ANATOMY OF CORPORATE BORROWING CONSTRAINTS*

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Macro-finance analyses commonly link firms' borrowing constraints to the liquidation value of physical assets. For U.S. nonfinancial 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* Codes: E22, E32, G31, G33.

I. 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; Holmström 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 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; Crouzet and Eberly 2018; Diamond, Hu, and Rajan 2020). 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 article, we collect detailed data on U.S. nonfinancial 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 United States, using a newly constructed data set that integrates a number of data sources and hand-collected data. The data set features two components. One is a classification of debt based on the primary determinants of debt value, which covers both the aggregate nonfinancial 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. These data on debt contracts allow 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 United States. First, borrowing against cash flows accounts for the majority of U.S. nonfinancial corporate debt. We find that 20% of corporate debt is based on specific physical or other separable assets (such as real estate, equipment, inventory, as well as receivables, or patents, which can be evaluated or repossessed on a standalone basis), in terms of aggregate dollar amount outstanding and for a typical large nonfinancial 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. Cash flow–based lending can be either secured (by the corporate entity) or unsecured, and the key determinant of creditors' payoffs in U.S. Chapter 11 bankruptcy is the cash flow value from the continuing operations 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 any indirect positive dependence on physical asset value. We also show that the distinction of asset-based debt and cash flow–based debt is conceptually and empirically different from the issue of secured versus unsecured debt (which is about priority in bankruptcy in the United States, not necessarily the determinants of payoffs). Overall, the composition of corporate debt suggests that the liquidation value of physical assets may not be the defining constraint for major U.S. nonfinancial 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 expenses cannot exceed a multiple of EBITDA (earnings before interest, taxes, depreciation, and amortization) in the previous 12 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 generally 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 nonfinancial 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 procedures) 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 (Ramey and Shapiro 2001; Altig et al. 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 a higher likelihood of liquidation. Second, although 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.

After documenting the prevalence of cash flow–based lending and EBCs based on debt contracts, we investigate how they shape the way financial variables 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 $1 increase in EBITDA is on average associated with about a 28-cent increase in net debt issuance. This finding does not exist 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-profit-margin firms, airlines and utilities, Japanese firms). In addition, we further sharpen the tests and show that the sensitivity of borrowing to EBITDA is stronger when earnings-based covenants are more binding. It is also stronger when macroeconomic conditions are weaker, which tend to be periods with tougher contract enforcement (Chodorow-Reich and Falato 2020; Acharya et al. forthcoming). The full set of results 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 toward

operating earnings, whereas 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 United States 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 (commercial mortgages account for only 7% of corporate debt by value). Using traditional estimates of firm real estate value and hand-collected property-level data from company filings, we find that U.S. large nonfinancial firms' borrowing has relatively small sensitivity to real estate value, concentrated in asset-based debt. For cash flow–based debt, the sensitivity is absent. Overall, borrowing increases by 2 to 3 cents on average for a $1 increase in a firm's 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.

The story in the United States finds its antithesis in Japan. Unlike the United States, 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). We do not find similar results among U.S. firms during the Great Recession. 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 types of borrowing constraints (e.g., traditional collateral constraints à la Kiyotaki and Moore 1997 versus EBCs). With cash flow–based lending and EBCs, we find that asset price feedback through firms' balance sheets could diminish significantly. We further illustrate that the key to this result is the absence of a direct link between liquidation values and borrowing constraints. We also examine implications for the transmission of shocks in the Great Recession, credit access and allocation, and monetary policy. We end by delineating how our empirical findings translate into specifying firms' borrowing constraints in macro-finance models.

The domain of our analysis is nonfinancial corporations. For financial institutions, most assets are standardized and liquid, and borrowing constraints often tie to the liquidation value of securities pledged as collateral. The ensuing fire sale amplification has been thoroughly analyzed (Coval and Stafford 2007; Garleanu and Pedersen 2011), which attests to models of asset price feedback. For households, mortgages also emphasize "loan-to-value" constraints. Greenwald (2018) 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 United States, traditional fire sale amplification may have primary effects through financial institutions and households, rather than major nonfinancial firms.

Our article relates to several strands of research. First, our study is motivated by the importance of firms' borrowing constraints in macro-finance models (Shleifer and Vishny 1992; Hart and Moore 1994; 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

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1. As Greenwald (2018) 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, for which traditional collateral constraints are first order and cash flow–based constraints are absent).

2. For more analyses, see also Mendoza (2010) and Bianchi (2011) in international macro; Midrigan and Xu (2014), Buera and Moll (2015), and Catherine et al. (2018) in studies of productivity and misallocation;

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 U.S. nonfinancial 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 institutional environments and can lead to distinct implications.

Second, our findings inform several related papers on financial frictions and the macroeconomy. Greenwald (2019) analyzes how interest coverage ratio constraints, a form of EBCs, affect the transmission of monetary policy. Drechsel (2020) builds a business cycle model to study the impact of investment opportunity shocks under traditional collateral constraints versus earnings-based constraints. Cloyne et al. (2020) 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 article is related to studies of corporate debt heterogeneity. We analyze one key aspect of debt heterogeneity, that is, 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 (2020) 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 examined heterogeneity in debt types, sources, and priority (Rauh and Sufi 2010; De Fiore and Uhlig 2011; Crouzet 2017; Benmelech, Kumar, and Rajan 2020; Donaldson, Gromb, and Piacentino 2020). We also build on studies of financial covenants (Roberts and Sufi 2009; Sufi 2009; Nini, Smith, and Sufi 2012). We analyze earnings-based covenants as a common and legally binding way to implement EBCs, which have not been a focus of the literature. We show that earnings-based covenants are prevalent, their presence is tied to

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Bernanke and Gertler (1989), Liu, Wang, and Zha (2013), Azariadis, Kaas, and Wen (2015), and Ottonello and Winberry (forthcoming) in analyses of business cycles and monetary policies; Rampini and Viswanathan (2010, 2013) and Donaldson, Gromb, and Piacentino (forthcoming) in corporate finance; Crouzet and Mehrotra (forthcoming) and Dinlersoz et al. (2019) in studies of firm dynamics, among others.

the prevalence of cash flow–based lending, and they can have important implications for firm outcomes.

Finally, legal infrastructure provides the foundation for debt enforcement (La Porta et al. 1997; Djankov et al. 2008; Becker and Josephson 2016), which can affect the applicability of macro-finance mechanisms. In the context of trade finance, Antràs and Foley (2015) also point out that legal institutions affect financing contracts and the impact of crises.

The rest of the article is organized as follows. Section II documents the prevalence of cash flow–based lending among U.S. nonfinancial firms. Section III documents the prevalence of earnings-based borrowing constraints. Section IV studies how the characteristics of corporate borrowing shape the way different financial variables affect firm outcomes on the margin. Section V discusses additional implications for macro-finance analyses. Section VI concludes.

II. Prevalence of Cash Flow–Based Lending

In this section, we document the prevalence of cash flow–based lending among U.S. nonfinancial firms. In Section II.A, we explain the definition and classification procedure of asset-based debt and cash flow–based debt and report the classification results. In Section II.B, we show the key properties of asset-based and cash flow–based debt. In Section II.C, we explain the institutional foundations of cash flow–based lending and delineate heterogeneity in debt composition among different firm groups.

II.A. 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 from the continuing operation of the business (in both normal course and restructuring). These concepts are central in credit markets in practice, and they map closely into classic models (e.g., Kiyotaki and Moore 1997). Because 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 II.B.

1. Definition. We describe asset-based lending and cash flow–based lending from three aspects: (i) general definition, (ii) debt structure and default resolution, and (iii) typical examples. We also describe the standard procedures for assessing the liquidation value of specific assets for asset-based lending and assessing the cash flow value for cash flow–based lending. The differentiation of asset-based lending and cash flow–based lending is shaped by the default resolution of different types of debt according to bankruptcy laws. We focus on the case of Chapter 11 restructuring-based bankruptcy, which accounts for around 90% of U.S. corporate bankruptcy filings by value.[3] In Chapter 11, total payments to creditors are given by the cash flow value of the continuing operation of the restructured firm, which is verified and approved in court. U.S. bankruptcy laws also prohibit creditors from seizing assets to disrupt firms' operations (automatic stay). The institutional setting is therefore different from models where cash flows are not verifiable and creditors use seizing assets as a threat for debt enforcement (Hart and Moore 1998).

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, and inventory, as well as other separable assets such as receivables or 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). One could alternatively refer to "asset-based debt" as "liquidation value–based debt," but we follow the conventional terminology of creditors in this article.
- 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 (the liquidation value

3. The alternative is Chapter 7, which focuses on liquidation. In Chapter 7, asset-based debt receives the liquidation value of the specific assets pledged to them; cash flow–based debt receives additional liquidation value, which tends to be minimal.

is estimated in Chapter 11 when the firm does not actually liquidate). If this value falls short of the debt claim, then creditors have a secured claim up to the aforementioned collateral value, plus an unsecured (i.e., low-priority) general claim (deficiency claim) based on the size of the remaining undercollateralized 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.

- Common examples: Examples of asset-based lending include commercial mortgages (backed by commercial real estate) and other asset-based loans (backed by machinery and equipment, inventory, receivable, oil and gas reserves, etc.). Each debt typically has a primary borrowing limit based on the liquidation value of the particular assets pledged as collateral for that debt.

- Liquidation value assessment: At debt issuance, lenders of asset-based debt hire specialist appraisers to perform on-site field exams and simulate live liquidations to estimate the liquidation value of assets pledged to them and set the borrowing limit for the debt accordingly (the "Comptroller's Handbook on Asset-Based Lending" by the Office of the Comptroller of the Currency [OCC] provides some descriptions). After issuance, lenders update field exams and liquidation value estimates periodically, and debt limit enforcement is based on the most recent estimate. If the firm defaults, there is a similar liquidation value appraisal process in Chapter 11 to determine the collateral value and payoffs of asset-based debt.[4]

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4. Asset-based lending aims to set debt limits based on the liquidation value of the particular assets pledged. For assets with changing quantities (e.g., inventory), book values may be used to help calculate the liquidation value (to track the quantity of the asset at a given point in time). In particular, for asset-based debt against working capital, at debt issuance creditors use the appraised liquidation value to set debt limits as a fraction of the book value (e.g., a firm can borrow up to 60% of the book value of eligible inventory under an asset-based facility). The fraction may change given the latest appraisals. Meanwhile, for assets with fixed quantities (e.g., equipment or a building), at debt issuance creditors directly use the appraised liquidation value in dollar amounts to set the borrowing limit against the particular asset. The borrowing limit would change given the latest appraisals.

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 (i.e., going-concern value): creditors' payoffs (in default) are driven by the cash flow value from continuing operations of the restructured firm. Cash flow–based debt corresponds to debt against "fruits" in Kiyotaki and Moore (1997). One could alternatively refer to "cash flow–based debt" as "going-concern value–based debt," but again we follow creditors' terminology.

- Debt structure and default resolution: For cash flow–based debt, creditors have claims against the value of the firm as a whole. In Chapter 11, their payoffs are pinned down by the going-concern cash flow value of the restructured firm (minus the liquidation value of specific assets pledged to asset-based debt). Cash flow–based debt can be secured by the corporate entity ("substantially all assets" in legal parlance, and sometimes referred to as a blanket lien, excluding specific assets pledged to asset-based debt), or unsecured, which we discuss further in Section II.B. The collateral value of blanket liens in Chapter 11 is determined by the going-concern cash flow value of the firm (minus the liquidation value of specific assets pledged to asset-based debt).

- Common examples: Examples of cash flow–based lending include the majority of corporate bonds, as well as a significant share of corporate loans such as most syndicated loans. For debt limits, creditors do not use the liquidation value of specific assets, in contrast with asset-based lending. Instead, they focus on monitoring firms' cash flows from operations.

- Cash flow value assessment: At debt issuance and during default resolution, creditors assess cash flow values using a variety of methods, including discounted cash flow analyses and benchmarks based on multiples of earnings. After debt issuance, creditors continuously monitor cash flows, primarily in the form of operating earnings over the past 12 months, which we discuss in more detail in Section III.

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), whereas 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).[5] 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 nonfinancial firms can be highly specialized and firm-specific, and have limited alternative use (Ramey and Shapiro 2001): once installed, capital has little value unless used in production (Bertola and Caballero 1994). Fourth, firms may face adjustment costs when they liquidate assets (Abel and Blanchard 1986; Bernanke, Gertler, and Gilchrist 1999).

In the United States, the Chapter 11 bankruptcy procedure plays an important 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, it directly ties total payments to creditors to the going-concern cash flow value of the firm.

2. Classification Procedures. We perform the classification in the aggregate (for the overall nonfinancial corporate sector, including public and private firms) and at the firm level (for the majority of Compustat nonfinancial firms, namely, firms with SIC codes outside of 6000 to 6999). We summarize the classification procedures below, and explain the details in Online Appendix IA1.1 and IA1.2. We then present the results and test the properties of asset-based versus cash flow–based debt afterward.

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

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5. 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.

commercial loan aggregates from Shard National Credit (SNC), DealScan, ABL Advisor, small business loan aggregates from Small Business Administration (SBA), and 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: (i) we directly observe the key features of asset-based lending (e.g., secured by specific assets or have borrowing limits tied to them); (ii) the debt belongs to a debt class that is usually asset-based (e.g., small business loans, finance company loans, secured revolving lines of credit, capital leases, etc.), or it is labeled as asset-based. We then classify cash flow–based debt, if one of the following criteria is met: (i) the debt is secured by the corporate entity or unsecured and does not have any features of asset-based lending; (ii) 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 overestimate rather than underestimate 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 1% in aggregate but can be more significant among certain small firms.

3. Results. Table I summarizes the main classification results. For the aggregate nonfinancial 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 commercial mortgages (backed by real estate) and 13% are other asset-based loans (backed by equipment, inventory, receivable,

TABLE I

COMPOSITION OF U.S. NONFINANCIAL CORPORATE DEBT

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	11.1%	7.1%	53.5%
Cash flow–based lending	85.3%	90.5%	8.4%

Notes. This table summarizes the composition of U.S. nonfinancial 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 nonfinancial firms).

etc.).[6] Meanwhile, cash flow–based lending accounts for about 80% of total debt outstanding 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 U.S. nonfinancial corporate sector.

For individual firms, the composition is similar in large nonfinancial firms. Among the larger half of Compustat firms (by book assets), the median share of asset-based lending is 11%, while that of cash flow–based lending is 85%. Among rated firms, the median share of asset-based lending is 7%, while that of cash flow–based lending is 91% (93% for investment grade firms and 87% for noninvestment grade firms).[7] Figure I, Panel A, shows that the median share of asset-based and cash

6. We classify debt against inventory and receivable as asset-based, as in the "Comptroller's Handbook on Asset-Based Lending" by the OCC. Other work (e.g., Ivashina, Laeven, and Moral-Benito 2020) may use a more restrictive definition, focusing 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 (2020) focus on.

7. Rated firms account for about a quarter of Compustat firms, primarily in the top quartile 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., bonds, revolvers, mortgages). With assumptions about whether each debt class is asset-based or cash flow–based (e.g., mortgages are asset-based, bonds are primarily cash flow–based, revolvers and term loans are a mix), we can get rough estimates

(A) Median Share of Cash Flow–Based Lending

(B) Fraction of Firms with Earnings-Based Covenants
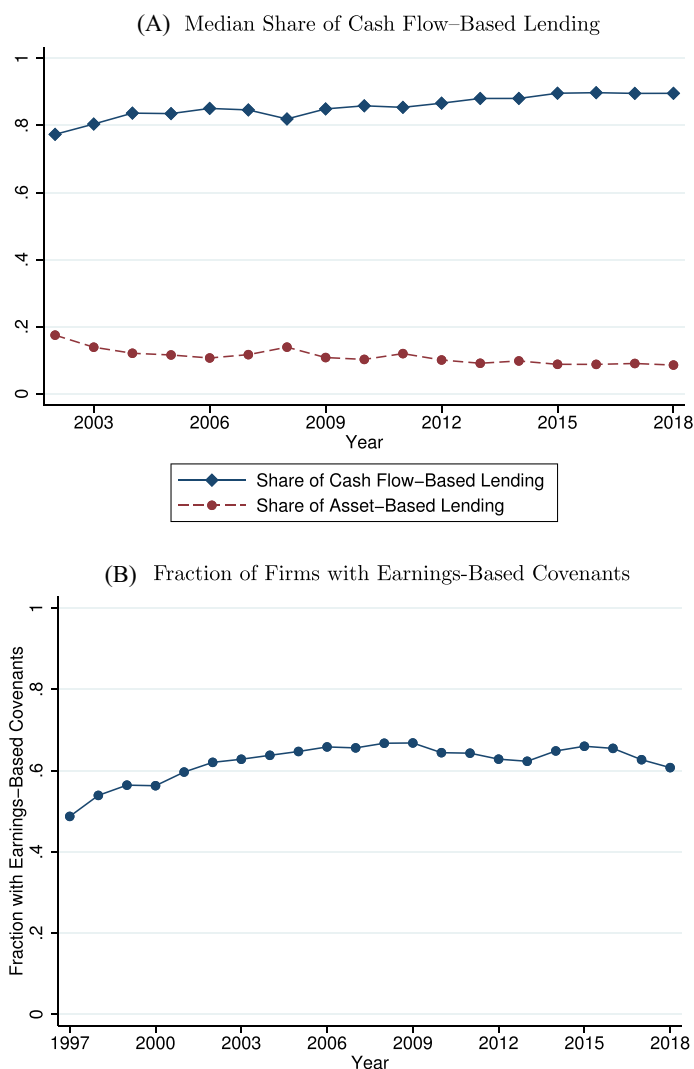
FIGURE I

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 U.S. nonfinancial 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 diamonds represents the share of cash flow–based lending (i.e., cash flow–based debt/total debt); the dashed line with circles 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.

flow–based lending among large nonfinancial firms is generally less than 20% and slightly over 80%, respectively, in recent years. These large firms account for over 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 54% and the median share of cash flow–based lending is about 8%. We further analyze heterogeneity among firm groups in Section II.C.

For individual private firms outside of Compustat, which account for roughly 20% of total nonfinancial corporate debt by value, we make two observations. First, there are a number of large private firms in the United States, and many private firms come from private equity buyouts. These firms have a substantial amount of cash flow–based debt, similar to large public firms, which we verify through examples (including Dell, Neiman Marcus, Petco, Univision, and Dex Media) and data on buyout activities.[8] Second, our analysis of aggregate debt composition covers private firms, including small businesses. For small private firms, most debt is likely asset-based, but their impact on aggregate debt composition is limited.

II.B. 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.

1. 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

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of debt composition in their data. These estimates line up with our results among firms in both samples: the levels match one for one for the median firm.

8. Annual cash flow–based loan issuance due to private equity activities in recent years is about $200 billion based on S&P LCD data. Accordingly, the total amount outstanding could be up to $1 trillion, which is substantial relative to $1.8 trillion total debt of private nonfinancial firms around 2015.

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.[9]

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 negative), as shown in Table II. This property holds for cash flow–based debt in general. It also holds for cash flow–based loans, which are a key component of commercial loans in the United States as discussed above (i.e., in the United States it is not the case that loans have to depend on the abundance of physical or tangible assets). Relatedly, we also find that cash flow–based debt is sizable among firms with a minimal amount of traditional tangible assets. For example, among large firms where fixed assets (plant, property, and equipment) are less than 5% of total assets, the median level of cash flow–based debt is 21% of total assets, which is much larger. This shows that cash flow–based debt can be supported, and is quite prevalent, even when firms do not have many physical assets.

2. Difference with Secured versus Unsecured Debt. The distinction of asset-based debt versus cash flow–based debt is conceptually and empirically different from the distinction of secured debt versus unsecured debt, which is a common topic in economic research (Berger and Udell 1990; Azariadis, Kaas, and Wen 2015; Arias and Wen 2017; Benmelech, Kumar, and Rajan 2020). Our classification 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). Meanwhile, the essence of secured versus unsecured debt is priority in bankruptcy under U.S. law (Baird and Jackson 1984), not necessarily the economic

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9. In Chapter 11, for instance, the payoffs of cash flow–based debt are given by the going-concern cash flow value of the restructured firm, minus the liquidation value of the specific assets pledged to asset-based lenders. The payoffs of cash flow–based debt therefore depend negatively on the liquidation value of specific assets; the negative dependence is greater when more such assets are pledged for asset-based debt (zero if there is no asset-based debt). Accordingly, it is not the case that for the distinction of asset-based and cash flow–based debt to be clear, firms need to have pledged away most of their specific assets for asset-based debt.

TABLE II

PROPERTIES OF ASSET-BASED DEBT AND CASH FLOW–BASED DEBT

Panel A: Asset-based debt

	All		Mortgage		Nonmortgage	
	(1)	(2)	(3)	(4)	(5)	(6)
Plant, property, and equipment	0.131***		0.032***		0.073***	
	(0.009)		(0.002)		(0.008)	
Inventory	0.040**		−0.000		0.051***	
	(0.016)		(0.002)		(0.013)	
Receivable	0.047***		−0.006***		0.058***	
	(0.012)		(0.001)		(0.012)	
Liquidation value		0.131***		0.026***		0.096***
		(0.016)		(0.003)		(0.015)
Observations	58,241	55,372	57,715	54,881	57,979	55,123
R^2	0.08	0.06	0.07	0.03	0.06	0.05

TABLE II
CONTINUED

Panel B: Cash flow–based debt	All		Cash flow–based loans		Secured cash flow–based	
	(1)	(2)	(3)	(4)	(5)	(6)
Plant, property, and equipment	-0.105***		-0.061***		-0.066***	
	(0.012)		(0.008)		(0.008)	
Inventory	-0.230***		-0.065***		-0.073***	
	(0.016)		(0.011)		(0.008)	
Receivable	-0.330***		-0.090***		-0.112***	
	(0.023)		(0.010)		(0.011)	
Liquidation value		-0.358***		-0.134***		-0.154***
		(0.023)		(0.017)		(0.016)
Observations	58,227	55,361	57,309	54,467	57,495	54,652
R^2	0.07	0.06	0.05	0.05	0.04	0.04

Notes. This table presents panel regressions of a firm's outstanding debt of a given type 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 real estate loans (mortgages) and nonmortgage asset-based debt in particular. In Panel B, the left-hand-side variables include all cash flow–based debt, as well as cash flow–based loans and secured cash flow–based debt in particular. Liquidation value is the estimated total liquidation value of plant, property, and equipment (PPE), inventory, and receivable, using industry-average liquidation recovery rates collected from bankruptcy filings in Kermani and Ma (2020). Controls include size (log book assets) and cash holdings. Table IA2 in Online Appendix IA1 presents additional results with firm fixed effects and year fixed effects. The sample period is 2002 to 2018, and all Compustat nonfinancial firms with CapitalIQ debt detail data are included. Standard errors are clustered by firm and time, *** *p* < .01, ** *p* < .05.

variables that determine creditors' payoffs.[10] Asset-based debt can be secured and take priority over the liquidation value of specific assets (and it typically is explicitly secured to make clear that such creditors have exclusive priority over particular assets). Cash flow–based debt can also be secured and take priority over the going-concern cash flow value of the firm through "blanket liens" (minus what is pledged to asset-based debt), as mentioned already.

In the data, we find that about one-third of total secured debt is cash flow–based in Compustat. The results are in line with Ivashina, Laeven, and Moral-Benito (2020), who also find that a substantial portion of secured debt is cash flow–based. Moreover, Table II, Panel B shows that secured cash flow–based debt behaves similarly to cash flow–based debt in general, and very differently from asset-based debt. The prevalence of secured cash flow–based debt does not have any positive dependence on the amount of physical and other separable assets. The relationship, if anything, is negative, which is the opposite of the properties of asset-based debt. As mentioned, in Chapter 11, the collateral value of secured cash flow–based debt is determined by the going-concern value of the restructured firms (and Chapter 7 liquidations are uncommon for large nonfinancial firms). Accordingly, the liquidation value of specific assets, while first order for asset-based debt, is not the foundation for secured cash flow–based debt.

Taken together, to study the determinants of borrowing constraints and the corresponding macro-finance implications, our classification of asset-based versus cash flow–based debt aims to most closely follow the economic foundations of different debt claims (liquidation value of specific assets versus going-concern cash flow value of the firm). This distinction maps into the key concepts in classic macro-finance models, as well as predictions about how financial variables affect firm outcomes on the margin,

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10. While secured versus unsecured debt in the data are given by contracts and the legal framework, some research has used different interpretations. For example, Azariadis, Kaas, and Wen (2015) interpret secured debt as debt based on the liquidation value of physical assets and unsecured debt as debt sustained by reputation value not enforced by courts. In the United States, as we verify, not all secured debt is tied to the liquidation value of physical assets. Meanwhile, unsecured debt can be enforced by courts, not just resorting to reputation-based self-enforcement. As we show in Section III, corporate debt contracts in the U.S. legal environment rely extensively on cash flow verifiability, which is a key feature of financial contracting for U.S. firms (Kaplan and Strömberg 2003).

financial acceleration dynamics, and credit access, among other issues, as we study in Sections IV and V.

II.C. 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, cash flow–based lending is especially relevant when firms' asset specificity is high. Nonfinancial firms often have a limited amount of standardized, transferable assets that can support low-cost asset-based lending, while the majority of assets are specialized or illiquid with limited liquidation values (Ramey and Shapiro 2001). Online Appendix IA5 illustrates these forces in a simple framework.

1. 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 (the median EBITDA among small firms in Compustat is around zero). In addition, financial distress of these firms is more likely to be resolved through liquidations (Bris, Welch, and Zhu 2006; Bernstein, Colonnelli, and Iverson 2019), given fixed costs of restructuring (e.g., legal and financial personnel) and their 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 8%, while that of asset-based lending is 53% (the rest are personal loans and other miscellaneous borrowings). This compares with median shares of 85% and 11% among large firms. Among young firms (less than 15 years since incorporation date),

the median share of cash flow–based lending is 43%, whereas that of asset-based lending is 38%. This compares with median shares of 56% and 29% 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 44% and 36%, respectively, while among high-margin firms the median shares are 75% and 16%, respectively.

2. Airlines and Utilities. The prevalence of cash flow–based lending can differ across industries given differences in asset specificity. Figure II, 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 of cash flow–based lending is 26% and the median share of asset-based lending is 72% among rated firms. The prevalence of asset-based lending in airlines is in line with Pulvino (1998) and Benmelech and Bergman (2009, 2011), who thoroughly analyze the impact of aircraft collateral and fire sale amplification in this industry. Utilities also have a lower share of cash flow–based lending compared with the other Fama-French 12 industries. While most nonfinancial 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. Finally, car rentals and auto dealers also have a relatively high fraction of asset-based debt (median share among rated firms is 44%), given relatively standardized and transferable car inventory, although they are smaller industries with fewer firms in our sample.

3. Cross-Country Variation. Although our main analysis focuses on the United States, lending practices may also vary across countries given different legal infrastructure. In developing countries, high-quality accounting information may not be available. Moreover, bankruptcy laws and practices have major differences across countries, which can shape variations in the nature of debt (Gennaioli and Rossi 2013).

As discussed already, in the United States, 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 United States. In particular, Japanese bankruptcy courts were largely dysfunctional before a major reform 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 separable assets 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 V, we contrast our findings in the United States 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 nonfinancial 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 United States), 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 Online Appendix IA2.

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

III. 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 EBCs. In Section III.A, we explain the definition and enforcement of EBCs. In Section III.B, we show their prevalence, tightness, and connections with cash flow–based lending. In Section III.C, we show variations in the prevalence of EBCs among different firm groups.

III.A. *Earnings-Based Borrowing Constraints*

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

$$(1) \qquad b_t \leqslant \phi \pi_t,$$

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 expenses (equivalently, maximum interest expenses to earnings):

$$(2) \qquad b_t \leqslant \frac{\theta \pi_t}{r_t},$$

where $r_t b_t$ is the firm's annual interest expenses, π_t is the firm's annual operating earnings, and θ is the maximum ratio of interest expenses to earnings or the inverse of the minimum interest coverage ratio (i.e., earnings relative to interest expenses).

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 expenses $r_t b_t$) are those of the borrowing firm. In other words, the constraint restricts the total debt of the firm.[12] Second, the commonly used measure for π_t is EBITDA over the previous 12 months. It excludes nonoperating income (e.g., windfalls, natural disaster losses, and capital gains or losses). As a measure of operating earnings, EBITDA is affected by firms' human capital, business model, and organizational capital and is not necessarily a function of the liquidation value of specific assets. Third, EBCs apply not just when firms issue new debt; they can also

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

12. 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.

affect the maintenance of existing debt. If earnings decline significantly, for instance, firms may need to reduce debt to comply with constraints from existing debt (e.g., through legally binding covenants, as further explained below).

1. Earnings-Based Covenants. An important way to impose EBCs 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 covenant specifies debt limits as a function of operating earnings, which we refer to as earnings-based covenants.[13] They follow the forms in 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 generally measured based on EBITDA. Third, compliance with debt limits is assessed continuously, generally every quarter for regular loans (maintenance tests), and when borrowers take certain actions (e.g., issue additional debt) for bonds (incurrence tests).

Violations of covenants trigger "technical defaults," in which case creditors have legal power to make the debt due immediately. Although creditors rarely do so, they use this power as threats to implement their requests, such as restricting financial and investment decisions, or 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 for creditors to impose their demands and restrictions, which can be costly to borrowers. In addition, covenant violations and renegotiation often come with substantial amendment fees, which are also costly to borrowers.

In our setting, the key is to verify that the earnings-based covenants impose effective borrowing limits. Here we focus on

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13. Debt contracts can also specify other types of financial and nonfinancial 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 Online Appendix Section IA4. 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, and violations are uncommon. The second type specifies limits on the ratio of current assets to current liabilities, which also has relatively low prevalence.

earnings-based covenants in loans, for which we have information about covenant specifications and thresholds from DealScan, a comprehensive data set on commercial loans. We merge DealScan data with firm financials in Compustat. Online Appendix Table IA4 provides detailed information on covenant specifications in DealScan and the corresponding accounting variables compiled by Demerjian and Owens (2016). Figure III plots firms' total debt growth in year $t + 1$ against their distance to the threshold of their earnings-based covenants at the end of year t.[14] Debt growth is on average positive when firms are in compliance with their 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 their borrowing capacity is limited by these restrictions.[15]

2. Other EBCs. The earnings-based borrowing constraints firms face are not limited to financial covenants. The corporate credit market has important norms about debt relative to earnings: when firms issue debt, it can be difficult to surpass the reference level of debt-to-EBITDA ratio that lenders use. We document the effect of these additional constraints in Online Appendix IA3.3 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 cutoff, which borrow more from the leveraged loan market where the reference ratio is emphasized the most. In addition, the sensitivity is large for firms that primarily use cash flow–based debt (e.g., share in total

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14. We compute the difference between the required financial ratio and the current actual ratio and normalize it using the firm-level standard deviation of the financial ratio. We take the minimum standardized distance across different earnings-based covenants if the firm has multiple.

15. DealScan's data allow 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 2020). 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.

debt greater than 50%) and close to zero for firms that do not. As another example, the Federal Reserve's Main Street Lending Program, launched in 2020, also requires the borrowing firm's total debt to be less than four or six times (depending on the sub-program) of its EBITDA in 2019 (Federal Reserve 2020a, 2020b, 2020c). This is another reflection of the prevalence of EBCs that firms need to comply with when they borrow.

Since 2010, there has been an increasing amount of issuance of covenant light (cov-lite) corporate loans. Generally, cov-lite loans refer to loans with covenants that only require compliance when borrowers take certain actions, such as raising new debt (i.e., incurrence tests, like those commonly used in bonds), instead of covenants that require compliance on a regular, quarterly basis (i.e., maintenance tests, like those in regular corporate loans). In this case, borrowing limits specified by financial covenants are still relevant but assessed less frequently. In addition, EBCs do not just take the form of covenants; they are also prevalent at debt issuance due to credit market norms. Accordingly, the rise of cov-lite loans does not necessarily imply that EBCs are no longer present.[16]

III.B. Properties

In the following, we further document properties of EBCs in the form of earnings-based covenants, which are directly observable and legally binding. We use data from three sources: DealScan for commercial loans, FISD for corporate bonds, and scraped and hand-collected data from annual reports to check the comprehensiveness of DealScan and FISD.

1. Prevalence and Tightness. Figure I, Panel B, shows that earnings-based covenants are prevalent among large nonfinancial firms. Of all large Compustat nonfinancial firms, about 50% to 60% have earnings-based covenants explicitly written in their debt contracts.[17] If we add mentions of earnings-based covenants

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16. So far, using information of cov-lite loan issuance from LCD and DealScan, less than 1% of firm-years in our sample from 1997 to 2018 (around 500 observations) have cov-lite loans with earnings-based covenants, so we have not accumulated enough data points to reliably test the impact of cov-lite loans.

17. Examples include 3M, AAR Corp, AT&T, Best Buy, Caterpillar, CBS, Comcast, Costco, Disney, Equifax, Expedia, FedEx, GE, General Mills, Gilead, Hershey's, Home Depot, Honeywell, HP, IBM, Kohl's, Lear, Macy's, Marriott, Merck, Northrop Grumman, Pfizer, Qualcomm, Safeway, Sprint, Staples, Starbucks, Target, Time Warner, T-Mobile, U.S. Steel, Verizon, Walmart, Xerox, and Yum Brands.

(A) Median Share of Cash Flow–Based Lending

(B) Fraction of Firms with Earnings-Based Covenants
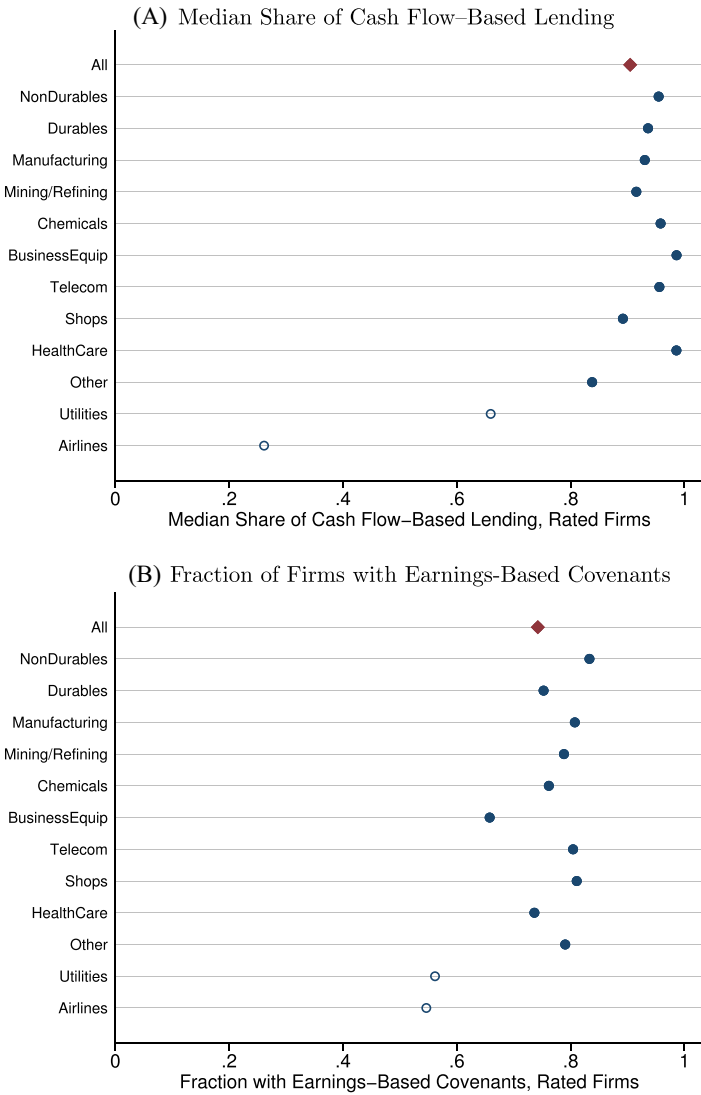
FIGURE II

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.

FIGURE III

Debt Growth and Earnings-Based Covenants

This plot shows the relationship between firm-level 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 earnings-based covenant thresholds by year end, and the *y*-axis is firm-level total 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. A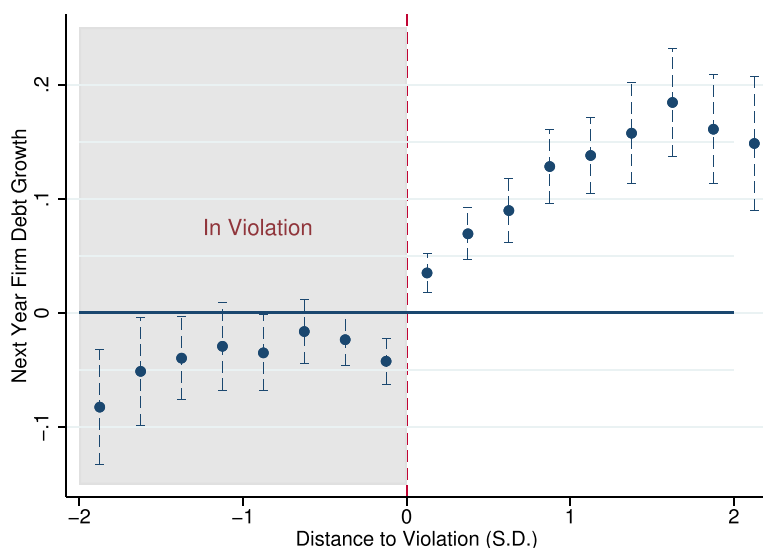s shown in Online Appendix IA3.1, Table IA4, there are several variants of earnings-based covenants. Firms sometimes have more than one type, and different firms may also have different types. To find a uniform measure of distance, we compute the difference between the actual financial ratios and permitted financial ratios. We normalize this difference using the firm-level standard deviation of the financial ratio. We take the firm-level minimum distance among all earnings-based covenants if the firm has multiple earnings-based covenants. Firms in the shaded region to the left of 0 are those that are not in compliance with at least one earnings-based covenant based on DealScan data; those to the right of 0 are in compliance with all such covenants.

from scraped data, the share of large firms with earnings-based covenants increases by another 5% a 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. Nonetheless, the constraint still exists and they are likely to have explicit debt covenants if the debt level is higher.

For the tightness of earnings-based covenants, the median value of ϕ in the debt-to-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 0.4 (interquartile range roughly $\frac{1}{2}$ to $\frac{1}{3}$). Every year around 12% of large firms with DealScan loans break the covenant thresholds. Another 25% are within one standard deviation of the thresholds. These statistics are in line with prior work (Dichev and Skinner 2002; Nini, Smith, and Sufi 2012). In Online Appendix IA3, Figure IA1, 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 suggest that these constraints are tight and relevant.

2. Relationship with Cash Flow–Based Lending. We verify that earnings-based covenants primarily come from cash flow–based debt. For commercial loans and bonds, data on financial covenants are directly available from DealScan and FISD. Nonetheless, these data sets do not cover several types of debt, and in particular they may miss important parts of asset-based debt such as commercial mortgages and equipment loans. To get a comprehensive picture that includes earnings-based covenants from all types of debt, we read annual reports 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 filings, more than 80% come from cash flow–based debt (or are packaged with cash flow–based debt),[18] such as cash flow–based commercial loans and corporate bonds. Few come from other types of debt (e.g., mortgages, equipment loans), although the overall number of contracts for asset-based debt and cash flow–based debt is about the same. Moreover, in Section III.C we show that variations in the prevalence of earnings-based covenants follow variations in the prevalence of cash flow–based debt.

Taken together, the data point to a close link between earnings-based constraints and cash flow–based debt. In addition,

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18. 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.

the analysis also verifies the validity of using covenant information on commercial loans and bonds (from DealScan and FISD) for systematic analyses of earnings-based covenants.

III.C. Contractual Foundations and Heterogeneity

To motivate the use of EBCs, 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). Specifically, 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 II, in the U.S. setting, if a borrower defaults, then in Chapter 11 the cash flow value of the restructured firm determines creditors' total payoffs; correspondingly, the firm's cash flow value shapes its ex ante total debt limits.

1. Focus on Current EBITDA. In practice, given constraints on contractibility, EBCs in debt contracts typically use EBITDA over the previous 12 months as a key metric for cash flow value. In particular, to facilitate enforcement on a regular basis, contracts need a measure that is readily observable and verifiable, and whose value borrowers and lenders do not dispute. EBITDA over the previous 12 months aims to strike a balance between being informative about firms' cash flow values and satisfying the important contractibility requirements. 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 every quarter based on firms' financial statements (whereas projections of future cash flows, for instance, are not easily verifiable and can be disputed). We discuss this issue in more detail in Online Appendix IA5.

2. Prevalence across Firm Groups. Variations in the prevalence of EBCs mirror those of cash flow–based lending discussed in Section II.C. 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 find 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 with 61% of large firms. For young firms, 30% have earnings-based covenants, compared to 37% of old firms. For low–profit margin firms, 30% have earnings-based covenants, compared to 46% of high-margin firms. These patterns hold despite the fact 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 II, Panel B, shows that earnings-based covenants are also less common.

In sum, earnings-based borrowing constraints play an important role in U.S. 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.

IV. Corporate Borrowing Sensitivity on the Margin

In the foregoing sections, we document the prevalence of cash flow–based lending and EBCs among U.S. nonfinancial firms, based on debt contract data. In this section, we further examine how these features of corporate borrowing affect firm outcomes on the margin (we provide a simple illustration of this connection in Online Appendix IA5). Section IV.A studies how they shape the role of cash flows for corporate borrowing and investment. Section IV.B studies the mirror image: how they affect the sensitivity of firm outcomes to the value of physical assets, in particular real estate. The empirical results attest to the contract-level evidence. For U.S. nonfinancial 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, while the value of physical assets has a mild influence.

IV.A. 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.[19] This mechanism is not present among firms

19. As a concrete example, firms' filings state that they face primary constraints focused on their earnings. For instance, in its 2012 annual report, Coty Inc. (a leading global beauty product producer) writes: "We remain dependent

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, and Japanese firms). In the following, we first present the borrowing sensitivity to operating earnings, across different firm groups and economic conditions. We then supplement the baseline tests by studying exogenous variations in operating earnings due to changes in accounting rules. The results indicate the effect of EBCs on the margin and shed further light on the way cash flows affect firm outcomes.

1. Borrowing Sensitivity to Operating Earnings. 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. With EBCs, however, cash flows in the form of operating earnings (EBITDA) can relax borrowing constraints and help firms borrow more.

We begin with standard annual firm-level regressions as in Fazzari, Hubbard, and Petersen (1988) and Kaplan and Zingales (1997):

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

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 Online Appendix IA6. We focus

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upon others for our financing needs, and our debt agreements contain restrictive covenants...Financial 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."

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 1).

The main independent variable of interest is operating earnings (EBITDA), which directly affect EBCs, normalized by lagged book assets.[20] To isolate the impact of EBITDA through borrowing constraints, we then control for measures of internal funds. As discussed, without controlling for internal funds, the impact of EBITDA on borrowing can be understated. To tease out the internal funds 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 nonoperating income, taxes, and so on, which do not count toward EBITDA. We also control for cash holdings at the beginning of year t.

Other control variables include Q and past 12 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 firm characteristics (e.g., tangible assets such as PPE and inventory, and depreciation rates which can affect the need to invest), 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 regressions. Results are similar with industry-year fixed effects or lagged dependent variables instead of firm fixed effects, as shown in Online Appendix Tables IA9 and IA10.

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

Results when EBCs relevant. We first examine firms where EBCs are most relevant. We focus on 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 (2019), 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 III. Our main sample period is 1997 to 2018, because data on financial covenants was sparse prior to 1997. We present results separately for each firm group to facilitate presentation and allow for different coefficients on control variables among different groups. We present robustness checks using a dummy variable (representing large firms with earnings-based covenants) and interactions with EBITDA in Online Appendix Table IA6.

Table III, 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. 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 2.3, and the median book leverage is 0.3.

Table IV reports the regression results. Panel A, columns (1) and (2) show that for a $1 increase in EBITDA, net debt issuance increases by around 28 cents on average.[21] Columns (3) and (4) show that the results are similar when debt issuance is measured using the net change in long-term book debt. We also study different types of borrowing in Online Appendix Table IA7, in particular asset-based debt and cash flow–based debt, as well as secured (high-priority) debt and unsecured (low-priority) debt. Because 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, and the coefficients for different types of debt are roughly proportional to their shares in total debt. Columns (5) to (8) show that higher EBITDA is also associated with higher capital expenditures and R&D spending.[22]

21. The sensitivity of 28 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 (the average annual persistence of shocks to EBITDA in our data is about 0.3).

22. R&D expenses, unlike CAPX, are included in operating expenses, which would produce an automatic negative link between R&D and EBITDA. 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.

TABLE III

SUMMARY STATISTICS OF U.S. NONFINANCIAL FIRMS

Panel A: Large firms with earnings-based covenants						
Variable	p25	p50	p75	Mean	Std. dev.	N
Log assets	6.47	7.35	8.45	7.54	1.47	22,701
Log market cap	6.07	7.12	8.26	7.19	1.71	22,701
EBITDA/l.assets	0.09	0.13	0.18	0.14	0.10	22,701
Debt/EBITDA	1.09	2.26	3.91	2.75	3.48	22,423
Debt/assets	0.18	0.30	0.43	0.32	0.22	22,701
EDF	0.00	0.00	0.06	0.12	0.26	22,699
Q	0.80	1.08	1.59	1.34	0.92	22,701
PPE/assets	0.12	0.26	0.49	0.32	0.24	22,701
Inventory/assets	0.01	0.08	0.17	0.11	0.12	22,701
Net debt issuance/l.assets	−0.02	0.00	0.05	0.03	0.15	21,189
CAPX/l.assets	0.02	0.04	0.07	0.06	0.07	22,589
R&D/l.assets	0.00	0.01	0.04	0.03	0.05	11,560
Cash flow–based lending/debt	0.49	0.89	0.99	0.70	0.36	16,800

TABLE III
CONTINUED

Panel B: Other firm groups

Variable	Large w/o EBCs		Small		Low margin		Air and utilities	
	p50	N	p50	N	p50	N	p50	N
Log assets	6.77	12,134	4.11	27,666	5.15	31,022	8.14	3,150
Log market cap	6.98	12,134	4.16	27,666	4.97	31,022	7.36	3,150
EBITDA/l.assets	0.12	12,134	0.04	27,666	0.05	31,022	0.10	3,150
Debt/EBITDA	0.82	11,911	0.00	27,194	0.49	30,130	3.64	3,107
Debt/assets	0.16	12,134	0.06	27,666	0.19	31,022	0.36	3,150
EDF	0.00	12,132	0.01	27,662	0.02	31,018	0.00	3,150
Q	1.30	12,134	1.29	27,666	1.01	31,022	0.86	3,150
PPE/assets	0.19	12,134	0.13	27,666	0.16	31,022	0.64	3,150
Inventory/assets	0.06	12,134	0.07	27,666	0.07	31,022	0.02	3,150
Net debt issuance/l.assets	0.00	11,487	0.00	26,284	0.00	29,229	0.01	3,082
CAPX/l.assets	0.04	12,055	0.03	27,462	0.03	30,816	0.07	3,138
R&D/l.assets	0.05	7,725	0.09	19,732	0.07	20,239	0.01	113
Cash flow–based lending/debt	0.83	6,473	0.00	12,988	0.48	18,236	0.63	2,326

Notes. This table presents summary statistics of nonfinancial firm samples. Panel A shows statistics for large firms with earnings-based covenants. Large firms are those with book assets above the 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 (which 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. 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 article. The sample period is 1997 to 2018.

TABLE IV

DEBT ISSUANCE AND INVESTMENT ACTIVITIES: LARGE FIRMS WITH EARNINGS-BASED COVENANTS

Panel A: Baseline results

	Net debt issuance		ΔLT book debt		CAPX		R&D	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
EBITDA	0.281***	0.283***	0.409***	0.379***	0.111***	0.081***	0.035***	0.028**
	(0.041)	(0.040)	(0.051)	(0.045)	(0.015)	(0.017)	(0.011)	(0.013)
OCF		−0.004		0.057		0.057***		0.011
		(0.040)		(0.044)		(0.012)		(0.012)
Q	0.011**	0.011**	0.005	0.005	0.009***	0.008***	0.004***	0.004***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.001)	(0.001)	(0.001)	(0.001)
Past 12m stock ret	−0.003	−0.003	−0.003	−0.002	0.005**	0.006**	−0.002***	−0.002***
	(0.004)	(0.004)	(0.005)	(0.005)	(0.002)	(0.002)	(0.001)	(0.001)
L.Cash holding	0.015	0.014	0.058*	0.060**	−0.002	0.001	0.013	0.013
	(0.028)	(0.029)	(0.030)	(0.031)	(0.008)	(0.009)	(0.009)	(0.009)
Controls				Yes				
Fixed effects				Firm, Year				
Observations	20,675	20,675	22,072	22,059	22,107	22,107	11,308	11,306
R^2	0.11	0.11	0.12	0.12	0.14	0.15	0.11	0.11

TABLE IV
CONTINUED

Panel B: State dependence

	Net debt issuance				
	(1)	(2)	(3)	(4)	(5)
EBITDA	0.166***	0.267***	0.266***	0.172***	0.171***
	(0.063)	(0.043)	(0.041)	(0.057)	(0.059)
Tight	−0.025***			−0.025***	−0.025***
	(0.009)			(0.009)	(0.009)
Tight × EBITDA	0.136**			0.139**	0.140**
	(0.056)			(0.054)	(0.056)
Output gap (demeaned) × EBITDA		−3.397**		−3.351**	
		(1.398)		(1.432)	
Unemployment rate (demeaned) × EBITDA			0.045***		0.044***
			(0.017)		(0.017)
Controls					
Fixed effects			Firm, year		
Observations	19,352	19,352	19,352	19,352	19,352
R^2	0.10	0.10	0.10	0.10	0.10

Notes. Panel A presents firm-level annual regressions of debt issuance and investment activities: $Y_{it} = \alpha_i + \eta_t + \beta \text{EBITDA}_{it} + X'_{it}\gamma + \epsilon_{it}$. The outcome variable Y_{it} is net debt issuance (Compustat item DLTIS − DLTR) in year t (normalized by assets at the beginning of year t) in columns (1) and (2), the change in long-term book debt in columns (3) and (4), capital expenditures (CAPX) in columns (5) and (6), and R&D spending in columns (7) and (8). EBITDA$_{it}$ is earnings before interest, taxes, depreciation, and amortization (Compustat item EBITDA) in year t, normalized by assets at the beginning of year t. 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) at the beginning of year t, stock returns in year $t−1$, as well as cash holdings, book leverage, PPE (plant, property, equipment), inventory, depreciation, and size (log book assets) at the beginning of year t. We also control for lagged EBITDA to focus on the impact of current EBITDA. Panel B presents firm-level annual regressions of variations in sensitivity of net debt issuance to EBITDA: $Y_{it} = \alpha_i + \eta_t + \beta \text{EBITDA}_{it} \times S_{it} + X'_{it}\gamma + \epsilon_{it}$. The variable S_{it} is a dummy variable of earnings-based covenants being tight at the beginning of year t in column (1), which takes the value 1 if the minimum distance to violation is within one standard deviation. The variable S_{it} is the demeaned output gap in column (2), calculated as the log difference between actual real GDP and potential real GDP. The variable S_{it} is the demeaned unemployment rate (in percentages) in column (3). The controls are the same as those in Panel A, together with OCF interacted with S_{it}. Firm fixed effects and year fixed effects are included (R^2 does not include fixed effects). Sample period is 1997 to 2018. The sample includes large U.S. nonfinancial firms that have earnings-based covenants in year t. Standard errors are clustered by firm and time, $***p < .01$, $**p < .05$, $*p < .01$.

State dependence. We further sharpen our tests by investigating how the sensitivity of borrowing to EBITDA varies depending on the tightness of EBCs and the state of the economy, shown in Table IV, Panel B. First, one may expect that borrowing would be more sensitive to EBITDA when the earnings-based covenants are more binding. Although the theoretical prediction for this comparative static could be ambiguous (for reasons similar to the arguments of Kaplan and Zingales 1997), the tightness of earnings-based covenants should have some impact. In column (1), we create an indicator variable (Tight) which takes value 1 if the firm is less than one standard deviation above the covenant threshold at the beginning of year t (using the same distance measure as in Section III). The interaction of this variable with EBITDA is both statistically and economically significant. The borrowing sensitivity to EBITDA almost doubles when the indicator variable is equal to 1. In addition, the level of net debt issuance falls by another 2.5% of assets when the indicator variable for tight earnings-based covenants is equal to 1.

Second, prior work suggests that covenant enforcement is stricter and punishment for covenant violations is more severe in recessions (Chodorow-Reich and Falato 2020; Acharya et al. forthcoming), so one may expect that borrowing could be more sensitive to EBITDA in these periods. In columns (2) and (3), we use the output gap (log actual GDP minus log potential GDP) and the unemployment rate to capture macroeconomic conditions. We demean the output gap and the unemployment rate, so the coefficient on the EBITDA variable represents the borrowing sensitivity to EBITDA when macro-conditions are around the average level. We find that the borrowing sensitivity to EBITDA is higher when output is lower and the unemployment rate is higher. In terms of magnitude, when the output gap falls by 1 percentage point, the borrowing sensitivity to EBITDA increases by 0.034 (in the Great Recession, the output gap was about −5%, which implies an increase in the sensitivity to EBITDA of about 0.17 relative to the average level of zero output gap). When the unemployment rate increases by 1 percentage point, the borrowing sensitivity to EBITDA increases by 0.045 (in the Great Recession, the unemployment rate reached around 10%, which implies an increase in the sensitivity to EBITDA of about 0.23 relative to the average level of 5% unemployment). Overall, columns (2) and (3) suggest that the coefficient on EBITDA is about 0.25 when the output gap or unemployment rate is at the average level, and it would roughly double in situations like the Great Recession. Finally, columns (4)

and (5) include interactions using both the indicator variable (for tight earnings-based covenants) and macro-conditions. We find that firm conditions and macro-conditions are both relevant.

Results when EBCs are not relevant. We also 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 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 (due to several distinct factors including size, profitability, asset specificity, and legal environments) where earnings are not key determinants of borrowing constraints: small firms, low-margin firms, airlines and utilities, and Japanese firms (later in Section V.A). Table III, Panel B presents summary statistics of the comparison groups, which display rich heterogeneity in characteristics. Overall, it appears difficult to account for the different impact of EBITDA across all these groups based on common alternative explanations.

We perform the regression in equation (3) (Table IV, Panel A, column (2)) for each group, and plot the coefficient β on EBITDA in Figure IV. The regression results are shown in Online Appendix Table IA8. For all the comparison groups where EBCs are not relevant, the coefficient on EBITDA is about 0, consistent with predictions.

Additional checks for alternative explanations. Finally, we also perform additional checks to address the common concern that cash flow variables may proxy for Q. We do not find that this concern easily accounts for our results, for several reasons. In particular, the positive relationship between EBITDA and borrowing does not exist among various groups of firms that are not bound by EBCs as shown above. 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 Online Appendix Section IA8.2 (including tests of earnings quality and predictive regressions of future profitability). In addition, the results on state dependence are also not easy to explain based on mismeasurement of Q. We also check that the sensitivity of borrowing to EBITDA is not driven by EBITDA being correlated with the value of physical collateral. In
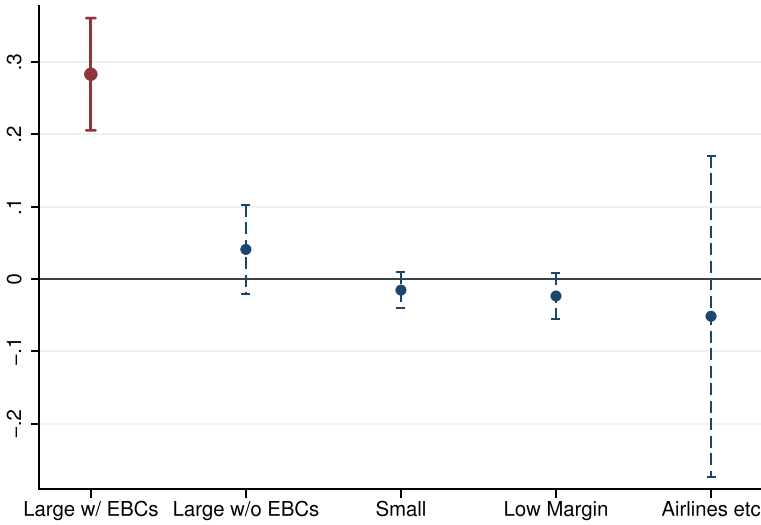
Borrowing Sensitivity to Operating Earnings by Firm Group

This figure shows the coefficient β on EBITDA from Table IV, Panel A, column (2) and Online Appendix Table IA8, Panel A, columns (2), (4), (6), and (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 nonfinancial firms with earnings-based covenants. "Large w/o EBCs" is large nonfinancial 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 "Airlines etc" are small firms, low-profit margin firms, and airlines and utilities which have low prevalence of cash flow–based lending and EBCs.

Online Appendix Table IA7, we study the issuance of cash flow–based debt, which is unlikely to be affected by the value of physical collateral (as we confirm in Table II). In Online Appendix Table IA11, we 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.

2. Exogenous Variations in Operating Earnings: An Accounting Natural Experiment. We supplement the foregoing results 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 effect 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 toward 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 V. We instrument EBITDA in 2006 (postadoption) 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, and a set of firm characteristics (the same

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23. There are two questions about EBITDA definitions in debt contracts that we need to examine. The first is whether covenants calculate EBITDA using fixed accounting methods (where accounting changes do not affect covenant tightness) or latest accounting methods (where accounting changes do matter). Reviews of sample contracts show that the latter is common (Moser, Newberry, and Puckett 2011; Shroff 2017), given transaction costs for the former (firms' financial statements comply with latest accounting methods, so the former case requires an additional set of financial statements). The second is some debt contracts allow borrowers to exclude expenses with no cash impact (such as depreciation, amortization, stock-based compensation) from 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.

TABLE V
CHANGES IN EBITDA: ACCOUNTING NATURAL EXPERIMENT

Panel A: First stage

	Large w/ EBCs	EBITDA$^{06}_i$ Large w/o EBCs	Small
	(1)	(2)	(3)
Avg opt comp expense 2002-2004	−0.806***	−1.073***	−0.623***
	(0.169)	(0.231)	(0.240)
Controls		Yes	
Observations	668	434	843

TABLE V
CONTINUED

Panel B: IV

	Net debt issuance			CAPX		
	Large w/ EBCs (1)	Large w/o EBCs (2)	Small (3)	Large w/ EBCs (4)	Large w/o EBCs (5)	Small (6)
$\widehat{EBITDA}_i^{06}$	0.964**	−0.532**	0.311	0.500***	0.145	−0.093
	(0.398)	(0.235)	(0.203)	(0.125)	(0.150)	(0.112)
Controls			Yes			
First-stage F	19.74	18.47	5.95	18.80	27.27	7.85
Observations	668	434	843	665	431	833

Notes. This table presents cross-sectional instrumental variable regressions:

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

where $EBITDA_i^{06}$ is EBITDA in fiscal year 2006 (normalized by assets), and is instrumented with average option compensation expenses (Compustat XINTOPT, normalized by assets) in fiscal years 2002 to 2004. Control variables include all the control variables in Table IV as of 2004, together with two additional lags of the outcome variable and EBITDA as well as sales in adoption year (which are not affected by the accounting rule change). Industry fixed effects are included. Panel A presents the first stage. Panel B presents the IV results. The outcome variable is net debt issuance in fiscal 2006 in columns (1) to (3), and capital expenditures in fiscal 2006 in columns (4) to (6). 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). Standard errors are in parentheses, clustered by industry, ***$p < .01$, **$p < .05$.

controls as in Table IV and sales which are not affected by the accounting rule change):

$$(4) \qquad Y_i^{2006} = \alpha + \beta \widehat{\text{EBITDA}}_i^{2006} + X_i'\gamma + \epsilon_i.$$

We study results for large firms bound by EBCs, large firms not bound by EBCs, and small firms. For firms bound by EBCs, we require that they have had earnings-based covenants since the announcement of SFAS 123(r) in 2004, so we focus on the impact of old covenants that have become tighter after the rule change, which is advantageous to lenders and disadvantageous to borrowers. As discussed in Section III, covenant violations are generally costly to borrowers, so firms may want to reduce borrowing as their covenants become tighter.

Table V, 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 on the impact of operating earnings through EBCs.[24] We also perform placebo tests using other years in Online Appendix Section IA8.3. Overall, to account for the results using alternative explanations, there need to be certain links between prior option compensation and subsequent changes in borrowing and investment which are unique to firms bound by EBCs, but are unrelated to EBCs. In addition, such links need to be especially pronounced around this period. We do not find a strong reason for such channels.

IV.B. The Role of Physical Asset Values

We study the mirror image of Section IV.A: 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. We first investigate the general sensitivity of corporate borrowing to real estate value. We explore implications for

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24. The second-stage coefficients on EBITDA among firms bound by EBCs are higher than the baseline results in Table IV, Panel A. The accounting rule change induces a persistent shock to earnings (the new rule 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 the effect size larger. In addition, the estimates here are local average treatment effect (LATE), and it appears that firms that are most intensively treated are more responsive.

the Great Recession in Section V.A. 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.

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

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

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). Here we analyze these two types of debt separately, since only asset-based debt has debt limits that depend on the value of physical assets such as real estate. Therefore, we may expect to see some positive response of asset-based debt to real estate value, but would not expect to see it for cash flow–based debt. Since we only have detailed firm-level categorization of cash flow–based and asset-based debt starting in 2002, we focus on the sample period of 2002 to 2018. In addition, our real estate value estimates are also more widely available for the post-2000 period, as explained below. The control variables include EBITDA and net cash receipts in year t, as well as Q, past 12 month stock returns, cash holdings, book leverage, depreciation rate, lagged EBITDA, and size (log assets) at the beginning of year t (similar to Table IV).

2. 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 nonzero amount of real estate, as indicated by the net book value.

Method 1: Traditional estimates. Chaney, Sraer, and Thesmar (2012) provide a 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 is no longer reported after 1993, this procedure requires firms to exist in Compustat since

1993, which restricts the sample size. The key assumption is that most real estate which firms own are located near 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). Online Appendix IA7 explains the construction of the estimates by step.

Method 2: Property ownership information from annual reports. U.S. firms are required to discuss their properties in annual reports. 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 0.9 correlated). We restrict to owned real estate located in the United States, and keep firms that have information for substantially all owned properties in the United States. Online Appendix IA7 provides examples of property-holding information from annual reports, and detailed explanations of variable construction.

Online Appendix Table IA16 presents the characteristics of firms with real estate value estimates. Given the data requirements, the samples tilt toward large firms. The majority of these firms have earnings-based covenants. The median market value of real estate is about 10% to 20% of book assets for these firms, similar to Chaney, Sraer, and Thesmar (2012). Online Appendix Table IA16 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 about 0.7 correlated. The levels also match up. The similarity is high because most firms' owned properties do concentrate in the headquarters location, as we see from the property-level reporting in firms' filings, so the assumptions in Method 1 largely hold.

3. Results. Table VI presents the results. A $1 increase in the real estate value is on average associated with an increase in net debt issuance of about 2–3 cents. The positive response is

TABLE VI
CORPORATE BORROWING AND REAL ESTATE VALUE

	Net debt issuance		ΔAsset-based		ΔCash flow–based		CAPX	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
RE (Method 1)	0.034**		0.027		0.003		0.042***	
	(0.017)		(0.017)		(0.025)		(0.010)	
RE (Method 2)		0.016		0.053***		−0.002		−0.014
		(0.035)		(0.016)		(0.051)		(0.014)
EBITDA	0.309***	0.163***	0.151***	0.095***	0.325***	0.158***	0.066***	0.057***
	(0.100)	(0.040)	(0.043)	(0.036)	(0.105)	(0.043)	(0.013)	(0.015)
OCF	−0.153***	−0.142***	−0.121**	−0.188***	−0.096	−0.025	−0.011	−0.012
	(0.053)	(0.054)	(0.049)	(0.032)	(0.081)	(0.062)	(0.010)	(0.009)
Q	0.025***	0.016***	−0.002	0.005*	0.019***	0.010*	0.006***	0.007***
	(0.008)	(0.005)	(0.002)	(0.003)	(0.007)	(0.006)	(0.002)	(0.001)
Past 12m stock ret	−0.008**	−0.006	−0.005	−0.004	−0.007	−0.003	−0.000	0.003**
	(0.004)	(0.004)	(0.004)	(0.003)	(0.005)	(0.004)	(0.001)	(0.001)
L.Cash holding	−0.109***	−0.065**	0.003	−0.008	−0.097***	−0.071*	0.017	0.001
	(0.031)	(0.032)	(0.022)	(0.022)	(0.028)	(0.038)	(0.012)	(0.006)

TABLE VI
CONTINUED

	Net debt issuance		ΔAsset-based		ΔCash flow–based		CAPX	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Controls				Yes				
Fixed effects				Firm, Year				
Observations	5,751	5,776	5,751	5,776	5,751	5,776	5,749	5,771
R^2	0.11	0.09	0.03	0.03	0.06	0.06	0.11	0.10

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

$$Y_{it} = \alpha_i + \eta_t + \beta RE_{it} + X_{it}'\gamma + \epsilon_{it}.$$

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 IV.B and Online Appendix IA7. Control variables include EBITDA and net cash receipts OCF in year t, Q, cash holdings, book leverage, and size (log book assets) at the beginning of year t, lagged EBITDA, and lagged real estate value. Firm fixed effects and year fixed effects are included (R^2 does not include fixed effects). Sample period is 2002 to 2018. Standard errors are clustered by firm and time, $^{***}\,p < .01$, $^{**}\,p < .05$, $^*\,p < .1$.

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 II. The response of investment activities is also relatively limited.

Taken together, the results suggest that a substantial portion of large nonfinancial 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 U.S. nonfinancial firms where cash flow–based lending prevails. One may wonder about results among firm groups where asset-based lending prevails. 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 aircraft is central, previous work shows that fluctuations in the collateral value of aircraft have significant consequences (Benmelech and Bergman 2009, 2011). Finally, in Section V, we also contrast our findings in the United States with findings from Japan, a country where corporate lending traditionally emphasized physical collateral and real estate.

V. FURTHER IMPLICATIONS

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

V.A. Applications

1. Financial Acceleration. Classic financial acceleration through asset price feedback builds on borrowing constraints tied

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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.

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 analyze financial acceleration dynamics under different forms of borrowing constraints, based on a standard general equilibrium framework following Kiyotaki and Moore (1997). The details of the setup and equilibrium dynamics are presented in Online Appendix IA9. We examine two cases. In the first case, we consider the traditional collateral constraints (borrowing limits depend on the liquidation value of physical assets) as in the original work:

$$(6) \qquad b_t \leqslant \frac{(1-\delta)}{R} q_{t+1} k_t,$$

where b_t and k_t denote the productive firm's borrowing and capital holding, q_{t+1} denotes the liquidation value of one unit of capital, R is the gross interest rate, and δ is the depreciation rate. In the second case, we consider earnings-based constraints (borrowing limits depend on a multiple of cash flows in the form of operating earnings):

$$(7) \qquad b_t \leqslant \frac{\theta}{R} a k_t,$$

where a denotes the productive firm's productivity and θ denotes the tightness of the EBC. We set θ such that firms in these two cases have the same steady-state leverage. 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.

We then compare the equilibrium impact of a shock to productive firms' internal funds in these two scenarios (the same shock as Kiyotaki and Moore 1997). The results show that after the shock hits, the impact on productive firms' capital holding and aggregate output is much stronger with traditional collateral constraints, due to asset price feedback. Using parameters similar to those in Kiyotaki and Moore (1997), we find that the effect on productive firms' capital holding and aggregate output under earnings-based constraints is about one-tenth of that under traditional collateral constraints. To illustrate further, we also consider the case in which some firms face traditional collateral

constraints while others face earnings-based constraints. We calibrate the proportion of each based on our empirical evidence. Given that the majority (80%) of U.S. nonfinancial corporate debt by value is not subject to the traditional collateral constraints, the general equilibrium response of firms' capital and aggregate output in this mixed case is still only about one-fifth of that under traditional collateral constraints. The results are presented in Online Appendix IA9.

In Online Appendix IA9, we also investigate the key mechanisms behind the differences between the case with traditional collateral constraints and the case with EBCs. We show that fire sale amplification is dampened in the case with EBCs because of the absence of a direct link between the liquidation value q and the firm' borrowing constraints. With traditional collateral constraints, when the liquidation value q of the firm's assets falls as it disinvests following the initial shock, borrowing constraints automatically tighten, which leads to asset price feedback. With EBCs, the firm's borrowing constraints depend on the value of earnings from its own operations, which are not affected by the liquidation value q, and asset price feedback is therefore absent. Similarly, if firms' borrowing constraints are based on the present value of future earnings, instead of current earnings, asset price feedback is still absent because the liquidation value q does not enter borrowing constraints.

Finally, even for asset-based lending, creditors may not be able to update appraisals of the liquidation value q very frequently, since many assets are specialized, illiquid, and difficult to assess. According to lenders, appraisals of the liquidation value are updated one to three times a year. These limitations for assessing q at high frequencies may also weaken the link between the liquidation value q and borrowing constraints for asset-based lending in practice. Correspondingly, fire sale amplification in the analyses above, which assume all asset-based debt uses the latest liquidation value, could be an upper bound. Taken together, fire sale amplification can be dampened among nonfinancial firms, given the prevalence of cash flow–based lending and EBCs, coupled with infrequent updating of the liquidation value q even in asset-based lending.

2. The Great Recession. Our analysis could also shed light on the impact of different shocks on firms in the Great Recession. We first perform a simple assessment of the role of EBCs. From 2007

to 2009, total earnings of large Compustat firms with earnings-based covenants fell by \$123 billion. Based on the results in Table IV, this would translate to a \$37.3 billion decline in net debt issuance due to EBCs, which accounts for 11.8% of the issuance decline among all Compustat firms. It would be associated with a \$10.6 billion reduction in CAPX due to EBCs, which accounts for 7.5% of CAPX declines among Compustat firms.

We also assess the impact of property price declines on firms through collateral damage. Since the Great Recession, many papers analyze the impact of the property price collapse through damages to household balance sheets, following Mian and Sufi (2014). Property price declines, however, may also transmit through collateral damage to firms, and less is known about the role of this channel. In Online Appendix Table IA17, we use our firm property holdings data to examine the corporate property collateral value channel. We exploit firms' differential exposures to property value shocks, through the following specification:

$$\Delta Y_i^{07-09} = \alpha + \lambda \Delta \text{RE}_{i,06}^{07-09} + \eta \text{RE}_i^{06} + \phi \Delta P_i^{07-09}$$
$$(8) \qquad\qquad + \beta \Delta \text{EBITDA}_i^{07-09} + X_i' \gamma + u_i.$$

The left-hand-side variable ΔY_i^{07-09} is the change in firm i's outcome from 2007 to 2009, including debt issuance in Panel A and investment in Panel B. The key independent variable is $\Delta \text{RE}_{i,06}^{07-09}$, which captures the change in firm i's real estate value from 2007 to 2009. It is measured as the market value gain/loss of firm i's precrisis (end of 2006) real estate holdings during the Great Recession, normalized by assets in 2006. We control for firm i's precrisis 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 effect of property prices that may work through local household demand), as well as firm characteristics. We measure firms' real estate values using both methods described in Section IV.B.[26]

26. For Method 1, RE_i^{06} uses the 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 $\Delta P_{i,j}^{07-09}$.

Finally, Online Appendix Table IA17 reports both OLS and least absolute deviation (LAD) estimates (following Gan 2007) to alleviate the potential influence of outliers. Across different tests, we do not find evidence that declines in firms' real estate value drove down debt issuance or investment during the Great Recession.

Overall, we find that the decline in earnings can account for some reduction in corporate borrowing and investment due to EBCs. The effect was meaningful but not catastrophic. We do not find that major nonfinancial firms were significantly affected by collateral damage because of falling real estate values. However, these results depend on the features of corporate borrowing in the United States, and we discuss the contrast between the United States and Japan below.

3. United States versus Japan. As discussed in Section II.C, the predominant form of corporate debt depends on institutional foundations. In Japan, corporate debt historically relies heavily on physical assets (especially real estate) given its legal environment and lending traditions. Accordingly, we contrast Japan with the United States in terms of how financial variables influence firms' outcomes.

First, we study the sensitivity of firms' borrowing to EBITDA in Online Appendix Table IA12. We run the baseline regressions in Section IV.A among large nonfinancial firms (i.e., assets above median among Compustat firms in each country) in the United States and in Japan. Large U.S. 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). 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 use the change in long-term book debt. Online Appendix Table IA12 shows that whereas there is a strong positive relationship between borrowing and EBITDA in the U.S. sample (driven by firms bound by EBCs), this relationship is absent in the Japan sample.

Second, around the early 1990s, Japan experienced a major boom-bust cycle in property prices. This cycle occurred in an environment where real estate was central for corporate credit. Correspondingly, with the property price collapse, Japanese firms' debt capacity and investment suffered significantly, as documented by Gan (2007). For public manufacturing firms in Japan, Gan (2007) constructs real estate value prior to the collapse as the

main measure of exposure to property price shocks (the market value of real estate is calculated following a similar procedure to Chaney, Sraer, and Thesmar 2012). She finds that Japanese firms that owned more real estate precollapse suffered particularly severely during the bust. Online Appendix Table IA18 presents results in the U.S. sample using the same regression specifications as Table 2, column (2) of Gan (2007). In the U.S. Great Recession, we do not find results similar to what Gan (2007) found in Japan. The 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.

4. Credit Access and Allocation. One concern in recent research is that 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; Li 2020). The form of corporate borrowing is important for the severity of such problems. In the United States, 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. As our findings suggest, for firms with easy access to cash flow–based lending, the sensitivity of borrowing to physical assets is small. 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.

5. Monetary Policy Transmission. As shown in Section III, EBCs are commonly specified as restrictions on total debt relative to operating earnings ($b_t \leqslant \phi \pi_t$, debt-to-earnings constraint), or interest payments relative to operating earnings ($r_t b_t \leqslant \theta \pi_t$, 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 an 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 (2019).

V.B. Implications for Modeling Assumptions

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

For major U.S. nonfinancial firms, we find that cash flow–based lending prevails (given the legal foundations in the United States that allow for high verifiable cash flows and the high asset specificity of nonfinancial firms), and borrowing constraints emphasize firms' cash flow value. For models with riskless debt and quantity constraints (e.g., Kiyotaki and Moore 1997), for example, the data suggest that a prevalent form of borrowing constraint restricts a firm's total debt as a function of its cash flows measured using current operating earnings (EBCs: $b_t \leqslant \phi \pi_t$). More generally, modeling borrowing constraints based on a firm's pledgeable going-concern cash flow value (or the present value of operating earnings) can also be viewed as broadly in line with the spirit of cash flow–based lending (Liu and Wang 2014). Traditional specifications of borrowing constraints in macro-finance models, such as restricting a firm's total debt based on the liquidation value of physical assets (e.g., $b_t \leqslant \frac{q_{t+1}}{R} k_t$) or based on the capital stock (e.g., $b_t \leqslant \psi k_t$),[27] may not be the most accurate description. Analogously, for more complicated models with risky debt and defaults in equilibrium (e.g., Ottonello and Winberry forthcoming), the data then suggest 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. Furthermore, as we note in Section III.A, EBCs in practice generally apply to the total debt of the firm (as in equations (1) and (2)), not just cash flow–based debt; meanwhile, the subset of asset-based debt (if this exists) would have borrowing limits based on the liquidation value of specific assets pledged to these lenders.[28]

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27. Borrowing constraints based on capital stock are used in Buera and Shin (2013), Moll (2014), and 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 intangible capital.

28. We explain the rationale for this design in detail in Online Appendix Section IA5.1. In short, in Chapter 11, total payments to creditors are pinned down by the going-concern cash flow value of the restructured firm. The payoffs of cash flow–based debt in Chapter 11 are determined by this value minus the

On the other hand, for firms that primarily borrow asset-based debt (because of low verifiable cash flows, limited bankruptcy court capacity or prevalent corporate liquidations, or predominance of standardized transferable assets, as discussed in Section II.C), such as firms in Japan (Gan 2007), small firms (Cloyne et al. 2020), and airlines (Pulvino 1998; Benmelech and Bergman 2009, 2011), the traditional specifications focusing on the liquidation value of physical assets fit well.[29]

VI. Conclusion

In this article, we collect detailed data to empirically study borrowing constraints of nonfinancial firms. Based on findings in the data and insights of classic models in contract theory and macro-finance, the overarching framework for firms' borrowing constraints has the following steps. First, the institutional environment shapes what types of contract terms can be enforced and what drives creditors' payoffs in default (e.g., liquidation value of specific assets versus cash flow value of firms' continuing operations). Second, the enforceability of contracts then shapes the determinants of firms' ex ante borrowing capacity. Third, the determinants of firms' borrowing constraints shape how financial variables (such as cash flows in the form of operating earnings, or the liquidation value of physical assets) influence firm outcomes and the applicability of macro-finance mechanisms.

In many classic macro-finance models, creditors can seize physical assets, whereas cash flows are not verifiable. Correspondingly, firms' debt capacity is tied to the liquidation value of physical assets that creditors can seize. On the other hand, in the United States, creditors may not be able to seize physical assets

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liquidation value of specific assets pledged to asset-based debt. It is easier to specify ex ante limits of total debt as a function of the firm's operating earnings, so cash flow–based lenders do not have to estimate the liquidation value of specific assets pledged to asset-based debt, which is generally not their specialty.

29. How do our findings relate to the idea of the net worth channel? The core of the net worth channel is that external financing is costly, in which case internal funds (i.e., net worth) affect firms' outcomes. It does not pin down the form of corporate borrowing and borrowing constraints. The general lesson of the net worth channel, that is, external financing has frictions and internal funds are valuable, applies in our setting. Our focus is the form of external borrowing and constraints, and the corresponding implications.

(given the automatic stay in bankruptcy), while firms may have high verifiable cash flows. Correspondingly, cash flow–based debt is prevalent and the accompanying earnings-based borrowing constraints can be the most relevant constraint for firms' total debt capacity.

As Djankov et al. (2008) show, countries differ in their legal foundations for debt enforcement. As a result, macro-finance mechanisms may not apply uniformly across the board. The relevant assumptions in modeling may need to adapt to the setting of interest.

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SUPPLEMENTARY MATERIAL

An Online Appendix for this article can be found at *The Quarterly Journal of Economics* online.

DATA AVAILABILITY

Code replicating the tables and figures in this article can be found in Lian and Ma (2020), in the Harvard Dataverse doi: 10.7910/DVN/T9KXMF.

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