Gan, 2007). Such a mechanism, however, could be attenuated if firms primarily utilize cash flow-based lending.

Findings in studies of the household demand channel offer some hints on the limited role of firm collateral damage. In particular, Mian and Sufi (2014) find that property price declines mainly affect the outcomes of non-tradable firms, but not the outcomes of tradable firms. While property value declines in a location affect non-tradable firms through local household demand, they can also affect *both* tradable and non-tradable firms through damages to firms' property collateral value. If the latter channel is strong, we would expect that *tradable firms* should also display some sensitivity to local property price changes.

We use our firm property holdings data to further assess the transmission of property price declines through the corporate property collateral value channel. We exploit firms' differential exposures to property value shocks, through the following specification:

$$\Delta Y_i^{07-09} = \alpha + \lambda \Delta \text{RE}_i^{07-09} + \eta \text{RE}_i^{06} + \phi \Delta P_i^{07-09} + \beta \Delta \text{EBITDA}_i^{07-09} + X_i' \gamma + u_i. \qquad (6)$$

The left hand side variable ΔY_i^{07-09} is the change in firm i's outcome from 2007 to 2009: Panel A studies debt issuance and Panel B studies investment. On the right hand side, the key variable of interest for analyzing the property collateral channel is $\Delta \text{RE}_{i,06}^{07-09}$, which captures changes in firm i's real estate value from 2007 to 2009. It is measured as the market value gain/loss of firm i's pre-crisis (end of 2006) real estate holdings during the Great Recession, normalized by assets in 2006. We control for firm i's pre-crisis real estate holdings RE_i^{06}, as well as the percentage change in property prices in firm i's locations, ΔP_i^{07-09} (which captures the impact of property prices that may work through local household demand). We also control for changes in EBITDA, net cash receipts, and Q from 2007 to 2009, as well as Q, leverage, cash holdings, size (log book assets) by the end of 2006, among others.

We measure firms' real estate value using both methods described in Section 4.2.[27] The bottom of Table 7 shows that the median property price decline from 2007 to 2009, ΔP_i^{07-09}, is about 8% for firms in our sample. The median decline in the market value of real estate from 2007 to 2009 (normalized by 2006 assets), $\Delta \text{RE}_{i,06}^{07-09}$, is about 0.01.[28]

Figure 6 shows a scatter plot of the change in debt issuance during the crisis (y-axis) and firm property value declines in this period $\Delta \text{RE}_{i,06}^{07-09}$ (x-axis). Internet Appendix Table

[27]For Method 1, RE_i^{06} uses the regular headquarters-based procedure, ΔP_i^{07-09} is the percent change in property prices in the headquarters location from 2007 to 2009, and $\Delta \text{RE}_{i,06}^{07-09} = \text{RE}_i^{06} \times \Delta P_i^{07-09}$. For Method 2, we sum across firm i's properties in 2006 to obtain $\text{RE}_i^{06} = \sum_j \text{RE}_{i,j}^{06}$ and $\Delta \text{RE}_{i,06}^{07-09} = \sum_j \text{RE}_{i,j}^{06} \times \Delta P_{i,j}^{07-09}$, where $\Delta P_{i,j}^{07-09}$ is the percentage change in property prices in the location of owned property j of firm i. In this case, we calculate the control ΔP_i^{07-09} as the average of $\Delta P_{i,j}^{07-09}$.

[28]In this cross-section setup, there could still be concerns of property prices being correlated with local demand. This issue can drive down λ (i.e., contribute to insensitivity to real estate value) if firms that own more real estate are systematically *less* sensitive to local demand. As discussed above, the local demand problem does not appear severe for firms in our data whose demand is generally not local. Nonetheless, we also perform additional checks in Internet Appendix Table IA10 using tradable firms only.

IA9 presents the regression results on debt issuance and investment. We report both OLS estimates and least absolute deviation (LAD) estimates (following Gan (2007)) to alleviate the potential influence of outliers and skewness in the cross-sectional data. Across different tests, we do not find evidence that declines in firms' real estate value drove down debt issuance or capital expenditures during the Great Recession. Finally, the coefficients on EBITDA in Table IA9 have the same signs and comparable magnitudes as results in Section 4.1.

In summary, our analysis suggests that property price declines during the Great Recession did not have a significant impact on firms' outcomes due to collateral damage. In the next section, we contrast results in the US and Japan property price collapse, which point to substantial differences in the transmission of property price shocks under different regimes of corporate borrowing.

4.4 US vs. Japan

As discussed in Section 2.3, the predominant form of corporate debt depends on institutional foundations. For instance, in Japan, corporate debt historically relies heavily on physical assets (especially real estate) given its legal environment and lending traditions. In this section, we show how these corporate borrowing practices in Japan shape the way financial variables influence Japanese firms' outcomes, and contrast with the US.

Impact of Operating Earnings

Section 4.1 shows that cash flows in the form of operating earnings have a significant impact on debt issuance and investment among large US firms. This relationship does not appear among Japanese firms as we show below.

Table 9 reruns the baseline regressions in Section 4.1 among large non-financial firms (i.e., book assets above median among Compustat firms in the respective country) in the US and in Japan. Large US firms primarily use cash flow-based debt and a majority have earnings-based covenants, while cash flow-based lending and EBCs are less common in Japan (Tan, 2004). Table 9 Panel A first tabulates the summary statistics for the US and Japan samples. For Japanese firms, we use data from Compustat Global, supplemented with WorldScope and stock prices from Datastream. Net debt issuance from the statement of cash flows is not available for the Japan sample, so we measure debt issuance here using changes in total book debt. Firms in the US and Japan samples are similar in size as measured by book assets. US firms have higher EBITDA, as well as a higher fraction of intangibles. Meanwhile, Japanese firms have higher debt-to-EBITDA ratios (as they are not bound by debt-to-EBITDA constraints) and similar debt to total book assets.

Table 9 Panel B performs regressions of borrowing sensitivity to EBITDA in the US and Japan. There is a strong positive relationship between debt issuance and EBITDA in the US sample (driven by firms bound by EBCs). This relationship is absent in the Japan sample.

Similarly, EBITDA does not have an independent impact on investment in the Japan sample.

Impact of Real Estate Value

In the late 1980s and early 1990s, Japan experienced a major boom-bust cycle in property prices. This cycle took place in an environment where real estate was central for corporate credit. Correspondingly, with the collapse of property prices, Japanese firms' debt capacity and investment activities suffered significantly, as documented by Gan (2007). For public manufacturing firms in Japan, Gan (2007) constructs the value of firms' real estate prior to the collapse as the main measure of exposures to property price shocks (she estimates the market value of real estate from accounting data through a procedure similar to Method 1 above). She finds that Japanese firms that owned more real estate pre-collapse suffered particularly severely during the bust: for a one dollar increase in a firm's pre-collapse land holdings in 1989, average CAPX investment is lower by 13 to 16 cents from 1994 to 1998. The impact is substantial, especially given that property prices peaked around 1990 and the outcome is measured several years afterwards.

Table 10 presents results in the US sample using the same regression specifications as Table 2 column (2) of Gan (2007):

$$\text{CAPX}_i^{post} = \alpha + \beta \text{RE}_i^{pre} + X_i'\gamma + v_i. \tag{7}$$

where CAPX_i^{post} is firm i's average annual investment rate during the property price collapse; RE_i^{pre} is the value of firm i's real estate holdings prior to the collapse, which captures firms' exposures to real estate; X_i includes firm-level controls. This specification is different from our tests in Equation (6) above and provides an alternative test.

As Table 10 shows, in the US Great Recession, we do not find results similar to what Gan (2007) found in Japan. There is no significant correlation between a firm's pre-crisis real estate holdings and its subsequent outcomes. The sharp contrast suggests that the transmission mechanisms of a property price collapse may differ in different settings, depending on the central determinants of firms' debt capacity.

5 Further Implications

In this section, we discuss further implications of our findings for questions in macro-finance research. Section 5.1 lays out the impact of different forms of borrowing constraints in several applications. Section 5.2 summarizes how the empirical evidence informs modeling assumptions.

5.1 Applications

Financial Acceleration. Classic financial acceleration through asset price feedback builds on borrowing constraints tied to the liquidation value of physical assets (Kiyotaki and Moore, 1997; Bernanke, Gertler, and Gilchrist, 1999; Mendoza, 2010). With cash flow-based lending and EBCs, such asset price feedback through firms' balance sheets may dampen.

To illustrate, we perform a simple analysis of financial acceleration dynamics under different forms of borrowing constraints, based on a standard general equilibrium framework following Kiyotaki and Moore (1997). We examine both traditional collateral-based constraints (borrowing limit depends on the liquidation value of physical assets) as in the original work, and earnings-based constraints (borrowing limit depends on a multiple of cash flows/earnings). We compare the equilibrium impact of a shock to productive firms' internal funds in these two scenarios (the same shock as considered by Kiyotaki and Moore (1997)), starting from the same steady state in both cases.

The results show that, after the shock hits, the impact on productive firms' capital holding and aggregate output is much stronger with traditional collateral-based constraints, due to asset price feedback. This mechanism is muted with EBCs: when the liquidation value falls, a firm's borrowing constraint is not automatically tightened, and fire sale amplification is not present. Using parameters similar to Kiyotaki and Moore (1997), we find that the impact on productive firms' capital holding and aggregate output under conventional collateral-based constraints can be about ten times as large as that under earnings-based constraints. Dampening the asset price feedback could be important in this standard model setting. We present the details of the setup, equilibrium dynamics, and analyses in Appendix F.

Credit Access and Allocation. One concern in recent research is firms' assets become increasingly intangible as the economy becomes more intensive in services and technology: firms may not have enough physical assets to pledge and find it more difficult to borrow (Giglio and Severo, 2012; Caggese and Pérez-Orive, 2019). Another concern is the lack of tangible assets may distort resource allocation across firms (Catherine et al., 2018).

The form of corporate borrowing is important for the severity of these problems. In the US, with the prevalence of cash flow-based lending and EBCs, firms do not necessarily need to rely on physical assets for borrowing. Indeed, in the data we find that firms with more intangibles have a higher share of cash flow-based debt and a greater prevalence of EBCs. For instance, among high vs. low intangible firms in Compustat (top vs. bottom half of intangibles normalized by book assets), the median share of cash flow-based debt in total debt is 68% vs. 29% respectively, and the fraction with earnings-based covenants is 39% vs. 17% respectively. As our findings suggest, for firms with easy access to cash flow-based lending, the sensitivity of borrowing to physical assets is small; we also do not find total borrowing to decrease with the amount of intangibles in this case. Nonetheless, intangibles

could limit borrowing capacity among small or low profitability firms that have less access to cash flow-based lending, or among firms in countries where asset-based lending dominates (thus the legal institutions in a country may affect the rise of intangibles and its impact).

Monetary Policy Transmission. As shown in Section 3, EBCs are commonly specified as restrictions on total debt relative to operating earnings ($b_t \leq \phi \pi_t$, debt-to-earnings constraint), or interest payments relative to operating earnings ($r_t b_t \leq \theta \pi_t$, interest coverage ratio constraint). Monetary policy can directly affect the latter constraint by changing the interest rate r_t (via benchmark rates and possibly also via impact on credit spreads (Gertler and Karadi, 2015)). This mechanism would be stronger in periods where the coverage ratio constraint is more binding than the debt-to-earnings constraint (e.g., when interest rates are high). This interest coverage channel is studied in detail in Greenwald (2019a).

Investment Cash Flow Sensitivity. The analysis of EBCs also points to a new perspective for the investment sensitivity to cash flows. In previous work on investment cash flow sensitivity (Fazzari, Hubbard, and Petersen, 1988; Froot, Scharfstein, and Stein, 1993; Kaplan and Zingales, 1997; Rauh, 2006), the role of cash flows is to increase internal funds: following the pecking order idea (Myers and Majluf, 1984), more internal funds boost investment but substitute out external financing as long as investment has diminishing marginal returns. With cash flow-based lending and EBCs, however, cash flows in the form of operating earnings can raise investment by directly relaxing borrowing constraints. As shown in Sections 4.1 and 4.4, this mechanism applies to firms where EBCs are relevant, and not to firms that primarily rely on asset-based lending.[29]

5.2 Implications for Modeling Assumptions

Specifying Firms' Borrowing Constraints. How do our findings map into specifying borrowing constraints in macro-finance models? As the data shows, the relevant modeling assumptions may differ depending on legal environments and firm characteristics.

Specifically, we show that cash flow-based lending prevails among major US non-financial firms (given the legal foundations in the US and the high asset specificity of non-financial firms). In this type of setting, borrowing constraints correspondingly emphasize firms' cash flow value. For models with riskless debt and quantity constraints (e.g., Kiyotaki and Moore (1997)), for example, the data suggests that a prevalent form of borrowing constraint restricts a firm's total debt as a function of its cash flows measured using operating earnings (EBCs: $b_t \leq \phi \pi_t$). More generally, modeling borrowing constraints based on a firm's pledgeable going-concern cash flow value (or enterprise value) can also be viewed as broadly in line with the spirit of cash flow-based lending. Traditional specifications of borrowing constraints in

[29] This mechanism through EBCs is not present when cash flows are measured using pure cash receipts. Many previous papers measure cash flows using earnings (Fazzari, Hubbard, and Petersen, 1988; Kaplan and Zingales, 1997; Baker, Stein, and Wurgler, 2003), so the results could be affected by the role of EBCs.

macro-finance models, such as restricting a firm's total debt based on the liquidation value of physical assets (e.g., $b_t \leq \frac{q_{t+1}}{R} k_t$) or based on the capital stock (e.g., $b_t \leq \psi k_t$),[30] may not be the most accurate description. Analogously, for more complicated models with risky debt and defaults in equilibrium (e.g., Ottonello and Winberry (2018)), the data then suggests that creditors' payoff in default should tie to the going-concern cash flow value of the firm, instead of necessarily the liquidation value of physical assets.

On the other hand, in settings where firms primarily borrow asset-based debt, such as Japan (Gan, 2007), small firms (Cloyne et al., 2018), and airlines (Benmelech and Bergman, 2009), the traditional specifications focusing on the value of physical assets fit well.

Relationship with the Net Worth Channel. How do our findings relate to the net worth channel in the macro-finance literature? The core of the net worth channel is that external financing is costly, in which case internal funds (i.e., net worth) have a significant impact on firms' financial and real outcomes. The existence of the net worth channel per se does not pin down the exact form of corporate borrowing and borrowing constraints (see Bernanke and Gertler (1989) and Holmstrom and Tirole (1997) for net worth channel with borrowing based on cash flows, and Kiyotaki and Moore (1997) and Bernanke, Gertler, and Gilchrist (1999) for net worth channel with borrowing based on physical assets; Internet Appendix Section IA4 provides a short summary). The general lesson of the net worth channel, i.e., external financing has frictions and costs and internal funds can influence firm outcomes, applies in our setting. Beyond this, our focus is the *form* of external borrowing and constraints, and the corresponding implications, as explained above.

6 Conclusion

In this paper, we collect detailed data to empirically study borrowing constraints of non-financial firms. We show that cash flow-based lending accounts for a substantial fraction of US non-financial corporate debt. With cash flow-based lending, a standard borrowing constraint restricts firms' total debt based on a measure of cash flows, namely operating earnings. We lay out the legal and economic determinants of these corporate borrowing practices, and show how these features of corporate borrowing influence firm outcomes on the margin. Taken together, our findings point to new venues for modeling firms' borrowing constraints in macro-finance analyses.

We also recognize that the predominant form of corporate borrowing depends on legal foundations. Correspondingly, macro-finance mechanisms may not apply uniformly across the board. The relevant assumptions in modeling may need to adapt to legal environments and firm characteristics in the setting of interest.

[30] Borrowing constraints based on capital stock are used in Buera and Shin (2013), Moll (2014), Midrigan and Xu (2014), among others. This constraint is distinct from cash flow-based lending and EBCs if firms have heterogeneous productivity, or if there is human capital, organizational capital, or other intangible capital.

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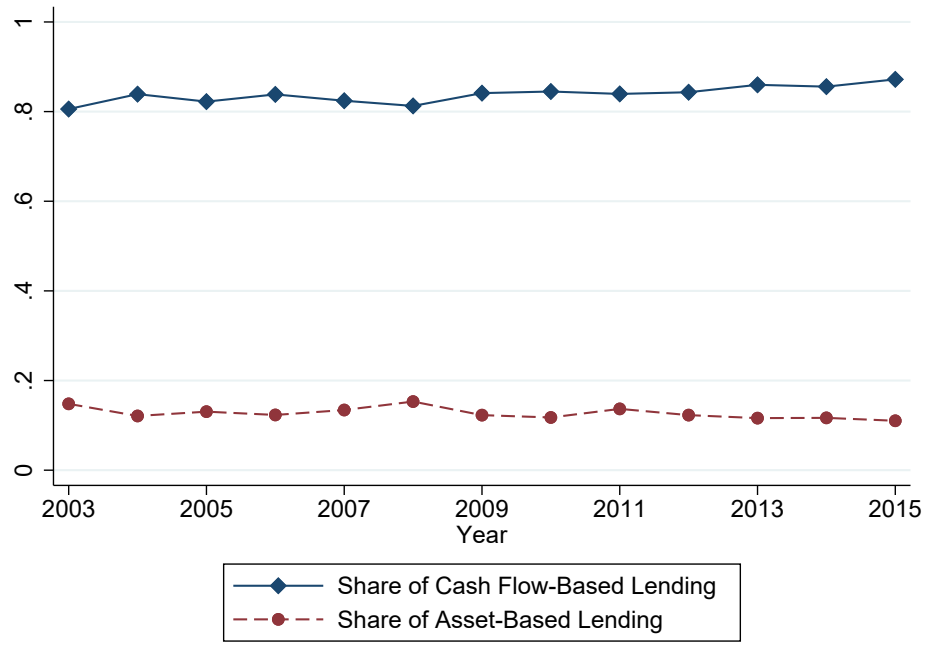
Main Figures and Tables

Figure 1: Prevalence of Cash Flow-Based Lending and EBCs: Large Compustat Firms

This figure shows the prevalence of cash flow-based lending and EBCs among large US non-financial firms in Compustat. In Panel A, we plot the median share of cash flow-based lending and asset-based lending in these firms. The solid line with diamond represents the share of cash flow-based lending (i.e., cash flow-based debt/total debt); the dashed line with circle represents the share of asset-based lending (i.e., asset-based debt/total debt). In Panel B, we merge covenant data from DealScan and FISD with Compustat, and plot the fraction of large firms with earnings-based covenants in each year.

Panel A. Median Share of Cash Flow-Based Lending



Panel B. Fraction of Firms with Earnings-Based Covenants

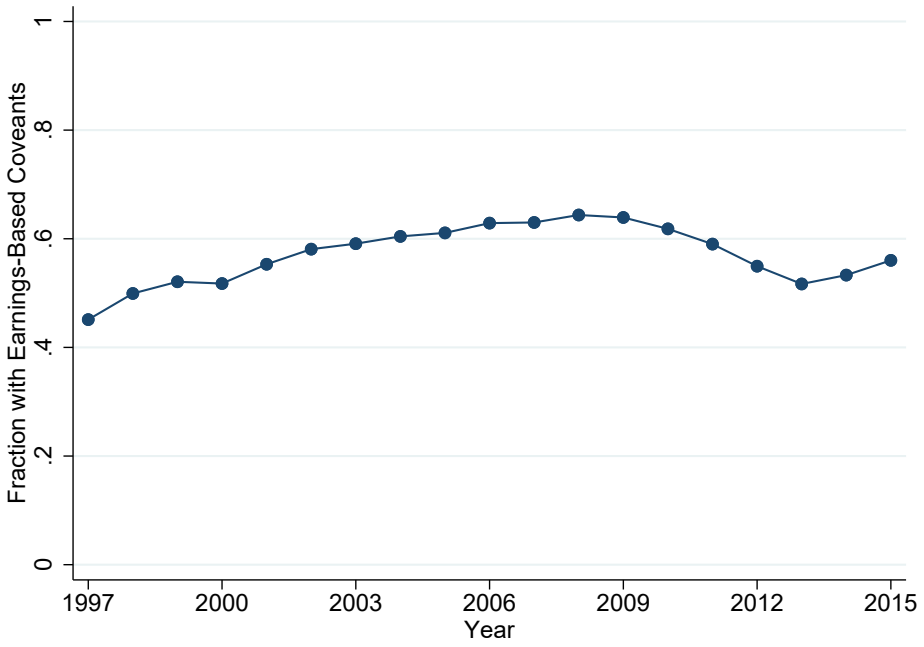
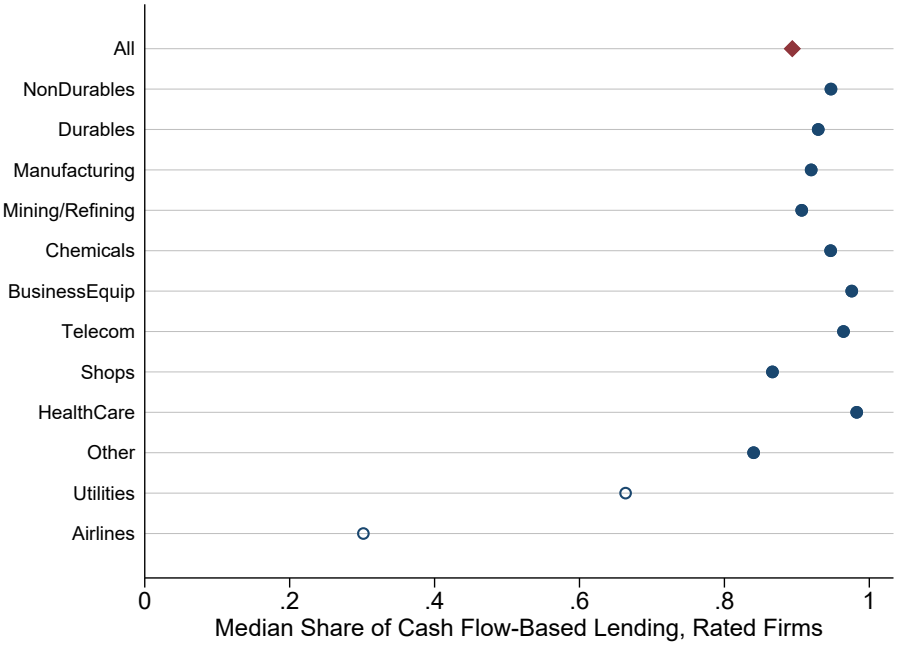


Figure 2: Prevalence of Cash Flow-Based Lending and EBCs: Rated Firms by Industry

This figure shows the prevalence of cash flow-based lending and EBCs across major industry groups. We focus on rated firms to make firm size and capital market access more comparable across industries. The industry groups are Fama-French 12 industries plus airlines (two-digit SIC is 45). Panel A shows the median share of cash flow-based lending in all rated firms and in rated firms of each industry group. Panel B shows the fraction of firms with earnings-based covenants in each group.

Panel A. Median Share of Cash Flow-Based Lending



Panel B. Fraction of Firms with Earnings-Based Covenants

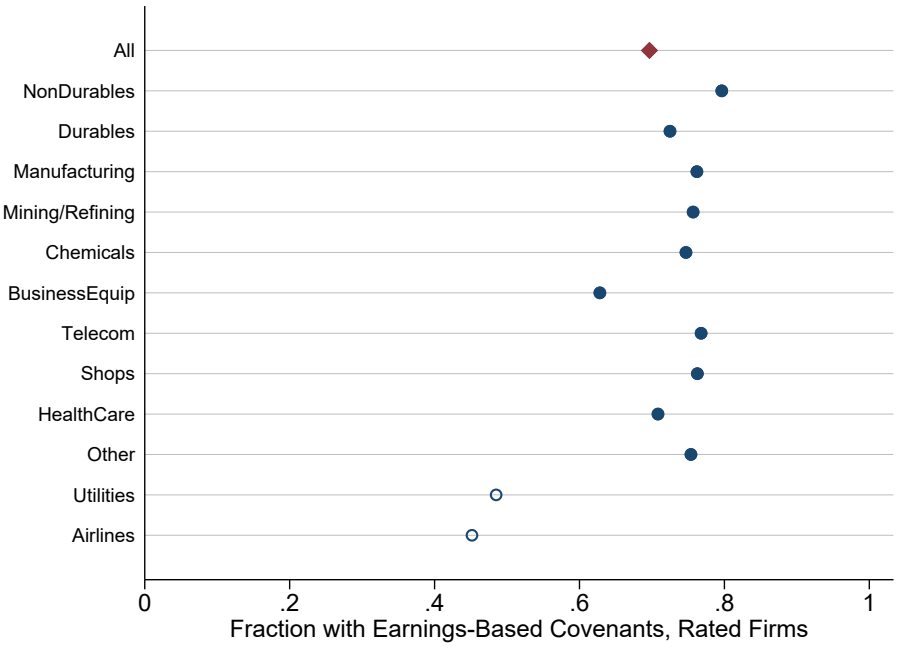


Figure 3: Debt Growth and Earnings-Based Covenants

This plot shows the relationship between firm debt growth and compliance with earnings-based covenants. We use covenant information from DealScan. The x-axis is 20 bins based on a firm's distance to covenant violation by year end, and the y-axis is firm-level debt growth in the next year in each bin. The dots show the average firm-level debt growth in each bin and the dashed vertical lines show the 95% confidence intervals. As shown in Appendix C.1 Table A3, there are several variants of earnings-based covenants. Firms sometimes have more than one type, and different firms can also use different types. To find a uniform measure of distance, we first compute the minimum amount of earnings ($\underline{\pi}_{it}$) required such that the firm is in compliance with all of its earnings-based covenants (given the current level of debt and interest payments). We then compute the difference between the minimum earnings required ($\underline{\pi}_{it}$) and the actual earnings (π_{it}), scaled by lagged book assets. We normalize this distance by the standard deviation of ROA in the firm's two-digit SIC industry. We take the firm-year observations that are within +/- 2 standard deviations, and group them into 20 equally spaced bins. The first bin on the right on the dashed line at zero includes firms within 0 to 0.2 standard deviations, so on so forth. Firms in the shaded region to the left of zero are those that are not in compliance with at least one earnings-based covenant based on DealScan data; those to the right of zero are in compliance with all such covenants.

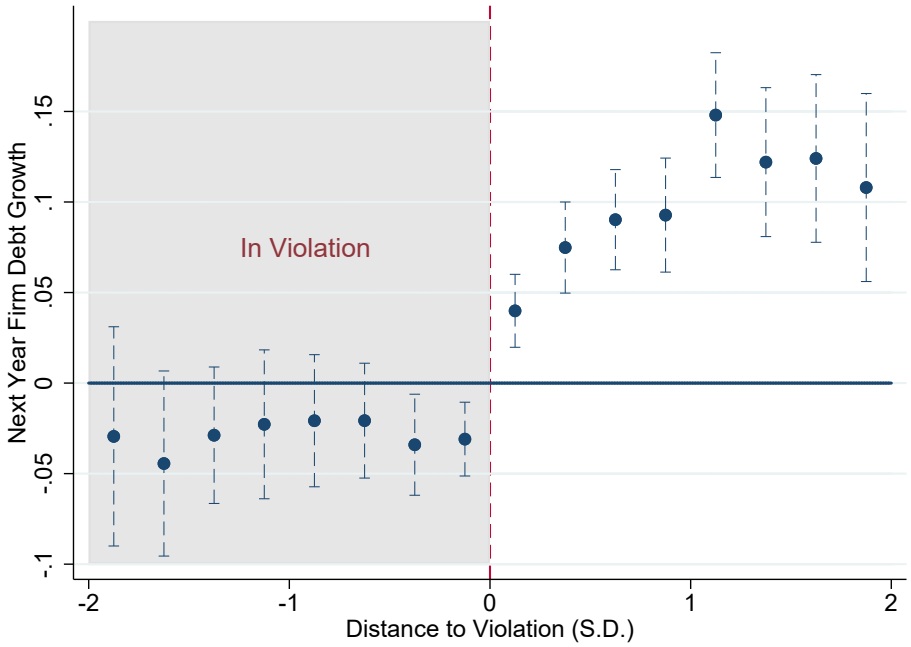


Figure 4: Borrowing Sensitivity to Operating Earnings by Firm Group

This figure shows the coefficient β on EBITDA from Table 4 Panel A column (2) and Table 5 Panel A columns (2), (4), (6), (8), which use the same baseline specification:

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

The outcome variable Y_{it} is net debt issuance. "Large w/ EBCs" is large non-financial firms with earnings-based covenants. "Large w/o EBCs" is large non-financial firms without earnings-based covenants, which are generally firms that use cash flow-based lending but are far from earnings-based constraints. "Small," "Low Margin," and "Air & Utilities" are small firms, low profit margin firms, and airlines and utilities which have low prevalence of cash flow-based lending and EBCs.

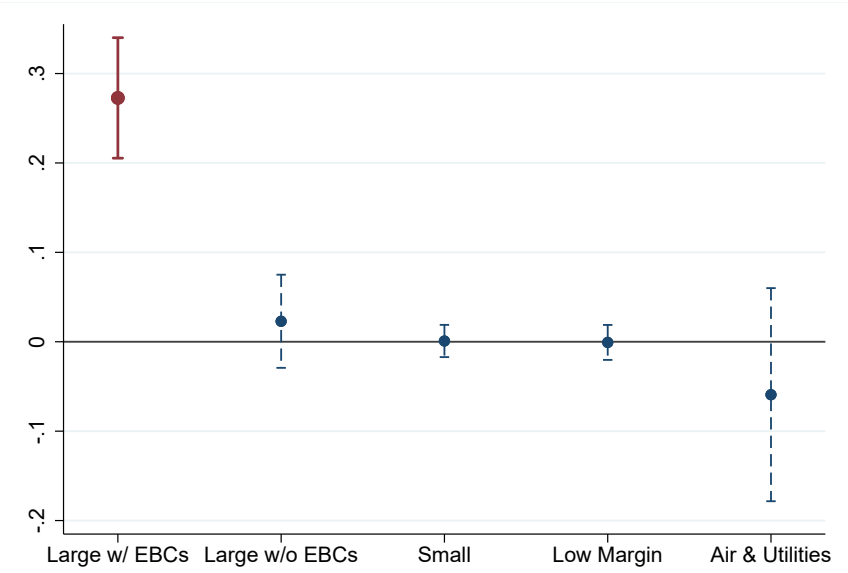
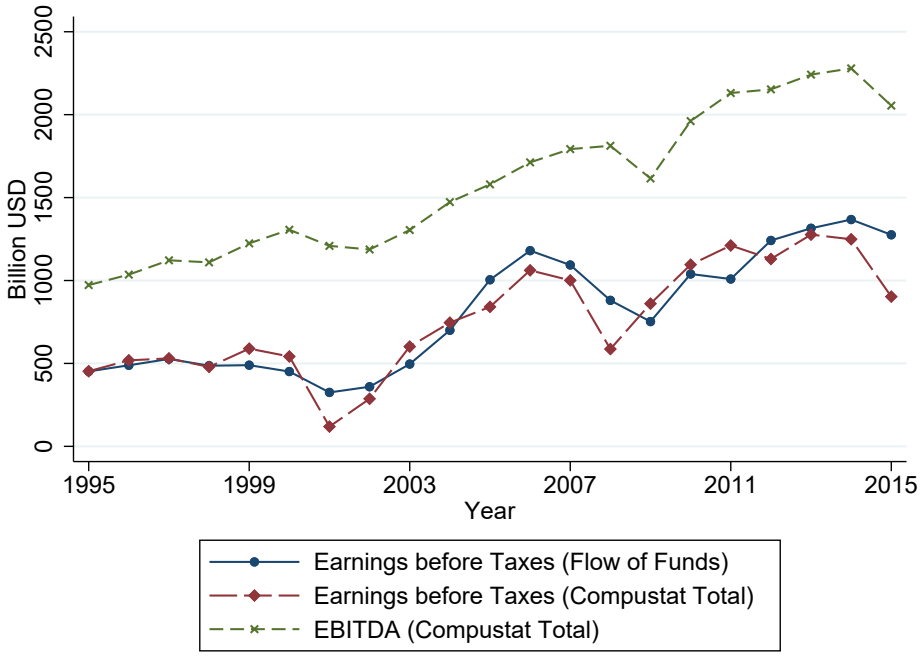


Figure 5: Non-Financial Corporate Earnings

Panel A shows total earnings before tax of the non-financial corporate sector in Flow of Funds (solid line with circles), total earnings before tax of firms in Compustat (dashed line with diamonds), and total earnings before interest, taxes, depreciation and amortization (EBITDA) of firms in Compustat (dashed line with crosses). Panel B shows EBITDA normalized by lagged assets for Compustat total (solid line with circles), median of large Compustat firms (dashed line with diamonds), and median of all Compustat firms (dashed line with crosses).

Panel A. Total Non-Financial Corporate Earnings



Panel B. EBITDA to Assets

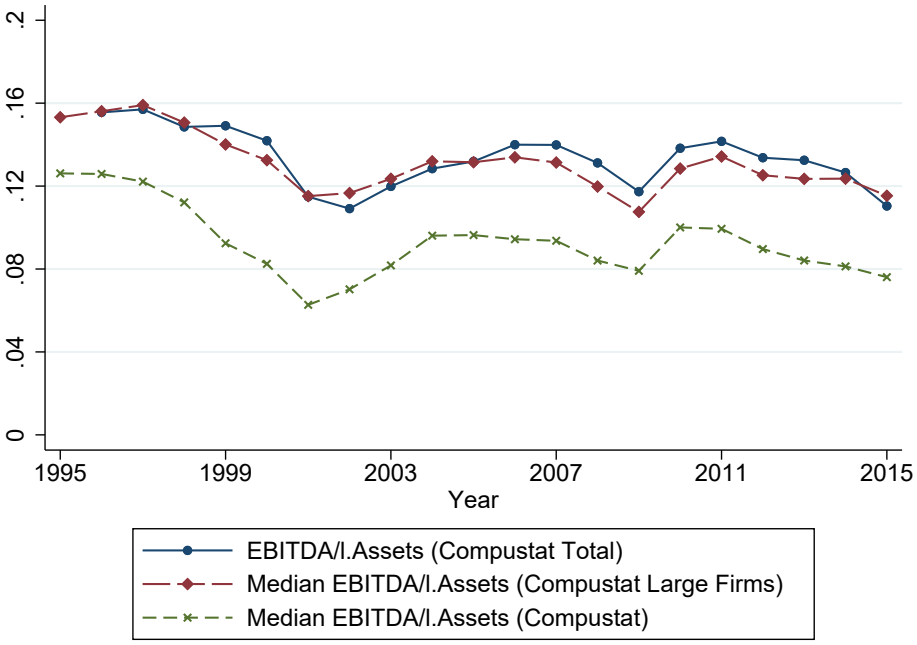
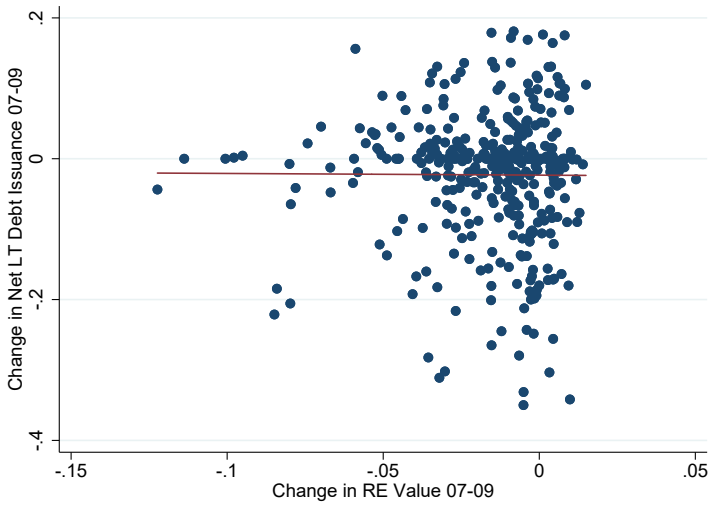


Figure 6: Net Debt Issuance and Real Estate Value: Great Recession

This plot shows the relationship between the change in the value of firms' real estate between 2007 and 2009, $\Delta \text{RE}_i^{07-09}$ (x-axis), and the change in net debt issuance, ΔY_i^{07-09} (y-axis). Panel A shows results using Method 1 of measuring real estate value; Panel B shows results using Method 2 of measuring real estate value. The construction of $\Delta \text{RE}_i^{07-09}$ is explained in footnote 27.

Panel A. Method 1



Panel B. Method 2

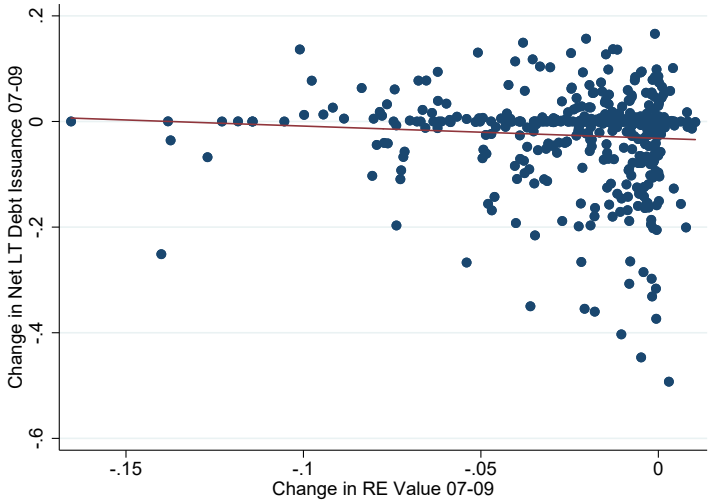


Table 1: Composition of US Non-Financial Corporate Debt

This table summarizes the composition of US non-financial corporate debt. Panel A shows aggregate estimates of the share of each type of debt in total debt outstanding. Panel B shows the median share of asset-based lending and cash flow-based lending in firm debt by firm group (among Compustat non-financial firms). Procedures for aggregate estimates and firm-level analyses are explained in detail in Appendix A.

Panel A. Aggregate Corporate Debt Share by Type

Category	Debt Type	Share
Asset-based lending (20%)	Mortgages	7%
	Asset-based loans	13%
Cash flow-based lending (80%)	Corporate bonds	57%
	Cash flow-based loans	23%

Panel B. Firm-Level Median Share by Group (Compustat)

	Large Firms	Rated Firms	Small Firms
Asset-based lending	12.4%	8.0%	61.0%
Cash flow-based lending	83.0%	89.0%	7.2%

Table 2: Properties of Asset-Based Debt and Cash Flow-Based Debt

This table presents panel regressions of a firm's outstanding debt in a given category on the amount of specific assets the firm has. All variables are normalized by book assets. In Panel A, the left hand side variables include all asset-based debt, as well as mortgages and non-mortgage asset-based loans in particular. In Panel B, the left hand side variables include all cash flow-based debt, as well as secured cash flow-based debt and cash flow-based loans in particular. Liquidation value is estimated liquidation value of plant, property, and equipment (PPE), inventory, and receivable, using industry average liquidation recovery rates collected from bankruptcy filings. Controls include size (log book assets) and cash holdings. Columns (3) and (4) include firm fixed effects. Sample period is 2003 to 2015, and all Compustat non-financial firms which have CapitalIQ debt detail data are included. Standard errors are clustered by firm and time.

Panel A. Asset-Based Lending and Physical Assets

	Total Asset-Based Lending/Assets			
PPE	0.129***		0.122***	
	(0.010)		(0.014)	
Inventory	0.051***		0.080**	
	(0.018)		(0.033)	
Receivable	0.065***		0.050**	
	(0.016)		(0.023)	
Liquidation value		0.189***		0.200***
		(0.020)		(0.029)
Firm FE	N	N	Y	Y
Obs	46,372	43,414	45,234	42,320
R^2	0.076	0.066	0.025	0.024
	Mortgages/Assets			
PPE	0.028***		0.016***	
	(0.002)		(0.002)	
Inventory	0.001		0.003	
	(0.002)		(0.003)	
Receivable	-0.007***		-0.000	
	(0.001)		(0.002)	
Liquidation value		0.022***		0.015***
		(0.003)		(0.003)
Firm FE	N	N	Y	Y
Obs	45,934	43,010	44,793	41,914
R^2	0.058	0.025	0.006	0.002
	(Non-Mortgage) Asset-Based Loans/Assets			
PPE	0.078***		0.099***	
	(0.009)		(0.012)	
Inventory	0.056***		0.070***	
	(0.014)		(0.026)	
Receivable	0.073***		0.051**	
	(0.014)		(0.020)	
Liquidation value		0.146***		0.164***
		(0.018)		(0.026)
Firm FE	N	N	Y	Y
Obs	46,206	43,257	45,063	42,160
R^2	0.061	0.059	0.023	0.022

Standard errors in parentheses, clustered by firm and time

Panel B. Cash Flow-Based Lending and Physical Assets

	Total Cash Flow-Based Lending/Assets			
PPE	-0.101***		-0.047*	
	(0.013)		(0.026)	
Inventory	-0.232***		-0.136***	
	(0.018)		(0.036)	
Receivable	-0.330***		-0.132***	
	(0.024)		(0.031)	
Liquidation value		-0.297***		-0.201***
		(0.023)		(0.046)
Firm FE	N	N	Y	Y
Obs	46,362	43,405	45,225	42,312
R^2	0.064	0.047	0.006	0.005
	Secured Cash Flow-Based Lending/Assets			
PPE	-0.054***		-0.029***	
	(0.007)		(0.008)	
Inventory	-0.064***		-0.042***	
	(0.009)		(0.012)	
Receivable	-0.094***		-0.048***	
	(0.011)		(0.008)	
Liquidation value		-0.115***		-0.080***
		(0.014)		(0.014)
Firm FE	N	N	Y	Y
Obs	45,683	42,751	44,532	41,644
R^2	0.034	0.029	0.012	0.011
	Cash Flow-Based Loans/Assets			
PPE	-0.050***		-0.019***	
	(0.008)		(0.007)	
Inventory	-0.057***		-0.041***	
	(0.010)		(0.009)	
Receivable	-0.071***		-0.041***	
	(0.008)		(0.007)	
Liquidation value		-0.101***		-0.067***
		(0.014)		(0.012)
Firm FE	N	N	Y	Y
Obs	45,491	42,560	44,345	41,458
R^2	0.051	0.048	0.014	0.013

Standard errors in parentheses, clustered by firm and time

Table 3: Summary Statistics of US Non-Financial Firms

This table presents summary statistics of non-financial firm samples. Panel A shows statistics for large firms with earnings-based covenants. Large firms are those with book assets above Compustat median, and earnings-based covenants use DealScan and FISD data. Mean, median, standard deviation, and selected percentiles are presented. Panel B shows statistics for several firm groups that are not bound by EBCs, including large firms without earnings-based covenants (primarily use cash flow-based lending but are far from constraints), as well as small firms, low margin firms, and airlines and utilities that rely more on asset-based lending. Medians are presented for each group. EBITDA is earnings before interest, taxes, and depreciation and amortization. OCF is net cash receipts from operations. MTB is market equity to book equity. Q is calculated as the sum of market value of equity and book value of debt, divided by book assets. EDF is expected default frequency. PPE is the book value of property, plant, and equipment. CAPX is capital expenditures (spending on property, plant, and equipment). As is customary, flow variables are normalized by lagged assets and stock variables are normalized by contemporaneous assets throughout the paper. The sample period is 1996 to 2015.

Panel A. Large Firms with Earnings-Based Covenants

Variable	p25	p50	p75	mean	s.d.	N
Log book assets	6.36	7.16	8.15	7.33	1.33	17,458
Log market cap	5.94	6.91	7.95	6.95	1.57	17,458
EBITDA	68.39	172.15	464.44	611.98	2110.27	17,458
EBITDA/l.assets	0.09	0.13	0.19	0.14	0.09	17,458
EBITDA/sales	0.08	0.14	0.21	0.14	0.52	17,458
Debt/EBITDA	1.03	2.18	3.80	2.70	3.49	17,458
Debt/assets	0.17	0.29	0.43	0.31	0.22	17,458
EDF	0.00	0.00	0.07	0.13	0.26	17,458
Q	0.79	1.06	1.54	1.30	0.87	17,458
MTB	1.13	1.86	3.00	2.44	2.89	17,150
OCF/l.assets	0.08	0.12	0.16	0.12	0.08	17,445
Cash/assets	0.02	0.05	0.12	0.09	0.10	17,458
PPE/assets	0.13	0.26	0.48	0.32	0.24	17,458
Inventory/assets	0.01	0.08	0.18	0.12	0.12	17,458
Receivable/assets	0.07	0.12	0.20	0.15	0.11	17,458
Intangible/assets	0.05	0.16	0.34	0.22	0.20	17,458
Net debt issuance/l.assets	-0.02	0.00	0.05	0.03	0.15	16,186
CAPX/l.assets	0.02	0.04	0.07	0.06	0.07	17,371
R&D/l.assets	0.00	0.01	0.04	0.03	0.05	8,826
Cash flow-based lending/debt	0.46	0.88	0.99	0.69	0.36	10,855

Panel B. Other Firm Groups

	Large w/o EBCs		Small		Low Margin		Air & Utilities	
Variable	p50	N	p50	N	p50	N	p50	N
Log book assets	6.85	11,382	4.09	22,336	5.08	25,676	7.98	2,584
Log market cap	7.05	11,382	4.08	22,336	4.88	25,676	7.18	2,584
EBITDA	119.58	11,382	2.19	22,336	5.37	25,676	282.15	2,584
EBITDA/l.assets	0.12	11,382	0.06	22,336	0.06	25,676	0.10	2,584
EBITDA/sales	0.14	11,382	0.04	22,336	0.03	25,676	0.21	2,584
Debt/EBITDA	0.99	11,382	0.00	22,336	0.48	25,676	3.61	2,584
Debt/assets	0.18	11,382	0.07	22,336	0.18	25,676	0.36	2,584
EDF	0.00	11,382	0.01	22,336	0.02	25,676	0.00	2,584
Q	1.25	11,382	1.23	22,336	0.99	25,676	0.86	2,584
MTB	2.07	11,382	1.78	22,336	1.55	25,676	1.63	2,584
OCF/l.assets	0.11	11,377	0.05	22,289	0.06	25,631	0.10	2,580
Cash/assets	0.13	11,382	0.19	22,336	0.12	25,676	0.02	2,584
PPE/assets	0.21	11,382	0.13	22,336	0.17	25,676	0.63	2,584
Inventory/assets	0.06	11,382	0.08	22,336	0.07	25,676	0.02	2,584
Receivable/assets	0.11	11,382	0.15	22,336	0.13	25,676	0.06	2,584
Intangible/assets	0.08	11,382	0.04	22,336	0.07	25,676	0.02	2,584
Net debt issuance/l.assets	0.00	10,778	0.00	21,166	0.00	24,151	0.00	2,518
CAPX/l.assets	0.04	11,309	0.03	22,150	0.03	25,488	0.07	2,569
R&D/l.assets	0.05	7,085	0.08	15,485	0.07	16,474	0.01	89
Cash flow-based lending/debt	0.88	5,277	0.00	8,634	0.47	12,256	0.66	1,531

Table 4: Debt Issuance and Investment Activities: Large Firms w/ Earnings-Based Covenants

This table presents firm-level annual regressions of debt issuance and investment activities:

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

In Panel A the outcome variable Y_{it} is net debt issuance. In columns (1) and (2) Y_{it} is net debt issuance in year t from the statement of cash flows (Compustat item DLTIS - DLTR), normalized by assets at the end of year $t-1$. In columns (3) to (4) Y_{it} is the change in long-term book debt in year t. In columns (5) and (6), Y_{it} is the change in total book debt in year t. EBITDA_{it} is earnings before interest, taxes, depreciation and amortization (Compustat item EBITDA) in year t, normalized by assets at the end of year $t-1$. OCF_{it} is net cash receipts from operating activities (Compustat item OANCF + XINT) in year t. Other control variables include Q (market value of equity plus book value of debt normalized by book assets) as of the beginning of year t, stock returns in year $t-1$, as well as cash holdings, book leverage (debt/assets), PPE (plant, property, equipment), inventory, profit margin, size (log book assets) at the end of $t-1$. We also control for net operating assets at the end of year $t-1$ as a proxy for accounting quality (Hirshleifer et al., 2004), and lagged EBITDA to focus on the impact of current EBITDA. Firm fixed effects and year fixed effects are included (R^2 does not include fixed effects). Sample period is 1996 to 2015. The sample includes 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 Issuance		ΔLT Book Debt		ΔTotal Book Debt	
	(1)	(2)	(3)	(4)	(5)	(6)
EBITDA	0.216***	0.273***	0.366***	0.391***	0.345***	0.412***
	(0.030)	(0.034)	(0.039)	(0.046)	(0.039)	(0.042)
OCF		-0.111***		-0.050		-0.135***
		(0.033)		(0.042)		(0.045)
Q	0.010**	0.011**	0.005	0.005	0.004	0.005
	(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)	(0.003)	(0.003)	(0.003)	(0.003)
L.Cash holding	-0.033	-0.033	0.021	0.022	0.039	0.039
	(0.043)	(0.044)	(0.055)	(0.055)	(0.051)	(0.052)
Controls	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Obs	15,642	15,642	15,537	15,537	15,576	15,576
R^2	0.114	0.116	0.118	0.119	0.152	0.154

Standard errors in parentheses, clustered by firm and time

Panel B. Investment Activities

	CAPX		R&D	
	(1)	(2)	(3)	(4)
EBITDA	0.129***	0.101***	0.031***	0.035***
	(0.017)	(0.019)	(0.012)	(0.013)
OCF		0.053***		-0.007
		(0.013)		(0.011)
Q	0.011***	0.011***	0.004***	0.004***
	(0.002)	(0.002)	(0.002)	(0.002)
Past 12m stock ret	0.004*	0.004*	-0.003***	-0.003***
	(0.002)	(0.002)	(0.001)	(0.001)
L.Cash holding	0.015	0.015	-0.005	-0.004
	(0.013)	(0.013)	(0.012)	(0.012)
Controls	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Obs	16,907	16,907	8,588	8,586
R^2	0.156	0.160	0.108	0.108

Standard errors in parentheses, clustered by firm and time

Table 5: Debt Issuance and Investment Activities: Firms w/ Low Prevalence of EBCs

This table presents firm-level annual panel regressions of debt issuance and investment activities on EBITDA:

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

The regressions are the same as those in Table 4. The outcome variable is net debt issuance. Results are presented for several groups not bound by EBCs. "Large w/o EBCs" is large firms without earnings-based covenants, which use cash flow-based lending but are generally far from the earnings-based constraints. "Small," "Low Margin," and "Air & Utilities" are small firms, low profit margin firms, and airlines and utilities which have low prevalence of cash flow-based lending and EBCs. Sample period is 1996 to 2015. Standard errors are clustered by firm and time.

Panel A. Net Debt Issuance

	Large w/o EBCs		Small		Low Margin		Air & Utilities	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
EBITDA	-0.059***	0.023	-0.019***	0.001	-0.025***	-0.001	-0.093**	-0.059
	(0.021)	(0.027)	(0.007)	(0.009)	(0.008)	(0.010)	(0.045)	(0.061)
OCF		-0.127***		-0.033***		-0.039***		-0.050
		(0.027)		(0.011)		(0.010)		(0.079)
Q	0.007***	0.007***	0.004***	0.004***	0.007***	0.007***	0.042**	0.044**
	(0.003)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.018)	(0.019)
Past 12m stock ret	0.001	0.001	0.002	0.002	0.003	0.003	0.003	0.002
	(0.004)	(0.004)	(0.002)	(0.002)	(0.002)	(0.002)	(0.010)	(0.010)
L.Cash holding	-0.048**	-0.042*	-0.055***	-0.059***	-0.071***	-0.076***	-0.109**	-0.130**
	(0.024)	(0.024)	(0.016)	(0.017)	(0.019)	(0.020)	(0.055)	(0.063)
Controls	Y	Y	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Obs	10,137	10,136	20,153	20,129	22,557	22,534	2,475	2,474
R^2	0.073	0.078	0.029	0.030	0.036	0.038	0.087	0.088

Standard errors in parentheses, clustered by firm and time

Panel B. CAPX Investment

	Large w/o EBCs		Small		Low Margin		Air & Utilities	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
EBITDA	0.053***	0.033*	0.001	-0.002	0.002	-0.004	0.079	0.025
	(0.012)	(0.019)	(0.004)	(0.004)	(0.005)	(0.004)	(0.049)	(0.046)
OCF		0.024**		0.005		0.011**		0.158***
		(0.011)		(0.004)		(0.005)		(0.038)
Q	0.004***	0.004***	0.006***	0.006***	0.006***	0.006***	0.029***	0.026***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.010)	(0.010)
Past 12m stock ret	0.006***	0.006***	0.004***	0.004***	0.004***	0.004***	0.007	0.006
	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.006)	(0.006)
L.Cash holding	-0.019*	-0.019*	0.005	0.006	0.002	0.003	-0.018	-0.004
	(0.011)	(0.011)	(0.006)	(0.006)	(0.005)	(0.005)	(0.056)	(0.056)
Controls	Y	Y	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Obs	10,683	10,681	21,249	21,222	24,045	24,020	2,535	2,534
R^2	0.107	0.108	0.043	0.043	0.046	0.047	0.122	0.144

Standard errors in parentheses, clustered by firm and time

Table 6: Changes in EBITDA: Accounting Natural Experiment

This table presents cross-sectional instrumental variable regressions:

$$Y_i^{06} = \alpha + \beta \widehat{\text{EBITDA}}_i^{06} + X_i'\gamma + \epsilon_i.$$

where EBITDA_i^{06} is EBITDA in fiscal year 2006 (normalized by beginning of year assets), and is instrumented with average option compensation expenses (Compustat XINTOPT, normalized by assets) in fiscal years 2002 to 2004. Control variables include sales and net cash receipts OCF (which are not affected by the rule change), as well as three lags of the outcome variable, EBITDA, annual stock returns, and the market equity to book equity ratio by 2004, along with all the control variables in Table 4 as of 2004. Industry (Fama-French 12 industries) fixed effects are included. Panel A presents the first stage. Panel B presents the IV results. In columns (1) to (3), Y is net debt issuance in fiscal 2006; in columns (4) and (6), Y is capital expenditures in fiscal 2006. Results are presented for large firms with earnings-based covenants ("Large w/ EBCs"), large firms without earnings-based covenants ("Large w/o EBCs"), and small firms ("Small"). Robust standard errors in parentheses.

Panel A. First Stage

	EBITDA_i^{06}		
	Large w/ EBCs	Large w/o EBCs	Small
	(1)	(2)	(3)
Avg. option comp expense 02-04	-0.857***	-0.721***	-0.520**
	(0.212)	(0.134)	(0.208)
Controls	Y	Y	Y
Obs	686	435	727

Standard errors in parentheses

Panel B. IV

	Net Debt Issuance			CAPX		
	Large w/ EBCs	Large w/o EBCs	Small	Large w/ EBCs	Large w/o EBCs	Small
	(1)	(2)	(3)	(4)	(5)	(6)
$\widehat{\text{EBITDA}}_i^{06}$	0.869**	-0.327	0.225	0.497**	0.014	0.002
	(0.451)	(0.344)	(0.366)	(0.225)	(0.169)	(0.136)
1st stage F	16.39	23.42	9.08	16.39	23.42	9.08
Controls	Y	Y	Y	Y	Y	Y
Obs	686	435	727	686	435	727

Standard errors in parentheses

Table 7: Summary Statistics: Firm Real Estate Value

This table presents summary statistics of firms in the samples with market value of real estate measures. The column labeled "Method 1" refers to the sample where market value of real estate estimates are available using Method 1 described in Section 4.2 and Appendix E, which follows the traditional procedure (Chaney, Sraer, and Thesmar, 2012). The column labeled "Method 2" refers to the sample where market value of real estate estimates are available using Method 2 described in Section 4.2 and Appendix E, which uses hand-collected information from 10-K filings. The column labeled "All w/ RE" includes all non-financial firms with non-zero real estate holdings. Panel A displays statistics for the period 2003 to 2015 (sample period in Table 8), for which we have firm-level measures of asset-based and cash flow-based lending. Panel B displays additional statistics for the Great Recession period of 2007 to 2009. $\Delta \text{RE}_{06}^{07-09}/\text{assets}_{06}$ is the gain/loss on 2006 real estate holdings during the crisis, normalized by assets in 2006. $\Delta P^{07-09}(\text{HQ})$ is the percentage change in property price index in headquarters CBSA from 2007 to 2009. The remaining statistics are changes in EBITDA, net debt issuance, and capital expenditures between 2007 and 2009, normalized by assets in 2006.

	Sample		
	Method 1	Method 2	All w/ RE
	Panel A. 2003—2015		
Real estate (market value)/assets	0.21	0.13	-
Real estate (market value)/market cap	0.21	0.12	-
PPE/assets	0.25	0.21	0.25
EBITDA/l.assets	0.14	0.13	0.12
Q	1.15	1.14	1.10
Debt/assets	0.22	0.19	0.24
Log book assets	7.08	6.30	6.84
Asset-based lending/debt	0.12	0.25	0.22
Cash flow-based lending/debt	0.85	0.66	0.74
Asset-based lending/assets	0.02	0.02	0.03
Cash flow-based lending/assets	0.16	0.09	0.14
Net debt issuance/l.assets	0.00	0.00	0.00
CAPX/l.assets	0.04	0.04	0.04
Fraction of large firms	0.76	0.63	0.71
Fraction w/ earnings-based covenants	0.60	0.55	0.56
	Panel B. 2007—2009		
$\Delta \text{RE}_{06}^{07-09}/\text{assets}_{06}$	-0.01	-0.01	-
$\Delta P^{07-09}(\text{HQ})$	-0.07	-0.08	-0.07
$\Delta \text{EBITDA}_{06}^{07-09}/\text{assets}_{06}$	-0.02	-0.01	-0.01
$\Delta \text{Net Debt Issuance}_{06}^{07-09}/\text{assets}_{06}$	0.00	0.00	0.00
$\Delta \text{CAPX}_{06}^{07-09}/\text{assets}_{06}$	-0.01	-0.01	-0.01

Table 8: Corporate Borrowing and Real Estate Value

This table presents firm-level panel regressions of debt issuance on real estate value:

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

The outcome variable Y_{it} is net debt issuance in columns (1) and (2), the change in asset-based debt outstanding in columns (3) and (4), the change in cash flow-based debt outstanding in columns (5) and (6), and capital expenditures in columns (7) and (8), all normalized by beginning-of-year assets. The main independent variable is RE_{it}, which is beginning-of-year market value of real estate calculated using two methods described in Section 4.2 and Appendix E. Other independent variables include EBITDA and net cash receipts OCF in year t, Q, cash holdings, book leverage, inventory, receivable, and size (log book assets) at the beginning of year t. Firm fixed effects and year fixed effects are included (R^2 does not include fixed effects). Panel A presents results for all firms where market value of real estate estimates are available. Panel B restricts to the subsample with firms in tradable industries only. Sample period is 2003 to 2015. Standard errors are clustered by firm and time.

Panel A. All Sample Firms

	Net Debt Issuance		ΔAsset-Based		ΔCash Flow-Based		CAPX	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
RE (Method 1)	0.030**		0.042**		-0.007		0.035***	
	(0.014)		(0.021)		(0.022)		(0.009)	
RE (Method 2)		0.029**		0.030**		-0.002		0.011
		(0.014)		(0.016)		(0.026)		(0.008)
EBITDA	0.216***	0.173***	0.151***	0.105***	0.130*	0.093***	0.062***	0.081***
	(0.053)	(0.029)	(0.040)	(0.031)	(0.069)	(0.035)	(0.015)	(0.020)
OCF	-0.157***	-0.194***	-0.120***	-0.152***	-0.088**	-0.072	0.003	-0.020
	(0.035)	(0.043)	(0.025)	(0.030)	(0.038)	(0.047)	(0.010)	(0.013)
Q	0.011**	0.014***	-0.004	0.000	0.006	0.015***	0.008***	0.010***
	(0.005)	(0.005)	(0.002)	(0.004)	(0.006)	(0.005)	(0.002)	(0.001)
L.Cash holding	-0.095***	-0.073***	-0.075***	-0.044**	0.012	-0.019	0.039***	0.023***
	(0.027)	(0.021)	(0.027)	(0.022)	(0.032)	(0.035)	(0.014)	(0.007)
Controls	Y	Y	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Obs	4,999	4,551	4,999	4,551	4,999	4,551	4,999	4,551
R^2	0.116	0.120	0.196	0.217	0.193	0.244	0.103	0.105

Standard errors in parentheses, clustered by firm and time

Panel B. Tradable Firms Only

	Net Debt Issuance		ΔAsset-Based		ΔCash Flow-Based		CAPX	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
RE (Method 1)	0.024		0.060**		-0.090***		0.023*	
	(0.031)		(0.030)		(0.027)		(0.013)	
RE (Method 2)		0.063**		0.075*		-0.003		0.006
		(0.031)		(0.040)		(0.022)		(0.010)
EBITDA	0.182***	0.136***	0.119***	0.065**	0.121*	0.109**	0.063***	0.077***
	(0.055)	(0.043)	(0.046)	(0.033)	(0.071)	(0.050)	(0.021)	(0.025)
OCF	-0.155***	-0.170***	-0.109***	-0.141***	-0.097**	-0.089*	-0.014	-0.029*
	(0.035)	(0.045)	(0.039)	(0.035)	(0.047)	(0.048)	(0.015)	(0.016)
Q	0.006	0.016**	-0.005*	0.003	0.002	0.013	0.005***	0.008***
	(0.005)	(0.007)	(0.003)	(0.003)	(0.008)	(0.008)	(0.002)	(0.002)
L.Cash holding	-0.047	-0.074***	-0.081***	-0.063**	0.040	-0.020	0.047***	0.025***
	(0.038)	(0.027)	(0.030)	(0.029)	(0.040)	(0.036)	(0.016)	(0.010)
Controls	Y	Y	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Obs	3,174	2,820	3,174	2,820	3,174	2,820	3,174	2,820
R^2	0.111	0.122	0.212	0.234	0.211	0.195	0.091	0.106

Standard errors in parentheses, clustered by firm and time

Table 9: Firm Outcomes and EBITDA: US vs. Japan

This table shows a comparison of the sensitivity of firm outcomes to EBITDA in US and Japan. Panel A presents summary statistics of the US and Japan samples. The samples cover all large non-financial firms in US and Japan (book assets above Compustat median in the respective country). Panel B presents firm-level annual regressions of debt issuance and investment activities on EBITDA:

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

The independent variables are the same as those in Table 4. The outcome variable Y_{it} includes the change in book debt as well as capital expenditures in year t, normalized by assets at the end of year $t-1$. Here we do not use net debt issuance from the statement of cash flows because it is not available for Japan. 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. Summary Statistics

	US					Japan				
Variables	p25	p50	p75	mean	N	p25	p50	p75	mean	N
Log book assets	6.20	7.06	8.19	7.30	28,840	6.34	6.93	7.83	7.25	20,567
Log market cap	5.97	6.97	8.09	7.06	28,840	5.23	6.06	7.16	6.28	20,567
EBITDA	52.83	153.91	493.51	789.55	28,840	37.11	79.89	216.46	357.67	20,567
EBITDA/l.assets	0.08	0.13	0.19	0.13	28,840	0.05	0.08	0.11	0.08	20,567
EBITDA/sales	0.08	0.14	0.22	0.06	28,840	0.04	0.08	0.12	0.09	20,567
Debt/EBITDA	0.47	1.78	3.53	2.10	28,840	0.74	2.51	5.49	4.40	20,567
Debt/assets	0.10	0.26	0.39	0.27	28,840	0.07	0.20	0.35	0.23	20,567
Q	0.80	1.12	1.70	1.46	28,840	0.50	0.66	0.85	0.74	20,567
MTB	1.20	1.94	3.18	2.62	28,840	0.66	0.97	1.45	1.21	20,567
OCF/l.assets	0.07	0.12	0.16	0.12	28,822	0.03	0.06	0.09	0.06	20,491
Cash/assets	0.02	0.07	0.19	0.14	28,840	0.07	0.12	0.19	0.14	20,567
PPE/assets	0.11	0.24	0.46	0.31	28,840	0.20	0.30	0.41	0.32	20,567
Inventory/assets	0.01	0.07	0.17	0.11	28,840	0.06	0.11	0.16	0.12	20,567
Receivable/assets	0.06	0.12	0.19	0.14	28,840	0.14	0.21	0.29	0.23	20,567
Intangible/assets	0.03	0.13	0.30	0.19	28,840	0.00	0.01	0.02	0.02	20,567
ΔBook debt/l.assets	-0.02	0.00	0.05	0.03	28,783	-0.02	0.00	0.01	0.00	20,438
CAPX/l.assets	0.02	0.04	0.07	0.06	28,680	0.02	0.03	0.05	0.04	20,195

Panel B. Results

	ΔTotal Book Debt				CAPX			
	US Large NF		JPN Large NF		US Large NF		JPN Large NF	
EBITDA	0.160***	0.283***	-0.178***	-0.022	0.099***	0.078***	0.037***	0.017
	(0.028)	(0.025)	(0.021)	(0.016)	(0.011)	(0.012)	(0.012)	(0.011)
OCF		-0.194***		-0.329***		0.038***		0.020**
		(0.030)		(0.020)		(0.008)		(0.010)
Q	0.003*	0.003*	0.013***	0.011***	0.006***	0.006***	0.008***	0.008***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)
Past 12m stock ret	0.003	0.003	-0.004***	-0.004***	0.005***	0.005***	-0.001	-0.001
	(0.003)	(0.003)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)
L.Cash holding	0.020	0.023	-0.072***	-0.081***	0.013*	0.014*	-0.012	-0.012
	(0.028)	(0.028)	(0.016)	(0.017)	(0.007)	(0.008)	(0.008)	(0.007)
Controls	Y	Y	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Obs	27,936	27,919	20,422	20,338	27,982	27,980	20,176	20,086
R^2	0.116	0.123	0.112	0.169	0.129	0.131	0.071	0.070

Standard errors in parentheses, clustered by firm and time

Table 10: Property Price Collapse and Firm Investment: US vs. Japan

This table compares results in Gan (2007)'s analysis of Japanese firms during Japan's property price collapse and similar specifications using US firms during the Great Recession. The specification follows Table 2 column (2) of Gan (2007):

$$\text{CAPX}_i^{post} = \alpha + \beta \text{RE}_i^{pre} + X_i'\gamma + v_i.$$

CAPX_i^{post} is firm i's average annual investment rate (CAPX normalized by assets) over a period of time during the property price collapse, and the period is labeled in row "Outcome Period." RE_i^{pre} is firm i's real estate holdings prior to the collapse (normalized by pre-collapse assets). Gan (2007) uses the estimated market value of land holdings in 1989. In the US sample, we use the market value of real estate in 2006 measured using the two methods described in Section 4.2 and Appendix E. Controls X_i include cash flows (contemporaneous with the investment variable), as well as Q, cash holdings and book leverage (measured prior to the outcome variable). The regression also follows Gan (2007) and includes a dummy variable that is equal to one if the firm's pre-collapse real estate holdings fall into the top industry quartile, and interactions of this dummy with cash flows and cash holdings. Gan (2007) uses least absolute deviation (LAD) estimate, and we report both OLS and LAD estimates.

	CAPX Investment						
	Japan (Gan 07)	US					
Outcome Period	1994–1998	2007–2009		2007–2011		2009–2013	
Specification	LAD	OLS	LAD	OLS	LAD	OLS	LAD
RE 1989	-0.165***						
	(0.016)						
RE 2006	-	0.007	0.014	-0.001	0.007	-0.01	0.004
Method 1	-	(0.009)	(0.008)	(0.008)	(0.005)	(0.009)	(0.004)
RE 2006	-	0.007	0.002	0.008	0.005	-0.005	-0.004
Method 2	-	(0.007)	(0.004)	(0.007)	(0.005)	(0.005)	(0.005)

Standard errors in parentheses

Supplementary Appendix

A Asset-Based Lending and Cash Flow-Based Lending

In this appendix, we explain in detail the categorization of asset-based lending and cash flow-based lending. We first lay out the main types of debt in each category. We then describe our categorization procedure in the aggregate and at the firm level.[31]

Asset-Based Lending

The main components of asset-based lending are commercial mortgages and business loans backed by specific assets (often referred to as asset-based loans) such as equipment, inventory, accounts receivable, etc. We also include capital leases (explained below).

1. Commercial mortgages

   Commercial mortgages are corporate debt backed by real estate. The collateral is typically commercial real estate, mostly office buildings and sometimes retail properties like shopping malls and hotels. Very small firms may also use residential mortgages.

2. Asset-based loans

   Asset-based loans are business (non-mortgage) loans backed by specific assets such as equipment, inventory, receivable, oil and gas reserves, etc. Asset-based loans often specify a "borrowing base," calculated based on the liquidation value of eligible collateral. Creditors regularly monitor the borrowing base and require that the loan size cannot exceed a fraction of the borrowing base. Asset-based loans can be originated by banks, commonly in the form of secured revolving lines of credit ("revolvers"), as well as by finance companies that specialize in lending against specific types of assets. We include receivable factoring in asset-based loans.

3. Capital leases

   In a capital lease, the lessee is likely to have ultimate ownership of the leased asset (e.g., buy the asset at the end of the lease), and therefore assumes the risks associated with ownership (e.g., price fluctuations of the asset) and also enjoys some benefits of ownership (e.g., more control over the asset). In this case, the leased asset shows up on the asset side of the lessee's balance sheet, and the lease shows up on the liability side. Since capital leases are often treated as debt (Compustat includes capital leases as part of the debt variable), and the lessee can be the effective owner, we include them in our classification.[32] A well known example of capital lease is used in aircraft financing and studied in Benmelech and Bergman (2011). In this case, a trust (often sponsored

[31] In the categorization, we do not include commercial papers, which are short-term debt for liquidity purposes. In the aggregate, commercial papers account for about 3% of US non-financial corporate debt by value, so the impact of this exclusion is small.

[32] Another type of lease is operating lease (e.g., normal rent), where the lessee is unlikely to have effective ownership of the asset. Because the lessee does not have ownership and is not exposed to the value of the asset, we do not include operating leases as part of debt.

by an airline) purchases the aircraft, leases it to the airline (who would take over the aircraft ownership at the end of the lease), and finances the purchase by issuing notes backed by the aircraft. Because the financing of assets in capital leases is generally tied to the assets' liquidation value, we categorize capital leases as asset-based lending. As the size of this portion is relatively small (about $70 billion among Compustat firms), in the following we merge capital leases with asset-based loans.

Cash Flow-Based Lending

There are two main components of cash flow-based lending: corporate bonds and cash flow-based loans.

1. Corporate bonds

   Corporate bonds are generally backed by borrowers' cash flow value. FISD data shows that in recent periods about 1% of US non-financial corporate bond issuance by value is asset-based (asset-backed bonds, industrial revenue bonds, or other bonds against physical assets such as equipment and real estate). About 10% of bond issuance by value is secured and most secured bonds are cash flow-based (e.g., secured by liens on the corporate entity).

2. Cash flow-based loans

   Cash flow-based loans comprise of commercial loans that are primarily backed by borrowers' cash flows. They do not use specific assets as collateral. Rather, the collateral (if secured) is typically a lien on the entire corporate entity ("substantially all assets"), and collateral value is calculated based on the borrower's going-concern cash flow value. Creditors perform detailed cash flow analyses, and closely monitor borrowers' cash flows. These loans use earnings-based covenants extensively. Term loans in syndicated loans are prototypical cash flow-based loans.

   Revolving lines of credit ("revolvers") can belong to cash flow-based lending as well as asset-based lending. Some revolvers are not backed by specific assets and fit into cash flow-based lending. Other revolvers are secured by inventory, receivables, etc. and fall into asset-based loans as discussed above.[33]

A.1 Aggregate Composition

In the following, we estimate the share of asset-based lending and cash flow-based lending among aggregate US non-financial corporate debt outstanding. Here we primarily rely on aggregate sources, so the estimates are not confined to public firms.

Asset-Based Lending: Around 20% of Debt Outstanding

1. Commercial mortgages

[33]However, due to institutional reasons, asset-based revolvers in syndicated loans are often bundled with prototypical cash flow-based loans (e.g., term loans) into a single package, and share the earnings-based covenants.

- Share in total non-financial debt outstanding: 7%.
- Data sources: Flow of Funds.
- Calculation: We use commercial mortgages outstanding from the Flow of Funds, which is around $0.6 trillion.

2. Asset-based loans:
   - Share in total non-financial debt outstanding: 13%.
   - Data sources: DealScan, ABL Advisor, Shared National Credit Program (SNC), Small Business Administration (SBA), Flow of Funds, Compustat.
   - Calculation: We first estimate asset-based loans to large firms. For this part, we focus on the portion of large commercial loans (such as syndicated loans) that are asset-based, using data from DealScan, ABL advisor, SNC, and Flow of Funds. We proceed in two steps. We first estimate the share of asset-based loans in large commercial loans, using loan issuance data from DealScan and ABL Advisor. In particular, ABL Advisor reports the volume of issuance in DealScan that can be classified as asset-based loans. We can compare this value to total loan issuance in DealScan. We can alternatively directly calculate using DealScan data the share of loan issuance with asset-based provisions (i.e., borrowing base requirements), and the results are very similar. The estimated share of asset based-based loans is about 5% (annual syndicated loan issuance is $1,500B to $2,000B, of which $60B to $100B is asset-based). We then turn to the amount of syndicated loans outstanding from the SNC report (amount outstanding is not available in DealScan), which is about $2.1 trillion. Taken together, outstanding asset-based loans from syndicated loans are about $0.11 trillion.

     We then estimate asset-based loans to small businesses. For this part, we use outstanding loans to small businesses compiled by the SBA based on Call Reports. These are loans under $1 million, and we categorize all small business lending as asset-based loans to be conservative. A small fraction of small business lending can also be cash flow-based loans, but detailed loan-level information is difficult to get and we take a conservative approach. Loans outstanding to small businesses total about $0.6 trillion.[34]

     For asset-based debt originated by finance companies, we use the Flow of Funds data and estimate the outstanding amount to be about $0.3 trillion.

     For capital leases, the total amount in Compustat non-financial firms is around $70 billion, and we estimate the total amount in all non-financial firms to be around $0.1 trillion.

     Putting these parts together, we get an estimate of asset-based loans of around $1.1 trillion. There may be some commercial loans to medium-sized firms missing

[34] See the Small Business Administration report "Small Business Lending in the United States." Data from the Community Reinvestment Act covers new origination of small business loans (not amount outstanding), which total about 0.2 trillion per year.

(not covered by SNC/DealScan and finance company loans, but not necessarily small business loans), which could lead to potential under-estimation. At the same time, the small business loans can include loans to non-corporate entities (sole proprietorship, partnership) or some mortgages (i.e., overlap with the commercial mortgages category above), leading to potential over-estimation. Nonetheless, in either case the magnitude should be small.

Cash Flow-Based Lending: Around 80% of Debt Outstanding

1. Corporate bonds
   - Share in total non-financial corporate debt outstanding: 57%.
   - Data source: Flow of Funds, Fixed Income Securities Database (FISD), CapitalIQ.
   - Calculation: According to Flow of Funds data, corporate bonds outstanding by US non-financial firms is about $4.9 trillion. Based on FISD and CapitalIQ data, which provide more information on the structure of individual corporate bonds, only a small portion of corporate bonds are backed by specific assets (less than 2% by value). Thus in the aggregate, we categorize all corporate bonds into cash flow-based lending.
2. Cash flow-based loans
   - Share in total non-financial corporate debt outstanding: 23%.
   - Data sources: DealScan, ABL Advisor; SNC, Flow of Funds, S&P Leveraged Commentary & Data (LCD).
   - Calculation: We approximate the amount of cash flow-based loans using the cash flow-based portion of large commercial loans. We use the procedure described above: we find that around 5% of large commercial loans are asset-based and 95% are cash flow-based, and then multiply the share with the size of large commercial loans outstanding (roughly $2.1 trillion). We may miss cash flow-based loans of middle-sized firms due to lack of data coverage, which can lead to potential under-estimation.

Table A1: Summary of Asset-Based Lending and Cash Flow-Based Lending

Debt Type	Category	Amount ($ Tr)	Share
Commercial mortgages	Asset-based lending	$0.6	7%
Asset-based loans	Asset-based lending	$1.1	13%
Corporate bonds	Cash flow-based lending	$4.9	57%
Cash flow-based loans	Cash flow-based lending	$2.0	23%

A.2 Firm-Level Composition

We now explain the firm-level categorization of asset-based lending and cash flow-based lending, using debt-level data for non-financial firms in CapitalIQ.

We begin with debt-level information from CapitalIQ, available since 2003. For each debt, CapitalIQ provides information about the amount outstanding, together with detailed descriptions of the debt (e.g., debt type, collateral structure, lender, etc.). CapitalIQ is very helpful because it covers all types of debt and tracks the amount outstanding for each debt in each firm-year, which facilitates a comprehensive analysis. CapitalIQ assembles these data from various filings. It covers about 80% of Compustat firms and 90% of debt by value in Compustat. The total debt value for each firm matches well based on CapitalIQ data and Compustat data. We supplement information from CapitalIQ with additional information on debt attributes from DealScan, FISD, and SDC Platinum. We examine non-financial firms, which have SIC codes outside of 6000 to 6999.

We categorize firms' debt into four groups: 1) asset-based lending, 2) cash flow-based lending, 3) personal loans, 4) miscellaneous and unclassified borrowing. We proceed in several steps:

1. We classify a debt as asset-based lending if
    - the debt information contains the following key words (and their variants): asset-based, ABL, borrowing base, mortgage, real estate/building, equipment, machine, fixed asset, receivable, inventory, working capital, automobile/vehicle, aircraft, capital lease, SBA/small business, oil/drill/rig, reserve-based, factoring, industrial revenue bond, finance company, capital lease, construction, project finance;
    - it is a secured revolver.
2. We classify a debt as personal loan if
    - the lender is an individual (Mr./Ms., etc);
    - it is from directors/executive/chairman/founder/shareholders/related parties.
3. We also assign a debt to the miscellaneous/unclassified category if it is
    - borrowing from governments or a pollution control bond;
    - insurance-related borrowing, or borrowing from vendor/seller/supplier/landlord;
    - borrowing from affiliated companies.
4. We classify a debt as cash flow-based lending if it **does not belong to any of the categories above** and
    - it explicitly says "cash flow-based"/"cash flow loan";
    - it is unsecured, is a "debenture", or is secured by "substantially all assets";
    - it contains the following key words and their variants, which are representative of cash flow-based loans: first lien/second lien/third lien, term facility/term loan facility/term loan a, b, c..., syndicated, tranche, acquisition line, bridge loan;

- it is a bond or it contains standard key words for bonds, such as senior subordinated, senior notes, x% notes due, private placement, medium term notes;
- it is a convertible bond.

5. We assign all remaining secured debt to asset-based lending to be conservative.

In Table 1, we show the median firm-level share of asset-based and cash flow-based lending. In Table 2, we show that the amount of asset-based lending a firm has is positively correlated with the amount of physical assets, while the amount of cash flow-based lending is not (and instead generally negatively correlated with physical assets). The results confirm that cash flow-based lending does not appear to depend on the value of physical assets.

B Legal Institutions and Cash Flow-Based Lending around the World

As discussed in Section 2.3, legal institutions for corporate bankruptcy resolution can be important for the prevalence of asset-based versus cash flow-based lending. In countries where the corporate bankruptcy system emphasizes reorganization instead of liquidation, cash flow-based lending is likely to be more common.

We are able to construct a rough estimate of the amount of asset-based and cash flow-based debt for Compustat non-financial firms in over 50 countries (non-financial firms are those with SIC codes outside of 6000 to 6999). We use debt-level data from CapitalIQ and follow the same categorization algorithm in Appendix A.2. We use the same procedure in all countries to maintain consistency and restrict degrees of freedom, although some assumptions in the estimation may ideally change based on the country's institutional setting.[35] For foreign firms, CapitalIQ sometimes has less detailed information, so the estimates can be less precise than our results for the US. The data covers 2003 to 2015.

For legal institutions, we use data on default resolution across 88 countries collected by Djankov et al. (2008). Djankov et al. (2008) present a hypothetical bankruptcy case of a hotel called Mirage to legal professionals in each country, and ask them to assess the outcome based on the legal regime around 2006. The case assumes that the firm value is higher as a going concern than if it is liquidated piecemeal. A dummy variable "reorganization" takes value one if legal professionals in a country think Mirage is most likely to be reorganized.

For each country-year, we calculate the total share of cash flow-based lending (cash flow-based debt of all firms in the sample divided by their total debt), the median firm-level share of cash flow-based lending, and the median firm-level share among large firms (book assets above Compustat median in each country-year). Table A2 Panel A shows the average values among countries where the reorganization dummy is one versus countries where it is zero.

[35] For instance, while in the US we assume corporate bonds are largely cash flow-based, in liquidation-focused countries this may not hold.

Panel B shows regression results of cash flow-based lending shares on the reorganization dummy, controlling for year fixed effects and real log GDP per capita (in dollars).

We see that in countries where the firm is likely to be reorganized rather than liquidated, there tends to be a higher prevalence of cash flow-based lending. We note three reasons that can weaken the result in our data. First, large public firms can be less affected by the legal regimes in their home countries. For instance, large firms in other countries often prefer to issue debt under US laws, through US subsidiaries, and utilize Chapter 11 in US courts for default resolution (see a detailed example of the Dutch chemical company LyondellBasell in Gilson (2012)). This would weaken the link between their debt composition and legal institutions in their home countries. In general, our data is restricted to Compustat firms, and variations among these firms can be smaller. Second, we follow the same categorization algorithm in all countries to maintain consistency, but some debt classes that are typically cash flow-based in the US (e.g., bonds) may not be so in liquidation-focused countries. Third, the data on legal institutions from Djankov et al. (2008) is a one-time snapshot. A number of countries go through bankruptcy law reforms over time, so there can be measurement error in the independent variable. Despite these potential complications that bias against our tests, Table A2 shows that we still observe a significant relationship between legal institutions and the prevalence of cash flow-based lending.

Table A2: Legal Environment and Corporate Debt Composition across Countries (Compustat Firms)

The outcome variable is the total share of cash flow-based lending (cash flow-based debt of all firms in a country-year divided by their total debt) in column (1), the median firm-level share of cash flow-based lending (in each country-year), and the median share among large firms (assets above Compustat median in each country-year). Panel A shows the mean of each variable for countries where the reorganization dummy in Djankov et al. (2008) is one ("Yes") and zero ("No"). Panel B shows regression results on the reorganization dummy, controlling for log real GDP per capita in each country-year and time fixed effects. Each observation is a country-year. Standard errors are clustered by country and time. We exclude countries where there are less than 500 firm-level observations. Sample period is 2003 to 2015.

Panel A. Average Share of Cash Flow-Based Debt by Country Group

Reorganization	Total Share (1)	Median Firm-Level Share (2)	Median Firm-Level Share (Large Firms) (3)
Yes	0.66	0.35	0.53
No	0.56	0.22	0.34

Panel B. Share of Cash Flow-Based Debt and Legal Environment

	Total Share (1)	Median Firm-Level Share (2)	Median Firm-Level Share (Large Firms) (3)
Reorganization dummy	0.085**	0.121**	0.184***
	(0.037)	(0.052)	(0.062)
Log GDP per capita	0.058***	0.035	0.031
	(0.018)	(0.025)	(0.029)
Year FE	Yes	Yes	Yes
Obs	598	598	598
R^2	0.16	0.09	0.13

Standard errors in parentheses, clustered by country and time

C Earnings-Based Borrowing Constraints

C.1 Specifications of Earnings-Based Covenants

Table A3: Variants of Earnings-Based Covenants

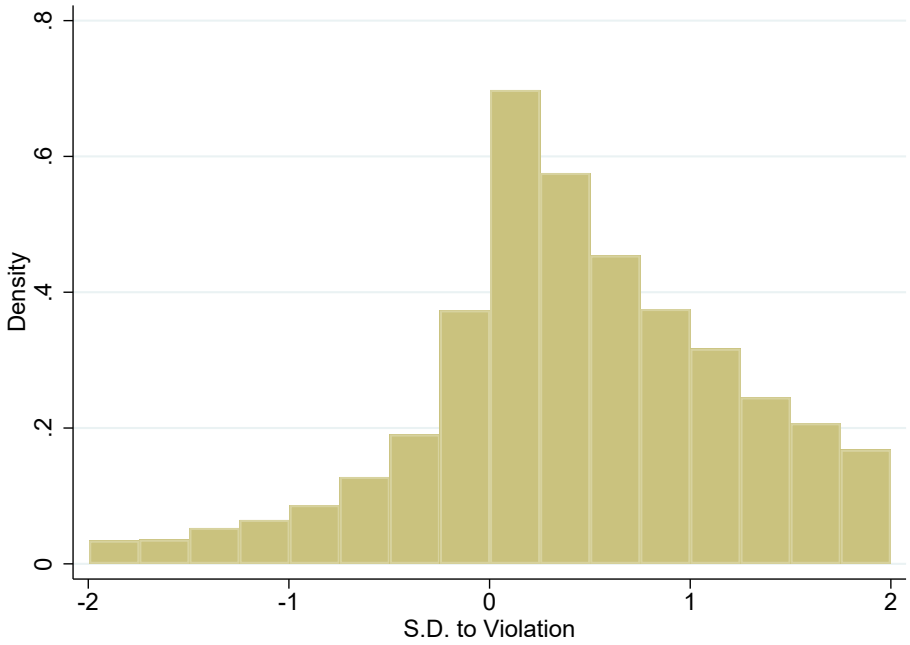
This table lists the main variants of earnings-based covenants and the construction using Compustat variables compiled by Demerjian and Owens (2016). The first column displays the covenant type, which is reported in DealScan data, and the second column describes the form of the covenant. The third column shows how to compute the metric used in each type of covenant using Compustat data. The fourth column tabulates the fraction of DealScan loans to US non-financial that have the specific type of covenant. The final column shows a check of the Compustat formula. For some types of covenants, the formula and details of the components may not be fully standardized across different debt contracts. Demerjian and Owens (2016) study a subset of DealScan loans where details of the covenant formula are provided by the Tearsheets dataset, and they calculate the frequency of cases where the Compustat formula listed is matches with details provided by the Tearsheets data.

Covenant Type	Standard definition	Compustat implementation	Fraction of loans	Exact match in Demerjian and Owens (2016)
Max. Debt to EBITDA	Debt/EBITDA	(DLTT+DLC)/EBITDA	29.7%	91.0%
Max. Senior Debt to EBITDA	Senior Debt/EBITDA	(DLTT+DLC–DS)/EBITDA	5.2%	89.4%
Min. Interest Coverage	EBITDA/Interest Expense	EBITDA/XINT	20.8%	76.3%
Min. Cash Interest Coverage	EBITDA/Interest Paid	EBITDA/INTPN	0.7%	76.8%
Min. Debt Service Coverage	EBITDA /(Interest Expense+ST Debt)	EBITDA/(XINT+L.DLC)	4.5%	37.9%
Min. Fixed Charge Coverage	EBITDA/(Interest Expense+ST Debt+Rent Expense)	EBITDA/(XINT+L.DLC+XRENT)	18.5%	2.7%
Min. EBITDA	EBITDA	EBITDA	5.0%	97.4%

C.2 Effect of Earnings-Based Covenants

Figure A1: Bunching around Earnings-Based Covenant Threshold

This plot shows the histogram of firm-year observations across bins that measure the distance to violating earnings-based loan covenants in DealScan data. As explained in Section 3.2, we first compute the minimum amount of earnings ($\underline{\pi}_{it}$) required such that the firm is in compliance with all of its earnings-based covenants (given the current level of debt and interest payments). We then compute the difference between the minimum earnings required ($\underline{\pi}_{it}$) and the actual earnings (π_{it}), scaled by lagged assets. We normalize this distance by the standard deviation of ROA in the firm's two-digit SIC industry. We take the firm-year observations that are within +/- 2 standard deviations, and group them into 20 equally spaced bins. Firms to the right of zero are in compliance with all earnings-based covenants in DealScan data. Firms to the left of zero are in violation of at least one such covenant.



C.3 Other Earnings-Based Constraints

This section provides more information about other forms of earnings-based borrowing constraints discussed in Section 3. As mentioned in Section 3, when a firm wants to raise debt, it can be hard to surpass a reference level of debt-to-EBITDA ratio. This type of credit market norms are most pronounced in the leveraged loan market (commercial loans to non-investment grade borrowers), and are especially relevant for non-investment grade firms.

Figure A2 below shows a time series of reference debt-to-EBITDA ratio in the leveraged loan market for large firms, using data from S&P Leveraged Commentary & Data (LCD). It is an indicator of the mean debt-to-EBITDA ratio lenders are willing to allow when large firms raise debt. Unlike financial covenants, this is primarily a market reference, and not legally binding. Nonetheless, to the extent that firms need to comply with such norms when they borrow, their debt-to-EBITDA ratio may end up being sensitive to the market norm.

Table A4 shows the sensitivity of firm-level debt to EBITDA to the reference level of debt

to EBITDA, based on a regression:

$$\text{Debt/EBITDA}_{it} = \alpha + \theta \text{Ref Debt/EBITDA}_t + X'_{it}\gamma + Z'_t\rho + v_{it}. \tag{A1}$$

where Debt/EBITDA_{it} is firm i's debt to EBITDA at time t, Ref Debt/EBITDA is the reference debt to EBITDA at time t (which LCD compiles based on the mean debt-to-EBITDA ratio of firms completing leveraged loan deals during period t), X_{it} is firm-level controls, and Z_t is macro controls including interest rates and business cycle proxies (credit spread, term spread, GDP growth). We show results for firms in different ratings categories: those just below the investment grade cut-off (BB+ and below), and those just above the investment grade cut-off (BBB- and above). We also show results separately for firms that primarily use cash flow-based debt (e.g., share of cash flow-based debt greater than 50%) and firms that do not.

Table A4: Sensitivity to Reference Debt/EBITDA

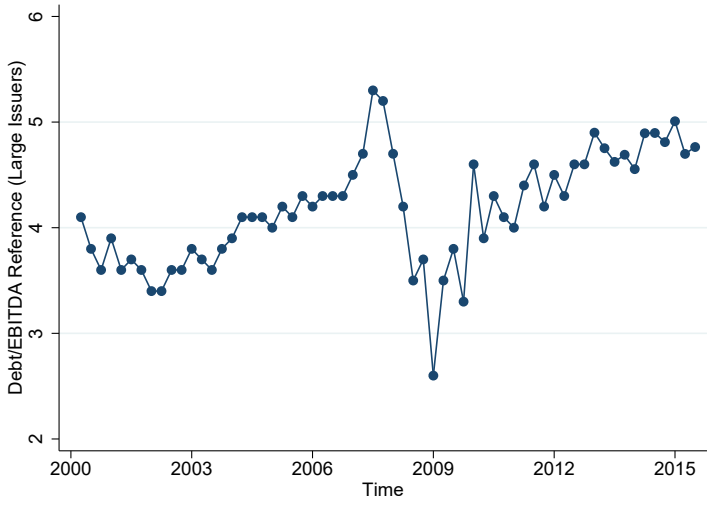
This table summarizes the regression coefficient θ from:

$$\text{Debt/EBITDA}_{it} = \alpha + \theta \text{Ref Debt/EBITDA}_t + X'_{it}\gamma + Z'_t\rho + v_{it}.$$

where Debt/EBITDA_{it} is firm i's debt to EBITDA at time t, Ref Debt/EBITDA is the reference debt to EBITDA at time t. Firm-level controls X_{it} include lagged debt/EBITDA, as well as Q, past 12 months stock returns, and book leverage (debt/assets), cash holdings, accounts receivable, inventory, PPE, size (log book assets) at the end of time $t-1$. Macro controls include term spread (spread between 10-year Treasury and 3-month Treasury), credit spreads (spread between BAA bond yield and 10-year Treasury yield, as well as spread between high yield bond yield and 10-year Treasury yield), and real GDP growth in the past 12 months. Observations with negative EBITDA are dropped (because debt/EBITDA is not well-defined in these cases). Standard errors are clustered by both firm and time.

	Non IG		IG		Share of Cash Flow-Based Debt	
	All BB	BB+	BBB-	All BBB	$> 50\%$	$< 50\%$
θ	0.433*	0.409*	0.269***	0.171**	0.202***	0.043
s.e.	(0.263)	(0.240)	(0.094)	(0.085)	(0.060)	(0.134)

Figure A2: Debt/EBITDA Reference Level for Large Corporate Issuers



D Definition of Main Firm-Level Variables

Variable	**Construction**	**Source**
Net debt issuance	(DLTIS-DLTR)/l.AT	Compustat
ΔLT book debt	(DLTT-l.DLTT)/l.AT	Compustat
ΔTotal book debt	(DLTT+DLC-l.DLTT-l.DLC)/l.AT	Compustat
Capital expenditure	CAPX/l.AT	Compustat
R&D spending	XRD/l.AT	Compustat
Operating earnings EBITDA	EBITDA/l.AT	Compustat
Net cash receipts OCF	(OANCF+XINT)/l.AT	Compustat
Q	(DLTT+DLC+PRC*SHROUT)/AT	CRSP, Compustat
Stock returns	RET	CRSP
Cash holding	CHE/AT	Compustat
Book leverage	(DLTT+DLC)/AT	Compustat
PPE	PPENT/AT	Compustat
Inventory	INVT/AT	Compustat
Receivable	RECT/AT	Compustat
Intangible	INTAN/AT	Compustat
Margin	EBITDA/SALE	Compustat
Size (log book assets)	Log(AT)	Compustat
Option compensation expense	XINTOPT/l.AT (available before fiscal year 2006)	Compustat
Firm age	# of years since min(incorporation year, IPO year), see Cloyne, Ferreira, Froemel, and Surico (2018)	Datastream (DATEOFINCORPORATION), Compustat (IPODATE)
W/ earnings-based covenants	With at least one earnings-based covenant from loans or bonds outstanding	Compustat, DealScan, FISD

Non-financial firms in Compustat are defined as firms with SIC codes outside of 6000 to 6999. US firms are those with country code (incorporation), namely Compustat variable FIC, being "USA." Japan firms are those with FIC being "JPN."

E Estimates of Market Value of Firm Real Estate

Because accounting data only reports the value of firm properties at historical cost, not market value, we need to estimate or collect additional data to know the market value of firm real estate. We use two methods described in detail below.

E.1 Method 1: Traditional Estimates

The first estimate we use builds on Chaney, Sraer, and Thesmar (2012). Firm real estate include buildings, land and improvements, and construction in progress. The steps to estimate market value are as follows:

1. We estimate the market value of firm real estate in 1993 RE_i^{93}. After 1993, the net book value and accumulated depreciation of real estate assets (buildings, land and improvements, and construction in progress) are no longer reported.

    - We calculate the net book value of firm real estate (sum of the net book value of buildings, land and improvements, and construction in progress). Net book value is equal to gross book value minus accumulated depreciation.
    - We estimate the average purchase year of firm real estate as in Chaney, Sraer, and Thesmar (2012). We compare accumulated depreciation and gross book value to estimate the fraction depreciated by 1993. Assuming linear depreciation and a 40 year depreciation horizon, we estimate the purchase year to be 1993 minus (percent depreciated times 40).
    - We estimate the market value in 1993 by inflating the net book value in 1993 (which is assumed to reflect the nominal value benchmarked to the purchase year) by the cumulative property price inflation between the purchase year and 1993. The cumulative property price inflation is calculated using state-level residential real estate index between 1975 and 1993 and CPI inflation before 1975 as in Chaney, Sraer, and Thesmar (2012).
    - If the book value of real estate or the net book value of PPE is zero in 1993, we enter zero as the market value of firm real estate in 1993.

2. We estimate the market value of firm real estate for each year after 1993.

    - Starting from 1994, we estimate the market value of firm real estate from two parts: appreciation of existing holdings and acquisition/disposition of holdings. Specifically we calculate $\text{RE}_{i,t+1}$ as $\text{RE}_{i,t} \times P_{it+1}/P_{it} \times 97.5\%$ (changes in the value of existing holdings) plus changes in the gross book value of real estate (net acquisitions), where P_{it} is the property price index in firm i's headquarters CBSA in year t and real estate is assumed to depreciate at 2.5% per year (again following a depreciation horizon of 40 years).
    - If in a given year, the firm's gross book value of real estate or net book value of PPE becomes zero, we assume the firm no longer owns real estate and reset the market value of real estate to zero.

    By using P_{it} as the property price index in firm i's headquarters location, this method assumes that most of the real estate owned by a firm is near its headquarters. The premise of this assumption is that corporate offices or properties near the headquarters

are the most common types of owned real estate. Chaney, Sraer, and Thesmar (2012) verify that this is not an unreasonable assumption. As discussed in Section 4.2, we also find this assumption to be plausible for most US non-financial firms.

E.2 Method 2: Property Information from Firm 10-K Filings

In US non-financial firms' 10-K filings (annual reports), Item 2 is called "Properties" where firms discuss property holdings and leases. A number of firms provide detailed information about the location, size, ownership, and usage of their properties.

For example, AVX Corporation's 2006 10-K filing provides the following table of properties in the US (AVX is a large international manufacturer of electronic connectors with 10,000 employees, headquartered in Myrtle Beach, SC):

Location	Size	Type of Interest	Usage
Myrtle Beach, SC	535,000	Owned	Manufacturing/Research/HQ
Myrtle Beach, SC	69,000	Owned	Office/Warehouse
Conway, SC	71,000	Owned	Manufacturing/Office
Biddeford, ME	73,000	Owned	Manufacturing
Colorado Springs, CO	15,000	Owned	Manufacturing
Atlanta, GA	49,000	Leased	Office/Warehouse
Olean, NY	113,000	Owned	Manufacturing
Raleigh, NC	203,000	Owned	Manufacturing
Sun Valley, CA	25,000	Leased	Manufacturing

For another example, Starbucks' 2006 10-K filing writes:

> The following table shows properties used by Starbucks in connection with its roasting and distribution operations:
>
> | Location | Size | Owned or Leased | Purpose |
> |---|---|---|---|
> | Kent, WA | 332,000 | Owned | Roasting and distribution |
> | Kent, WA | 402,000 | Leased | Warehouse |
> | Renton, WA | 125,000 | Leased | Warehouse |
> | York County, PA | 365,000 | Owned | Roasting and distribution |
> | York County, PA | 297,000 | Owned | Warehouse |
> | York County, PA | 42,000 | Leased | Warehouse |
> | Carson Valley, NV | 360,000 | Owned | Roasting and distribution |
> | Portland, OR | 80,000 | Leased | Warehouse |
> | Basildon, United Kingdom | 141,000 | Leased | Warehouse and distribution |
> | Amsterdam, Netherlands | 94,000 | Leased | Roasting and distribution |
>
> The Company leases approximately 1,000,000 square feet of office space and owns a 200,000 square foot office building in Seattle, Washington for corporate administrative purposes. As of October 1, 2006, Starbucks had more than 7,100 Company-operated retail stores, of which nearly all are located in leased premises. The Company also leases space in approximately 120 additional locations for regional, district and other administrative offices, training facilities and storage, not including certain seasonal retail storage locations.

For a final example, Microsoft's 2006 10-K filing writes:

> Our corporate offices consist of approximately 11.0 million square feet of office building space located in King County, Washington: 8.5 million square feet of

> owned space that is situated on approximately 500 acres of land we own in our corporate campus and approximately 2.5 million square feet of space we lease. We own approximately 533,000 square feet of office building space domestically (outside of the Puget Sound corporate campus) and lease many sites domestically totaling approximately 2.7 million square feet of office building space...We own 63 acres of land in Issaquah, Washington, which can accommodate 1.2 million square feet of office space and we have an agreement with the City of Redmond under which we may develop an additional 2.2 million square feet of facilities at our campus in Redmond, Washington.

We train assistants to read the 10-K filings and record the location, size, and usage for owned properties in the US; we also record whether the firm owns other properties for which these information are not available. We then match the properties with median property price per square footage in their respective counties using data from Zillow (we first try matching based on county, then city/metro area, and finally state if none of the previous matches were available). We use Zillow prices if the property is commercial or retail (e.g., offices, stores, restaurants, hotels, casinos). We multiply Zillow prices by 0.85 if the property is a mixture of manufacturing and office (often happens to headquarters of manufacturing firms), and by 0.7 if it is manufacturing (e.g., facilities, warehouses, distribution centers). For firms' owned land, we use state-level land price estimates.

F Borrowing Constraints and Financial Acceleration

This appendix analyzes how financial acceleration dynamics are influenced by the form of firms' borrowing constraints. We consider an environment similar to Kiyotaki and Moore (1997). We examine both traditional collateral constraints (a firm's borrowing capacity depends on the liquidation value of physical assets) as in the original study, and earnings-based constraints (a firm's borrowing capacity depends on a multiple of its earnings) analogous to the EBCs we document in Section 3. We compare the equilibrium impact of a shock to productive firms' internal funds (i.e., net worth) in these two settings.[36] The results show that earnings-based constraints lead to a more muted initial response in productive firms' capital and aggregate output.

F.1 Setup

Environment. The environment is similar to the baseline environment studied in Section 2 of Kiyotaki and Moore (1997). We maintain their assumptions about preferences, technologies, and markets. The only difference is that we introduce a non-zero depreciation rate of capital.[37] This modification guarantees the existence of steady states in environments with different borrowing constraints; it is not critical to the equilibrium dynamics in response to the shock per se.

We consider a discrete-time, infinite-horizon economy with two goods: a durable asset (land) and a nondurable commodity (fruit). The depreciation rate of land is δ and the total supply of land is $\bar{K}$. The fruit cannot be stored. There is a continuum of infinitely lived agents. Some are farmers and some are gatherers.

[36] This is the same shock considered by Kiyotaki and Moore (1997).

[37] Section 3 of Kiyotaki and Moore (1997) also introduces depreciation.

Farmers. There is a measure one of infinitely lived, risk neutral farmers. The expected utility of a farmer at date t is

$$E_t\left(\sum_{s=0}^{+\infty}\beta^s x_{t+s}\right),$$

where x_{t+s} is her consumption of fruits at date $t+s$, and $\beta \in (0,1)$ is her discount rate. Each farmer takes one period to produce fruits from the land she holds, with the following constant returns to scale production function:

$$y_{t+1} = F(k_t) = (a+c)\,k_t,$$

where k_t is the farmer's holding of land at the end of period t, ak_t is the portion of the output that is tradable, while the rest, ck_t, is non-tradable and can only be consumed by the farmer. Similar to Assumption 2 in Kiyotaki and Moore (1997), we assume c is large enough so that, in equilibrium, farmers will not want to consume more than the non-tradable portion of the fruits and invest all their funds in land. Finally, we use K_t to denote the aggregate land holding of farmers.

Gatherers. There is a measure one of infinitely lived, risk neutral gathers.[38] The expected utility of a gatherer at date t is

$$E_t\left(\sum_{s=0}^{+\infty}\left(\beta'\right)^s x'_{t+s}\right),$$

where x'_{t+s} is his consumption of fruits at date $t+s$ and $\beta' \in (0,1)$ is his discount rate. We assume $\beta' > \beta$ so that in equilibrium farmers always borrow up to the maximum and do not want to postpone production, because they are relatively impatient.

Each gatherer has an identical production function that exhibits decreasing returns to scale: an input of k'_t land at date t yields y'_{t+1} tradable fruits at date $t+1$, according to

$$y'_{t+1} = G\left(k'_t\right),$$

where $G' > 0$, $G'' < 0$ and $G'(0) > aR > G'\left(\bar{K}\right)$. The last two inequalities are included to ensure that both farmers and gatherers are producing in the neighborhood of a steady-state equilibrium. Finally, we use $K'_t = \bar{K} - K_t$ to denote the aggregate land holding of gatherers.

Markets. At each date t, there is a competitive spot market in which land is exchanged for fruits at price q_t.[39] The only other market is a one-period credit market in which one unit of fruit at date t can be exchanged for a claim to R_t units of fruits at date $t+1$. In equilibrium, as farmers are more impatient, they borrow from gatherers up to their borrowing constraints, and the rate of interest is always determined by gatherers' time preferences: $R_t = \frac{1}{\beta'} = R$.

Each farmer and each gatherer's flow-of-funds constraint in each period t can then be summarized as

$$\begin{aligned} q_t\left(k_t - (1-\delta)\,k_{t-1}\right) + Rb_{t-1} + x_t - ck_{t-1} &= ak_{t-1} + b_t, \\ q_t\left(k'_t - (1-\delta)\,k'_{t-1}\right) + Rb'_{t-1} + x'_t &= G\left(k'_{t-1}\right) + b'_t, \end{aligned}$$

[38] In Kiyotaki and Moore (1997), there is a measure m of gatherer. For simplicity, we consider the case with $m = 1$.

[39] Fruits are the numeraire throughout.

where b_t and $b_t^{'}$ are the amount of debt borrowed by the farmer and the gatherer at period t.

Equilibrium Concept. Same as Kiyotaki and Moore (1997), we consider perfect-foresight equilibria in which, without unanticipated shocks, the expectations of future variables get realized. We then consider the equilibrium effect of a shock to farmers' net worth in the steady state (characterized later) and its transmission. As in Kiyotaki and Moore (1997), this shock is driven by an unexpected temporary aggregate shock to farmers' productivity.

Capital Prices and User Costs. As the gatherer is not credit constrained, his demand for land is determined so the present value of the marginal product of land is equal to the opportunity cost, or user cost, of holding land, $u_t = q_t - (1-\delta)\, q_{t+1}/R$:

$$\frac{1}{R}G'\left(k_t^{'}\right) = \frac{1}{R}G'\left(K_t^{'}\right) = u_t,$$

where the symmetric concave production function guarantees that each gatherer holds the same amount of land. Ruling out exploding bubbles in the land price as in Kiyotaki and Moore (1997), one can then express the land price as the present value of user costs,

$$q_t = \sum_{s=0}^{+\infty}\left(\frac{1-\delta}{R}\right)^s u\left(K_{t+s}\right) = u\left(K_t\right) + \frac{(1-\delta)}{R}q_{t+1}, \tag{A2}$$

where $u\left(K_t\right) \triangleq \frac{1}{R}G'\left(\bar{K} - K_t\right) = u_t$ expresses the user cost in each period as an increasing function of *farmers'* aggregate land holding. The user cost is increasing in farmers' land holding because if farmers hold more land, gatherers hold less land and farmers' marginal productivity of land is higher. From the perspective of *farmers*, the above expression can be viewed as the capital supply curve they face. An increase in q_t or a decrease in q_{t+1} will increase the user cost of land, and increase the amount of land gatherers "supply" to farmers. Log-linearizing around the steady state, we can express the above supply curve as

$$\hat{q}_t = \frac{1}{\eta}\frac{\frac{1-\delta}{R}-1}{\frac{1-\delta}{R}}\hat{K}_t + \frac{\frac{1-\delta}{R}-1}{\left(\frac{1-\delta}{R}\right)^2}\hat{q}_{t+1} = \frac{1}{\eta}\frac{\frac{1-\delta}{R}-1}{\frac{1-\delta}{R}}\sum_{s=0}^{+\infty}\left(\frac{1-\delta}{R}\right)^{-s}\hat{K}_{t+s}, \tag{A3}$$

where, for any variable X, $\hat{X}$ denotes the log-deviation from the steady state and η denotes the elasticity of the residual supply of land to farmers, with respect to the user cost at the steady state.

F.2 Collateral-Based Constraints

In this part, we follow Kiyotaki and Moore (1997) and study the equilibrium impact of an aggregate shock to farmers' net worth under conventional collateral-based constraints.

Collateral-Based Constraints. Similar to Kiyotaki and Moore (1997), in period t, if the farmer has land k_t then she can borrow b_t in total, as long as the repayment does not exceed the market value of land (net of depreciation) at $t+1$:

$$Rb_t \leq q_{t+1}\left(1-\delta\right)k_t. \tag{A4}$$

The micro-foundation for such constraints is as follows. In Kiyotaki and Moore (1997), farmers' technology is idiosyncratic and they can always withdraw labor. As a result, fruits produced by farmers are not contractible. Creditors protect themselves by collateralizing

the farmers' land. The liquidation value of land is then the market value of land (net of depreciation) in the next period, which gives rise to the borrowing constraint in (A4).

Farmers' Behavior. As discussed above, farmers borrow up to the maximum amount as they are impatient. They also prefer to invest in land, consuming no more than their current output of non-tradable fruits.[40] This means for each farmer, $x_t = ck_{t-1}$, $b_t = q_{t+1}k_t(1-\delta)/R$ and

$$k_t = \frac{1}{q_t - \frac{1-\delta}{R}q_{t+1}}\left[\left(a + q_t(1-\delta)\right)k_{t-1} - Rb_{t-1}\right],$$

where $n_t = \left(a + q_t(1-\delta)\right)k_{t-1} - Rb_{t-1}$ is the farmer's net worth (defined as the maximum amount of funds available that can be used to acquire new assets and projects) at the beginning of date t, and $q_t - \frac{1-\delta}{R}q_{t+1} = u_t$ is the amount of down payment required to purchase a unit of land. In the case of collateral-based constraints, it coincides with the user cost of land at t.

Since the optimal k_t and b_t are linear in k_{t-1} and b_{t-1}, we can aggregate across farmers to find the equations of the dynamics of aggregate land demand and borrowing of farmers, K_t and B_t:

$$K_t = \frac{1}{q_t - \frac{1-\delta}{R}q_{t+1}}\left[\left(a + q_t(1-\delta)\right)K_{t-1} - RB_{t-1}\right], \tag{A5}$$

$$B_t = \frac{1-\delta}{R}q_{t+1}K_t. \tag{A6}$$

Steady State. Based on conditions (A2), (A5) and (A6), one can characterize the unique steady state, where

$$\left(1 - \frac{1}{R}(1-\delta)\right)q^* = u^* = a,$$
$$\frac{1}{R}G'\left[\left(\bar{K} - K^*\right)\right] = u^*,$$
$$\frac{B^*}{K*} = \frac{(1-\delta)a}{R\left(1 - \frac{1}{R}(1-\delta)\right)}.$$

Shock and Transmission. As in Kiyotaki and Moore (1997), we consider the equilibrium response to an unexpected aggregate shock to farmers' net worth at $t = 0$. Specifically, suppose at date -1 the economy is in the steady state: $K_{-1} = K^*$ and $B_{-1} = B^*$. There is an unexpected and temporary shock to all farmers' productivity at period 0, which increases the fruits they harvest to $1 + \Delta$ times the expected level, at the start of date 0.[41] Such a shock will then increase farmers' net worth by ΔaK^*. The production technologies then return to the pre-shock level thereafter. For exposition, we use a positive shock $\Delta > 0$. The analysis of a negative shock $\Delta < 0$ is identical under log-linearization.

Using conditions (A5) and (A6), one can then characterize farmers' land demand curves at $t = 0$ and $t \geq 1$. For period $t = 0$, farmers' land demand curves without and with

[40] This is because of a high enough c (non-tradable fruits), which guarantees the value of investing in land is high enough. Around the steady state, it suffices that $c < \frac{1-\beta}{\beta}a$, which is not restrictive when β is close to 1.

[41] Following Kiyotaki and Moore (1997), we take Δ to be small, so we can log-linearize around the steady state and find closed-form expressions for the new equilibrium path.

log-linearization are:[42]

$$u\left(K_0\right)K_0 = \left(q_0 - \frac{1-\delta}{R}q_1\right)K_0 = \left(a + \Delta a + \left(q_0 - q^*\right)\left(1-\delta\right)\right)K^*, \quad \text{(A7)}$$

$$\left(1+\frac{1}{\eta}\right)\hat{K}_0 = \frac{1}{1-\frac{1}{R}\left(1-\delta\right)}\hat{q}_0 - \frac{\frac{1}{R}\left(1-\delta\right)}{1-\frac{1}{R}\left(1-\delta\right)}\hat{q}_1 + \hat{K}_0 = \Delta + \frac{1-\delta}{1-\frac{1}{R}\left(1-\delta\right)}\hat{q}_0. \quad \text{(A8)}$$

An increase of land price q_0 increases farmers' net worth, $\left(a + \Delta a + \left(q_0 - q^*\right)\left(1-\delta\right)\right)K^*$, and increases their land demand, for a given down payment per unit of capital (in this case the same as the user cost $u\left(K_0\right) = q_0 - \frac{1-\delta}{R}q_1$).

Moreover, net worth increases more than proportionately with q_0 because of the leverage effect of outstanding debt. Even though the down payment also increases with q_0, this is largely dampened as the down payment decreases with next period land price q_1. As a result, the total impact of land prices on farmers' land demand is highly positive (when $R \approx 1$ and $\delta \approx 0$, the coefficient on $\hat{q}_0$ in condition (A8) could be very large).

For period $t \geq 1$, farmers' land demand curves without and with log-linearization are

$$u\left(K_t\right)K_t = \left(q_t - \frac{1-\delta}{R}q_{t+1}\right)K_t = aK_{t-1}, \quad \text{(A9)}$$

$$\left(1+\frac{1}{\eta}\right)\hat{K}_t = \frac{1}{1-\frac{1}{R}\left(1-\delta\right)}\hat{q}_t - \frac{\frac{1}{R}\left(1-\delta\right)}{1-\frac{1}{R}\left(1-\delta\right)}\hat{q}_{t+1} + \hat{K}_t = \hat{K}_{t-1}. \quad \text{(A10)}$$

An increase in farmers' land holding in period $t-1$ increases their net worth in period $t-1$, aK_{t-1}, and in turn translates into an increase in farmers' land holding in period t.[43] Through the forward-looking land pricing equation in condition (A2), the persistent increase in farmers' land holding then increases land prices in period 0, far more than what is driven by the increase in user cost in that particular period. The increase in land prices then further increases farmers' net worth and capital demand in period 0 through condition (A8), which in turn increases farmers' net worth and land holding in all periods and further pushes up the land price. This asset price feedback loop is the core of the financial acceleration mechanism in Kiyotaki and Moore (1997).

From conditions (A3), (A8), and (A10), we can solve the full equilibrium dynamics with collateral-based constraints:

[42] In condition (A8), $\frac{1}{1-\frac{1}{R}(1-\delta)} = \frac{q^*}{u^*}$ is the ratio between land price and down payment in the steady state and $\frac{1-\delta}{1-\frac{1}{R}(1-\delta)} = \frac{(1-\delta)q^*K^*}{aK^*}$ is the ratio between farmers' land holding collateral value and their net worth in the steady state.

[43] However, farmers' period-t net worth, aK_{t-1}, no longer depends on land prices in t. This is because, for all $t \geq 1$, an increase in period-t land prices will be anticipated in period $t-1$ and will allow farmers to borrow more. As a result, the impact of land prices on farmers' period-t net worth is offset by the increase in debt payment in period t.

$$\hat{K}_t = \left(1+\frac{1}{\eta}\right)^{-t-1} \frac{\eta}{\eta + \frac{\delta}{1-\frac{1-\delta}{R}}} \left(1 + \frac{\frac{R}{1-\delta}}{\frac{R}{1-\delta}-1}\frac{1}{\eta}\right)\Delta, \tag{A11}$$

$$\hat{q}_t = \left(1+\frac{1}{\eta}\right)^{-t} \frac{1}{\eta + \frac{\delta}{1-\frac{1-\delta}{R}}}\Delta.$$

When $R \approx 1$ and $\delta \approx 0$, the multiplier $1 + \frac{\frac{R}{1-\delta}}{\frac{R}{1-\delta}-1}\frac{1}{\eta}$ in farmers' land holding could be very large, which demonstrates financial acceleration driven by asset price feedback in Kiyotaki and Moore (1997).

F.3 Earnings-Based Constraints

In this part, we then consider the case of earnings-based constraints studied in this paper.

Earnings-Based Constraints. The constraint is specified as follows. If at period t, a farmer has land k_t, then she can borrow b_t in total, as long as the repayment does not exceed a multiple of her (tradable) earnings at $t+1$:[44]

$$Rb_t \leq \theta a k_t. \tag{A12}$$

Such a constraint could arise if the bankruptcy court is able to and prefers to enforce the continuation of operation when the farmer fails to pay her debt.[45]

Farmers' Behavior. Similar to the analysis in the previous subsection following Kiyotaki and Moore (1997), farmers prefer to borrow up to the maximum as they are impatient; they also prefer to invest in land, consuming no more than their current output of non-tradable fruits.[46] This means for each farmer, $x_t = ck_{t-1}$, $b_t = \theta a k_t / R$ and

$$k_t = \frac{1}{q_t - \frac{\theta a}{R}}\left[\left(a + q_t\left(1-\delta\right)\right)k_{t-1} - Rb_{t-1}\right],$$

where $q_t - \frac{\theta a}{R}$ is how much down payment is required to purchase a unit of land. In the case of earnings-based constraints, it does not depend on the land price in the next period q_{t+1} and does not coincide with the user cost u_t. This is because q_{t+1} does not directly enter the farmer's borrowing constraint (A12) in the case of EBCs. As we elaborate later, this missing link from asset prices to farmers' borrowing capacity is key to dampening asset price

[44] Here we tie the farmer's borrowing capacity to her earnings at $t+1$, generated by current period land holding k_t. One could also tie the farmer's borrowing capacity to her earnings at t, generated by the past period land holding k_{t-1}. Such backward-looking borrowing capacity will not change the key lesson about the attenuation of asset price feedback. However, it would open the door for more deviations from the Kiyotaki-Moore benchmark, such as path dependence of firms' outcomes beyond their dependence on current net worth level.

[45] It must be that $\theta \leq \bar{\theta} \triangleq \frac{1}{1-\frac{(1-\delta)}{R}} = 1 + \frac{1-\delta}{R} + \left(\frac{1-\delta}{R}\right)^2 + \cdots$, which is the present value of tradable fruits generated by one unit of land held by the farmer. The ratio $\frac{\theta}{\bar{\theta}}$ could be thought of as the proportion of tradable fruits that can be produced with court involvement and continuing operations.

[46] This could be guaranteed by a high enough c (non-tradable fruits). Note that the farmer's utility from investing a dollar in land today is at least $\beta\frac{(a+c+(1-\delta)q_{t+1})}{q_t - \frac{\theta a}{R}}$, the utility of investing in land in this period and consuming fully in the next period. It is always bigger than one with a large c, as q_t is bounded above (gatherers' marginal product is bounded above).

feedback under EBCs.

Since the optimal k_t and b_t are linear in k_{t-1} and b_{t-1}, we can aggregate across farmers to characterize the dynamics of aggregate land demand and borrowing of farmers, K_t and B_t:

$$K_t = \frac{1}{q_t - \frac{\theta a}{R}} \left[\left(a + q_t \left(1 - \delta \right) \right) K_{t-1} - R B_{t-1} \right], \tag{A13}$$

$$B_t = \frac{1}{R} \theta a K_t. \tag{A14}$$

Steady State. We set $\theta = \frac{1-\delta}{1-\frac{1}{R}(1-\delta)}$. This guarantees that the economy under earnings-based constraints shares the same steady states as the economy under collateral-based constraints. This ensures that the difference in the two economies' responses to the shock we consider is driven by the form of borrowing constraints, instead of the steady state leverage ratio.

Shock and Transmission. Similar to Kiyotaki and Moore (1997) and the analysis in the previous part, we consider the equilibrium response to an unexpected aggregate shock to farmers' net worth at $t = 0$. Specifically, suppose at date $t = -1$ the economy is in the steady state: $K_{-1} = K^*$ and $B_{-1} = B^*$. There is an unexpected and temporary shock to all farmers' productivity at period $t = 0$, which increases the fruits they harvest to $1 + \Delta$ times the expected level, at the start of date $t = 0$.[47]. Such a shock increases farmers' net worth by $\Delta a K^*$. The production technologies between 0 and 1 (and thereafter) then return to the pre-shock level.

Using conditions (A13) and (A14), one can then characterize farmers' land demand curves at period $t = 0$ and $t \geq 1$. For period 0, farmers' land demand curves without and with log linearization are:[48]

$$\left(q_0 - \frac{\theta a}{R} \right) K_0 = \left(\left(1 - \theta \right) a + \Delta a + q_0 \left(1 - \delta \right) \right) K^*, \tag{A15}$$

$$\begin{aligned} \hat{q}_0 \left(\frac{1}{1 - \frac{1}{R}\left(1 - \delta\right)} \right) + \hat{K}_0 &= \Delta + \frac{1 - \delta}{1 - \frac{1}{R}\left(1 - \delta\right)} \hat{q}_0, \\ \iff \hat{K}_0 &= \Delta - \frac{\delta}{1 - \frac{1}{R}\left(1 - \delta\right)} \hat{q}_0. \end{aligned} \tag{A16}$$

For a given down payment per unit of capital ($q_0 - \frac{\theta a}{R}$), an increase of land price q_0 still increases farmers' net worth, $\left(1 - \theta\right) a + \Delta a + q_0 \left(1 - \delta\right)$. However, the down payment per unit of capital also increases with land price q_0. Different from the case under collateral-based constraints, as farmers' borrowing capacity under EBCs does not depend on the land price in the next period q_1, an increase of q_1 will not relax their borrowing constraints and decrease the down payment per unit of capital. As a result, the total impact of land prices on farmers' land demand is negative, as shown by the last expression above. This is in contrast with the case under collateral-based constraints. The asset price movement now dampens the financial

[47] Following Kiyotaki and Moore (1997), we take Δ to be small, so we can log-linearize around the steady state and find closed-form expressions for the new equilibrium path.

[48] In condition (A8), $\frac{1}{1-\frac{1}{R}(1-\delta)} = \frac{q^*}{q^* - \frac{\theta a}{R}}$ is the ratio between land price and down payment in the steady state and $\frac{1-\delta}{1-\frac{1}{R}(1-\delta)} = \frac{(1-\delta) q^* K^*}{(1-\theta) a + (1-\delta) q^* K^*}$ is the ratio between collateral value of farmers' land holding and net worth in the steady state.

shock's impact on farmers' land holding, instead of generating financial amplification.

For period $t \geq 1$, farmers' land demand curve is:

$$\left(q_t - \frac{\theta a}{R}\right) K_t = \left[(1-\theta)\, a + (1-\delta)\, q_t\right] K_{t-1}, \tag{A17}$$

$$\hat{q}_t \left(\frac{1}{1-\frac{1}{R}(1-\delta)}\right) + \hat{K}_t = \frac{1-\delta}{1-\frac{1}{R}(1-\delta)} \hat{q}_t + \hat{K}_{t-1}, \tag{A18}$$

$$\iff \hat{K}_t = -\frac{\delta}{1-\frac{1}{R}(1-\delta)} \hat{q}_t + \hat{K}_{t-1}.$$

Compared to the case under collateral-based constraints, condition (A18), there are two differences. First, as discussed above, the down payment under EBCs does not depend on next period land price, q_{t+1}, as q_{t+1} does not relax farmers' borrowing constraints. Second, current period net worth, $(1-\theta)\, a + (1-\delta)\, q_t$, now increases with land prices in period t. Specifically, in the case with EBCs, as an increase of land prices in period t does not allow farmers to borrow more in $t-1$, q_t's impact on farmers' period-t net worth will *not* be offset by the increase in debt payment in period t. As we discuss more below, this may lead to a more persistent impact of the shock's impact on farmers' net worth, even though the initial impact is much more muted with EBCs.[49]

From conditions (A3) and (A18), we can then characterize the equilibrium dynamics under earning-based constraints:

$$\begin{pmatrix} \hat{q}_t \\ \hat{K}_t \end{pmatrix} = \begin{pmatrix} \frac{R}{1-\delta} & -\frac{1}{\eta}\left(\frac{R}{1-\delta} - 1\right) \\ -\delta \frac{\frac{R}{1-\delta}}{1-\frac{1-\delta}{R}} & 1 + \frac{\delta}{\eta} \frac{R}{1-\delta} \end{pmatrix} \begin{pmatrix} \hat{q}_{t-1} \\ \hat{K}_{t-1} \end{pmatrix} \quad \forall t \geq 1. \tag{A19}$$

The matrix $\begin{pmatrix} \frac{R}{1-\delta} & -\frac{1}{\eta}\left(\frac{R}{1-\delta} - 1\right) \\ -\delta \frac{\frac{R}{1-\delta}}{1-\frac{1-\delta}{R}} & 1 + \frac{\delta}{\eta} \frac{R}{1-\delta} \end{pmatrix}$ has only one eigenvalue $\lambda \in (0,1)$ within the unique circle.[50] Let (q_λ, k_λ) be the corresponding eigenvector and $\alpha = \frac{q_\lambda}{k_\lambda} > 0$. Together with the initial condition (A16), we have

$$\hat{K}_t = \frac{1}{1 + \frac{\delta}{1-\frac{1}{R}(1-\delta)}\alpha} \lambda^t \Delta \quad \text{and} \quad \hat{q}_t = \frac{\alpha}{1 + \frac{\delta}{1-\frac{1}{R}(1-\delta)}\alpha} \lambda^t \Delta. \tag{A20}$$

F.4 Financial Acceleration: A Comparison

Now we can compare the equilibrium impact of the aggregate shock to farmers' net worth under these two forms of borrowing constraints. As mentioned above, since land price increases have a negative impact on farmers' land demand in the case of EBCs, financial acceleration due to asset price feedback is dampened. Indeed, one can prove analytically

[49] As shown above, in farmers' land demand condition (A18), the appearance of the term $\frac{1-\delta}{1-\frac{1}{R}(1-\delta)} \hat{q}_t$ increases the persistence of the shock. The disappearance of term $-\frac{\frac{1}{R}(1-\delta)}{1-\frac{1}{R}(1-\delta)} \hat{q}_{t+1}$ on the left hand side, meanwhile, decreases the persistence of the shock. However, as $\hat{q}_t - \frac{1}{R}\hat{q}_{t+1} > 0$ in the equilibrium (from condition (A20)), the first effect dominates.

[50] Note that the land price is bounded as the gatherer's marginal product is bounded. As a result, explosive equilibrium can be ruled out. One can also prove the equilibrium uniqueness without the help of log-linearization.

that the shock's initial impact on farmers' capital holding and aggregate output is stronger with collateral-based constraints.

Lemma 1. *When the shock to farmers' net worth hits, the impact on farmers' land holding and aggregate output is stronger with collateral-based constraints.*

To numerically illustrate the difference, we consider a standard parametrization. Specially, we set $R = 1.01$, $\delta = 0.025$ and $\eta = 1$. Figure A3 shows the impulse response of farmers' land holding to the shock Δ. We find that the initial impact on farmers' land holding under collateral-based constraints is ten times as large as the one under earnings-based constraints. With EBCs, the dampening of financial acceleration driven by asset price feedback can be quantitatively important. As aggregate output $\hat{Y}$ is just a multiple of $\hat{K}$, the initial impact on aggregate output under collateral-based constraints is also ten times as large as the one under earnings-based constraints. Nonetheless, the impact of the shock in the economy with EBCs can be more persistent. This is because, with EBCs, for each period $t \geq 1$, as borrowing in the previous period does not depend on current period asset prices, higher land value increases farmers' net worth and is not offset by higher debt payment.

Figure A3: Impulse Response of Farmers' Land Holdings

This plot shows farmers' land holdings (log deviations from steady state) after a small positive unexpected shock to their net worth (one log point).