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TWO TALES OF DEBT

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ABSTRACT

We study the nature of debt among US non-financial firms and its determinants. One approach of debt enforcement lends against the liquidation value of discrete assets (such as fixed assets or working capital). Another approach lends against the going-concern value of the business. Using a new dataset on the liquidation value of different types of assets as well as the going-concern value of distressed firms across major industries, we present several findings. First, non-financial firms have limited liquidation values from fixed assets and working capital, which sum to around 23% of book assets for the average firm. Second, firms with lower liquidation values have more loans with monitoring and tighter performance covenants. Third, lower liquidation values are associated with higher interest rates, but only for debt against discrete assets. We finally present a model that matches the main findings, which demonstrates how covenants and control right institutions facilitate borrowing well beyond liquidation values.

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1 Introduction

Debt is one of the most widely used contracts for financing companies around the world. The nature and enforcement of debt have long been key questions in economics research. Broadly speaking, there are two general approaches of debt enforcement (Djankov, Hart, McLiesh, and Shleifer, 2008; Diamond, Hu, and Rajan, 2019b). In one approach, creditors lend against the liquidation value of discrete assets, namely separable, and often tangible, assets that can be evaluated (and if needed repossessed) on a standalone basis. In this approach, property right institutions are most important for enforcing debt contracts (De Soto, 2000), and the liquidation value of the assets conveyed to creditors is the main determinant of borrowing capacity. In another approach, creditors lend against the going-concern value of the firm, generated by the firm's operations, human capital, and business model, which is not necessarily encapsulated by the liquidation value of discrete or tangible assets. For this type of debt, lenders' payoffs are tied to the value created by the business, and the allocation of control rights (over business decisions) between firms and creditors can have important implications. Correspondingly, institutions that facilitate cash flow verifiability and creditor monitoring support debt enforcement and debt capacity.[1]

What shapes the nature of debt and the relative importance of these two approaches of lending? What are the foundations for implementing creditor monitoring and control? What ultimately determines firms' debt capacity? In this paper, we shed further light on these questions by collecting new data on the key attributes of US non-financial firms across different industries, including liquidation values that derive from discrete assets (such as fixed assets and working capital), as well as going-concern values in distress. We combine this data on the nature of firms' assets with detailed data on firms' liabilities to inform our understanding of the nature of non-financial corporate debt.

We start by presenting the data and the basic features of the nature of assets for public non-financial firms. We document that, in most industries, liquidation values from discrete assets such as property, plant, and equipment (PPE) and working capital are limited, accounting for only 23% of book assets on average. In contrast, going-concern values, even in distress, tend to be much higher. Both values vary systematically across industries, and are not significantly correlated with each other. Accordingly, debt capacity

[1]Commercial mortgages, and loans against working capital and equipment are standard examples of the first approach, while a substantial portion of business loans and the majority of corporate bonds in the US belong to the second approach (Lian and Ma, 2020). Throughout this paper, we use the terms "monitoring" and "control rights" to refer to monitoring and control of the firm's business decisions and operating performance.

solely based on liquidation values of discrete assets is limited, while debt capacity based on going-concern values of the firm (if can be enforced) is greater. We then exploit the variations in firms' liquidation values across different industries, and present empirical results that demonstrate the features of firms' debt contracts—including debt composition and covenant tightness—as a function of the liquidation value, the going-concern value, the amount of borrowing, and legal institutions in the background. We end with a simple model to understand the role of creditor monitoring as reflected by the data.

We obtain information about firms' liquidation values, as well as going-concern values in Chapter 11 restructuring, across different industries from US corporate bankruptcy filings between 2000 and 2016. For liquidation values, we hand collect liquidation recovery rate estimates (i.e., liquidation value as a fraction of net book value) for each main asset category (PPE, inventory, receivable, etc.) reported in the liquidation analysis of Chapter 11 cases. These estimates document the projected liquidation values if the firm were to be liquidated in Chapter 7 (in which case the firm ceases operations and a trustee sells off the assets).[2] We then take the average recovery rate of each asset class in each two-digit SIC industry to reduce noise. We then estimate the liquidation values of Compustat firms using the liquidation recovery rates of each type of asset in their industry, and the book value of assets they have. For going-concern values in distress, we also hand collect this information from the Chapter 11 cases, using firms' market values (or acquisition values) after emergence if available, and firm value estimates in Chapter 11 plans otherwise. We normalize the going-concern value by total book assets at filing to compute the going-concern recovery rate, and take the average for each two-digit SIC.

We perform extensive checks about the informativeness of the data. For liquidation recovery rate estimates, we cross check with prior work that documents equipment liquidation values using auctions data in a particular industry (Ramey and Shapiro, 2001) and with actual liquidation recovery rates in Chapter 7. These checks verify that our data is consistent with market-based transactions. We also cross check with benchmarks of liquidation recovery rates used by creditors in ex ante lending decisions for non-financial firms (which are 20% to 30% for industrial PPE for instance according to a large bank), and with recovery rates implied by PPE sales among Compustat firms. In a companion paper (Kermani and Ma, 2020), we further show that variations in liquidation recovery rates are closely tied to the physical attributes of assets used in different industries (such as mobility, durability, and standardization), measured independently based on industry-wide data from the BEA. These checks verify that our data lines up with the relevant

[2]These estimates commonly derive from appraisals by specialists in asset valuations and conducting liquidations, who perform on-site field exams and simulates live liquidations.

features of non-financial firms more generally. For going-concern values in restructuring, we cross check estimates in Chapter 11 plans and post-emergence market trading data, which are fairly consistent with each other on average. Overall, we do not find evidence of systematic biases. While these measures inevitably contain some noise, they have substantial explanatory power for the behavior of non-financial firms despite possible attenuation bias, as we show below and in Kermani and Ma (2020).

In the data, we find that for the average Compustat firm, the estimated liquidation value of PPE and working capital (inventory and receivable) combined is 23% of total book assets. Of this 23%, roughly 8.5% comes from PPE, 4.7% comes from inventory, and 9.3% comes from receivables. The inter-quartile range is 12% to 33%. If we additionally include all cash holdings, the mean becomes 44%, and the inter-quartile range becomes 30% to 54%. In comparison, for the same set of firms, the average Chapter 11 going-concern recovery rate is 81%, with inter-quartile range 68% to 100%.

Correspondingly, we find that a large number of firms borrow beyond the liquidation value of PPE and working capital. About one half of firms with positive leverage and 75% of non-investment grade firms have more debt than the estimated liquidation value of PPE and working capital. The fractions become 34% and 63%, respectively, when we also include all cash holdings in the liquidation value. Meanwhile, a small number of firms—12% of firms with positive leverage and 23% of non-investment grade firms—have more debt than the estimated Chapter 11 going-concern value. Overall, the data indicates that the liquidation values of non-financial firms are often quite limited, and debt enforcement goes beyond focusing on the liquidation value of discrete assets.

To further understand the nature of debt, we analyze the key features of firms' debt contracts in detail, and show their variations as a function of firms' liquidation values, Chapter 11 going-concern values, and borrowing amount. We study debt composition, monitoring intensity reflected by financial covenants, as well as additional attributes such as interest rates and recovery rates. We collect detailed data on debt composition using information from CapitalIQ (as in Lian and Ma (2020)), data on covenant strictness from DealScan (following Murfin (2012)), data on interest rates from CapitalIQ and DealScan, and data on debt recovery rates in default from Moody's.

For debt composition, we categorize debt into three main groups. We start with whether creditors have claims against discrete assets or against the firm as a whole (commonly referred to as "asset-based debt" and "cash flow-based debt" by creditors, and we follow their terminology).[3] We then decompose cash flow-based debt further into a part

[3]One could alternatively refer to them as "liquidation value-based debt" and "going-concern value-based debt" to reflect their economic properties. In this paper, we follow the conventional terms widely

with light monitoring (like bonds), and a part with strong monitoring (like loans). Our analyses follow the provisions of US bankrtupcy laws, where the automatic stay prevents creditors from seizing assets to threaten the firm or obtain payments beyond what their claims are entitled to.

We first look at asset-based debt, where creditors have claims against the liquidation value of discrete assets (e.g., commercial mortgages, inventory and equipment loans). Its prevalence is higher for firms with high liquidation values. Its share in total debt is high for the first 5% to 10% of book leverage, and declines substantially as firms take on more debt, especially for firms with low liquidation values. The prevalence of asset-based debt also decreases with estimated Chapter 11 going-concern values. We then turn to cash flow-based debt with weak control, where creditors have claims against the firm as a whole but do not typically have active interventions of firms' actions. In the baseline analysis, we represent this group using cash flow-based bonds. Its prevalence is higher for firms with lower liquidation values. Its share in total debt is highest for the medium range of leverage. We finally analyze cash flow-based debt with strong control, where creditors have claims against the firm as a whole, and often engage in active monitoring and control, for instance, by imposing restrictive financial covenants (Smith and Warner, 1979; Roberts and Sufi, 2009; Bradley and Roberts, 2015). In the baseline analysis, we represent this group using cash flow-based loans. Its prevalence is higher for firms with low liquidation values. In particular, this type of debt is most common when firms take on a substantial amount of debt. Its prevalence also increases with the Chapter 11 going-concern value.

Overall, the debt composition results indicate a slight pecking order. Firms use asset-based debt against liquid, standardized assets for the initial amount of borrowing, which can have a slight cost advantage. Many firms, however, do not have a large amount of such assets. Firms then transition to using cash flow-based debt with weak control for medium levels of borrowing. Eventually, firms rely on cash flow-based debt with strong control for high levels of borrowing. The results are similar if we use industry-average liquidation values (instead of firm-level liquidation values), or if we instrument firms' liquidation values using the physical attributes of their assets measured in Kermani and Ma (2020).

We also show that, in contrast to the conventional wisdom in the economics literature, secured debt in the US is not necessarily about lending against the liquidation value of discrete assets (i.e., it is different from asset-based debt). Under US law, the essence of security (or having "collateral") is to obtain priority and seniority. Creditors can

used by creditors.

take priority against the liquidation value of discrete assets through secured asset-based debt, or against the going-concern value of the firm through secured cash flow-based debt (with security against "substantially all assets" of the firm, sometimes referred to as "blanket liens"). A key economic function of having blanket liens is to implement strong control over the company, so secured cash flow-based debt could also be viewed as a representation of cash flow-based debt with strong control. In the data, we find that the prevalence of secured cash flow-based debt decreases with the firm's liquidation value, increases with leverage (especially for firms with low liquidation values), and increases with the Chapter 11 going-concern value. Indeed, these features are similar to cash flow-based loans discussed above, and are the *opposite* of asset-based debt.

We then examine covenant tightness as another indicator of monitoring intensity. We measure covenant tightness following Murfin (2012), and estimate the probability of covenant violation based on the covenant threshold specified at loan issuance. We find that financial covenants of corporate loans, especially performance covenants (generally specified as a function of firms' operating earnings), are tighter when the firm's liquidation values are lower and when leverage is higher. The tightness of financial covenants also has a positive correlation with the Chapter 11 going-concern value.

Additionally, we use other debt attributes to corroborate the nature of different types of debt. Using interest rates data, we find that the interest rates of asset-based debt decrease significantly more with liquidation values. Using debt recovery rates in default, we also find that the recovery rate of asset-based debt has a significant positive association with firms' liquidation values, but not with firms' Chapter 11 going-concern values. The recovery rate of cash flow-based debt displays the opposite pattern. These results are in line with default resolutions under US bankruptcy laws. Asset-based debt has claims against discrete assets, and their payments primarily depend on the liquidation values of such assets. Cash flow-based debt, on the other hand, primarily obtains recovery value based on the going-concern value of the restructured firm, and should be more concerned about the value of the firm's business operations.

Finally, for total borrowing, we find that leverage does not depend on liquidation values for large firms and firms with positive earnings. Leverage does have a strong positive relationship with liquidation values for small firms and firms with negative earnings.

After presenting the empirical findings, we provide a simple model to analyze the role of creditor monitoring, which sheds light on the empirical findings. We design the model to closely mimic the US institutional settings. In the model, the firm invests in a project that can result in success or failure (liquidation). The probability of success versus failure depends on costly effort by the entrepreneur, which is not contractible (moral hazard).

However, there is an observable noisy signal of performance in an interim period, and informed lenders can write a contract that allocates the control right over the firm as a function of this signal. This design can be thought of as a financial covenant. Upon a low realization of the signal, informed lenders can investigate and find out the true effort of the entrepreneur. If low effort is detected upon investigation, the informed lenders can threat an intervention, which can be interpreted as Chapter 11 restructuring.

The model offers several main takeaways. First, consistent with the data, the model shows that monitoring and creditor control are more important when liquidation values are low and leverage is high. Second, as long as covenants can be enforced and monitoring is not too costly, liquidation values affect debt composition but not necessarily total debt capacity. Third, monitoring is undertaken by a subset of cash flow-based debt: similar to the US institutional setting, the model suggests that such creditors have high priority against the firm's business value in success and in restructuring, but not against the firm's liquidation value. The going-concern value in Chapter 11, instead of liquidation value, is the key threat for monitoring. Fourth, although there is only a small fraction of debt with strong monitoring, it can provide valuable services to other creditors and help the firm borrow beyond the liquidation value. In comparison, the common approach for having debt capacity beyond liquidation values in several classic models is to threat seizing and foreclosing assets, which may not necessarily be consistent with the automatic stay under US bankruptcy laws.

The empirical evidence and the model shed further light on the roles of property right institutions (e.g., ability to perfect security interests against particular assets) and control right institutions (e.g., covenant enforcement, court-supervised restructuring such as US Chapter 11) for debt enforcement. Better property right institutions can help lenders avoid paying monitoring costs. However, given the low liquidation values of firms in most industries, control right institutions are ultimately essential for firms' access to debt financing.

1.1 Literature Review

Our paper makes three main contributions. First, we assemble new data on firms' liquidation values and Chapter 11 going-concern values, which provides valuable information for understanding the role of different approaches of debt enforcement. Second, we present a systematic characterization of debt attributes, including debt composition and monitoring intensity, as a function of firm characteristics. Third, we offer a simple theoretical framework that closely follows the US institutional setting and the empirical

evidence. It demonstrates how control right institutions facilitate borrowing of non-financial firms, most of which have high asset specificity and limited liquidation values from discrete assets.

Our work relates to several strands of literature. First, our analysis is related to, and in large part motivated by, prior studies focusing on different perspectives of debt enforcement. One branch of work focuses on pledging tangible assets as collateral that can be seized and liquidated by creditors (Hart and Moore, 1994, 1998; Kiyotaki and Moore, 1997; Rampini and Viswanathan, 2013, 2010; Demarzo, 2019). This view has influenced empirical analyses of both firms and households (Almeida and Campello, 2007; Benmelech and Bergman, 2009; Chaney, Sraer, and Thesmar, 2012; Mian and Sufi, 2011). Another branch of work points to the importance of monitoring and control rights (Diamond, 1984; Aghion and Bolton, 1992; Dewatripont and Tirole, 1994; Holmstrom and Tirole, 1997; Kaplan and Strömberg, 2003; Diamond et al., 2019a). A number of papers provide empirical evidence on the role of financial covenants for implementing creditor control rights (Smith and Warner, 1979; Chava and Roberts, 2008; Roberts and Sufi, 2009; Nini, Smith, and Sufi, 2012; Matvos, 2013; Becker and Ivashina, 2016; Green, 2018; Berlin, Nini, and Edison, 2020). We contribute to the literature by documenting the importance of firms' liquidation values vs. going-concern values for determining debt structures and covenant usage, and by developing a simple model that sheds further light on the interaction between firm attributes and debt characteristics.

Second, our work relates to studies on law and finance which investigate the importance of bankruptcy regimes and legal institutions for enforcing debt contracts (Porta, Lopez-de Silanes, Shleifer, and Vishny, 1998; Acemoglu and Johnson, 2005; Beck and Levine, 2005; Haselmann, Pistor, and Vig, 2010; Becker and Josephson, 2016). In addition, several papers highlight the importance of bankruptcy institutions for firms' real outcomes and the efficiency of resource allocation (Strömberg, 2000; Ponticelli and Alencar, 2016; Corbae and D'Erasmo, 2017; Iverson, 2018; Bernstein, Colonnelli, and Iverson, 2019; Iverson, Madsen, Wang, and Xu, 2019). Our results suggest that property right institutions can be crucial for early stages of financial development which focus on enforcing asset-based debt. However, as financial development progresses, further advancement of contracting institutions is needed so that financial performance can be verifiable, covenants can be enforced, and restructuring can be implemented to preserve firms' going-concern values.[4]

Third, our work connects to research on debt structure, which has covered a number

[4]Our result can also provide a rationale for the limitations of laws and bankruptcy reforms that focus on creditors' rights to access and seize hard assets (Acharya, Amihud, and Litov, 2011; Vig, 2013).

of issues. Rauh and Sufi (2010) highlight the importance of studying the heterogeneity of debt structure, an insight that we build on. Denis and Mihov (2003), De Fiore and Uhlig (2011), and Crouzet (2018), among others, focus on bank loans versus bonds. Donaldson, Gromb, and Piacentino (2019a) and Benmelech, Kumar, and Rajan (2020a) analyze security and priority. Brunnermeier and Oehmke (2013) and Benmelech (2008) examine maturity. Luck and Santos (2019) and Benmelech, Kumar, and Rajan (2020b) also study the interest rates of various types of debt. Lian and Ma (2020) and Ivashina, Laeven, and Moral-Benito (2020) investigate the prevalence and implications of asset-based debt and cash flow-based debt. In addition, some early work studies the impact of liquidation costs on debt choices and covenant usage, for firms emerging from bankruptcy (Alderson and Betker, 1995). Our work utilizes information from bankruptcy filings, extracts the industry-level features, and applies the information more broadly. We find that information on firms' liquidation values and Chapter 11 going-concern values has substantial explanatory power for debt contracts of firms in general, i.e., for firms with varying degrees of leverage out of bankruptcy.

The rest of the paper proceeds as follows. Section 2 describes the data. Section 3 shows basic properties of liquidation values, Chapter 11 going-concern values, and borrowing. Section 4 presents our main empirical results about how debt attributes vary with firms' liquidation values, Chapter 11 going-concern values, and amount of borrowing. Section 5 presents the model. Section 6 concludes.

2 Data and Definition

In this section, we describe the data collection and the definition of main variables.

2.1 Liquidation Recovery Rates and Chapter 11 Going-Concern Values

We hand collect data on liquidation recovery rates of major asset categories (i.e., PPE, inventory, receivable, etc.) and going-concern firm value estimates from Chapter 11 filings, from 2000 to 2016. We describe the data collection process below and perform extensive checks to verify the informativeness of the data.

2.1.1 Data Collection

We begin with a list of bankruptcy filings by public US non-financial firms from New Generation Research BankruptcyData.Com. We then retrieve disclosure statements of Chapter 11 cases from Public Access to Court Electronic Records (PACER) and BankruptcyData.Com. The disclosure statements provide information of firms' post-restructuring financial structure, estimates of the going-concern value of the business, and estimates of the liquidation value of the assets. When a case has multiple disclosure statements, we use the earliest version. If the information we need is not available, we then use the latest version.

Liquidation Recovery Rates

In the US Chapter 11 process, firms are asked to perform a liquidation analysis and document the liquidation value of their assets if they were liquidated in Chapter 7. In this scenario, the firm would cease operations and existence, and a trustee would sell off its assets (on a largely piecemeal basis over a roughly one year horizon). US bankruptcy laws require that claim holders should receive at least as much payments in Chapter 11 restructuring as what they would have received in liquidation.[5] To our knowledge, the liquidation analysis in Chapter 11 cases provides the most comprehensive reporting of liquidation values covering all types of assets (whereas secondary market trading data is sparse for many types of real assets, and it is also difficult to know the asset composition across industries to aggregate values of individual items to the firm level).

The liquidation analysis typically presents a summary table with the net book value (i.e., historical cost net of depreciation), liquidation value, and liquidation recovery rate (liquidation value as a fraction of net book value), for each type of asset (PPE, inventory, receivable, etc.) and for the firm as a whole.[6] It also includes additional notes that explain in more detail the sources and assumptions of the estimates. The estimates commonly derive from appraisals by companies that specialize in asset liquidations and valuations, who perform field exams and simulate live liquidations to assess the liquidation value of different types of assets. These specialists routinely conduct asset liquidations, which give them knowledge and information about how the liquidation would proceed in each

[5]The liquidation analysis is performed for both in-court and prepackaged Chapter 11 cases.

[6]Because the liquidation recovery rates are normalized by the net book value of assets, we also check that the depreciation rates firms use for book assets are reasonable. For each firm in Compustat, we calculate its PPE depreciation rate, as well as the fixed asset depreciation rate in its industry according to BEA's fixed asset tables. We find that depreciation rates used by firms are very similar to those used by the BEA (the correlation is over 0.5 and the average difference is about one percentage point). Nonetheless, firms generally apply linear depreciation while the BEA uses geometric depreciation. Given the depreciation rate is similar, this implies that the net book value using firms' depreciation methods tend to be smaller (which if anything would bias the liquidation recovery rate upward).

setting (e.g., how much can be sold to primary, secondary, and tertiary buyers). They are also responsible for assessing liquidation values for lenders, and some liquidation analyses directly use estimates by lenders. By definition, the liquidation value captures the value of reallocating standalone and separable assets by themselves, not combined with human capital or organizational capital.[7]

Figure 1 shows two examples of the liquidation analysis summary tables, from a chemical company LyondellBasell and a communication products company Sorenson Communications. As shown in these cases, the liquidation analysis often includes several scenarios (low, midpoint, high). We use the midpoint estimate in the baseline, and the average of low and high scenarios when the midpoint is not available. Section IA2 in the Internet Appendix shows excerpts from notes to LyondellBasell's liquidation analysis, which show that the liquidation value of PPE comes from facility-level appraisals by American Appraisal Associates, and the liquidation value of inventory and receivable uses estimates from their credit facilities against working capital assets.

The liquidation analysis data has several advantages. First, it covers the liquidation value of *all assets* owned by a firm, instead of the resale value of only assets that are traded frequently on secondary markets, pledged to lenders, or sold off (Berger, Ofek, and Swary, 1996; Murfin and Pratt, 2019). For instance, specialized, illiquid assets may not trade in secondary markets or be pledged to lenders. Firms' asset sales could have a number of strategic considerations (Maksimovic and Phillips, 2001). Second, the liquidation analysis data shows not just the liquidation value in dollar amounts but also the recovery rate, i.e., liquidation value as a fraction of book value, while most other data sources do not have information about book values or recovery rates. Having recovery rates is important for comparisons across different types of assets, and for constructing firm-level liquidation value estimates among a broader set of firms. Finally, compared to various indirect proxies of asset specificity (such as Rauch (1999) and Kim and Kung (2017)), our data allows for assessment of magnitudes such as comparisons of liquidation values with going-concern values and debt values. In Section 2.1.2, we perform detailed cross checks to further verify the informativeness of our data.

In the main analyses, we use the average liquidation recovery rates for each type of asset in a given industry (two-digit SIC). With the assumption that owned assets are similar in an industry, we can construct liquidation value estimates of a firm k in industry

[7]Whether different pieces of these discrete assets are likely to be sold together versus separately relies on the assessment and simulations by appraisal specialists. As shown in the examples of Figure 1, firms often provide high, midpoint, and low estimates of the liquidation value, which in part reflect whether items with possible synergies could be sold together (e.g., plant and equipment). For PPE recovery rates, the high estimate is on average two percentage points higher than the midpoint estimate.

i and year t as:

$$LiqVal_t^k = \sum_j \lambda_{ij} NBV_t^{kj}, \tag{1}$$

where λ_{ij} is the average liquidation recovery rate of asset type j in industry i, and NBV_t^{kj} is the net book value of asset type j of firm k in year t. In Kermani and Ma (2020), we verify that liquidation recovery rates are largely an industry feature, and are closely tied to the physical attributes of assets used in each industry. For PPE, for instance, we find that physical attributes (such as mobility, durability, and standardization) measured using BEA data can account for at least 40% of the cross-industry variation in PPE liquidation recovery rates. We also analyze variations of recovery rates due to time-varying macroeconomic conditions or industry conditions. We find that macro conditions (such as GDP growth) and industry conditions (such as industry leverage following Shleifer and Vishny (1992)) have relatively weak impact on liquidation recovery rates on average, but stronger impact for assets that are relatively standardized and used economy-wide or industry-wide (instead of being customized and firm-specific). Overall, time-varying economic conditions seem unlikely to offset major differences across industries due to physical attributes.[8]

Our data covers assets owned by firms. Some assets firms use may be under operating leases, instead of being owned (Eisfeldt and Rampini, 2009). In Internet Appendix Section IA3, we perform robustness checks of our main results, assuming operating lease liabilities are akin to asset-based debt (given lessors have ownership over certain discrete assets firms use, and can eventually repossess them when the leases end) and the leased assets contribute to the liquidation value of discrete assets. In addition, to gauge the prevalence of opearting leases, we check data from the new accounting rule (Accounting Standards Update 842) adopted in 2019 which requires firms to report leased (right-of-use) assets and corresponding operating lease liabilities. We find that the median ratio of leased assets to owned assets is about 2% among Compustat firms (inter-quartile range 0% to 5.5%), which is reasonably small.[9] Moreover, we also find that the prevalence of operating leases appears to be primarily an industry feature, and industry fixed effects (e.g., two-digit SIC) account for about 30% of R^2 in the variation of the ratio of leased assets to

[8]For instance, to bring PPE liquidation recovery rates from the highest industries (e.g., transportation at around 69%) to the median (e.g., a typical manufacturing industry at around 35%), macro or industry conditions need to change by more than 1.5 standard deviations.

[9]Another way to estimate the prevalence of operating leases is to calculate assets owned by the two lessor sectors using BEA data, which are 5320 (Rental and Leasing Services and Lessors of Intangible Assets) and 5310 (Real Estate, which includes REITs that lease real estate properties to others). The total (non-residential) assets owned by these two sectors are also less than 5% of total assets owned by non-financial corporate businesses in the Flow of Funds. Since the lessor sectors also include some lessors to households (e.g., car rentals), this estimate would be upward biased.

owned assets.[10] This finding is in line with our observation above that the features of assets firms own have general similarities within an industry.

Going-Concern Values in Restructuring

We also hand collect data on firms' going-concern values in Chapter 11. We use going-concern value estimates reported in the valuation analysis of the disclosure statement, as well as firm values based on post-emergence market values (market value of equity plus book value of debt, within one year of restructuring plan confirmation) if the firm emerged as a public company and enterprise values in acquisition if the firm was acquired. We normalize the going-concern value of the firm by total assets at filing, which provides an estimate of the going-concern recovery rate.

In the baseline analysis, we use post-emergence market value or acquisition value if they are available, and supplement with valuation analysis estimates otherwise. On average, the valuation analysis estimate and the post-emergence market value match with each other (i.e., the difference is close to zero for cases where both values are available), consistent with the observation in Gilson, Hotchkiss, and Ruback (2000). In Internet Appendix Section IA2, we show that the distributions of these two values are also similar, and overall the Chapter 11 going-concern value estimates seem reasonably reliable. Finally, we also take the average of going-concern recovery rates in each industry to decrease idiosyncratic noise.

At the industry level, there is no strong correlation between going-concern recovery rates and liquidation recovery rates of discrete assets. The correlation between industry-average going-concern recovery rate and industry-average liquidation recovery rate of PPE, inventory, and receivable is -0.26 (p-value 0.08), -0.13 (p-value 0.39), and 0.16 (p-value 0.30), respectively.

Data Coverage

We are able to find liquidation analysis data for non-cash assets for 387 cases in 48 two-digit SIC industries, and going-concern values for 328 cases in 49 two-digit SIC industries. Table IA1 shows the number of cases for each industry. For some small industries such as fishing (less than one firm in Compustat per year in our sample period), building materials (5 to 15 firms in Compustat per year), special construction (10 to 20 firms in Compustat per year), we have few observations. For large industries such as business services (500 to 1,000 firms in Compustat per year), chemicals (600 to 700 firms in Compustat per year), mining (200 to 300 firms in Compustat per year), communications (100 to 300 firms in

[10]The ratio of leased to owned assets is high for retail (average above 20% for apparel stores, department stores, restaurants, and furniture stores), modest for airlines and cinemas (average around 10%), and very low (average below 10%) for most other industries.

Compustat per year), etc., we have a large number of observations.

2.1.2 Cross Checks

We perform a number of checks for the liquidation recovery rates in our data. There are three types of possible concerns. The first type of concern is that firms in Chapter 11 may have incentives to understate the liquidation value of their assets, so that they can justify restructuring. We note that for the median Chapter 11 firm in our data, the going-concern value is twice as much as the gross liquidation value, so the manipulation incentive may not be very strong. The second type of concern is that firms in Chapter 11 are special and different from the typical non-financial firm, because the Chapter 11 restructuring may occur when the firm, its industry, or the economy experiences unfavorable conditions, which may contribute to lower recovery rates. The third type of concern is that the reported values can be noisy or arbitrary, and are therefore uninformative.

In the following, we discuss four categories of checks in light of these concerns. First, we verify that our data is consistent with market-based outcomes (in settings where such data is available), including liquidation proceeds in Chapter 7 and auction proceeds. Second, the data is also consistent with liquidation value benchmarks that creditors use in *ex ante* lending decisions to non-financial firms, and the data for PPE is broadly in line with recovery rates implied by PPE sales among Compustat firms. Third, we find that the key determinants of the liquidation recovery rates appear to be the physical characteristics of assets used in different industries (measured from all firms in the industry). Firm-specific conditions and industry conditions can have some impact (e.g., change recovery rates by five percentage points), but do not seem to make a qualitative difference. Finally, while the data inevitably contains some noise, in this paper and in Kermani and Ma (2020), we find that it has substantial explanatory power for the behavior of non-financial firms in general. Overall, we do not observe evidence of systematic biases or undervaluation in the data. We also find that the data is broadly consistent with the features relevant to non-financial firms in general, and is informative for their behavior.

Comparison with Chapter 7 Liquidation Proceeds. We cross check the estimated liquidation values in our data with liquidation proceeds realized in Chapter 7 cases, and the results are reported in Table 2. We cannot use Chapter 7 cases for our main analyses because they primarily release total liquidation proceeds realized by the trustee, so we cannot obtain the liquidation recovery rates for each category of assets. Instead, we can only analyze whether the total liquidation proceeds in Chapter 7 cases are comparable with the total estimated liquidation values in the liquidation analysis of

Chapter 11 cases. A further complication is that, in Chapter 7 cases, the trustee may "abandon" certain assets, whose values are not included in the reported gross liquidation receipts (Bris, Welch, and Zhu, 2006). This can happen if the assets have little value, or are fully encumbered (i.e., they are pledged to certain creditors and the estimated liquidation value is less than the amount of debt against such assets) so the trustee returns the assets to creditors for foreclosures (instead of the trustee selling the assets).[11] Accordingly, we make the following assumptions. In the "basic" scenario, we only use the gross liquidation receipts from the trustee report. In the "medium" scenario, we add 50% of either asset-based debt or secured debt. This assumes that 50% of such debt claims are associated with abandoned assets and they cover close to par. In the "high" scenario, we add 100% of either asset-based debt or secured debt. This assumes all of such debt claims are associated with abandoned assets and they recover close to par, which is an aggressive assumption that likely over-estimates the total liquidation value.

In Table 2, we compare the total estimated liquidation value in Chapter 11 cases with the liquidation value in Chapter 7 cases, controlling for industry and time fixed effects. We normalize total liquidation values by total assets at filing. Table 2 shows that the actual Chapter 7 liquidation value is less than the Chapter 11 liquidation analysis estimates in the "basic" scenario, about the same in the "medium" scenario, and slightly higher in the "high" scenario. Overall, the total liquidation value in Chapter 7 seems to match with estimates in the Chapter 11 liquidation analysis on average.

Comparison with Auction Proceeds. Ramey and Shapiro (2001) collect detailed data from liquidation auctions of aerospace manufacturing equipment. They estimate that the average liquidation recovery rate is 28% of replacement cost. In our data, based on the same three-digit SIC (372), the liquidation recovery rate on machinery and equipment is 32%, which is very similar.

Comparison with Lenders' Benchmarks. Our data is also consistent with the advance rate (i.e., the maximum allowed ratio of debt amount to book assets) that creditors use for lending against discrete assets, which reflects their liquidation value assessment. Such assessment also comes from field examinations and liquidation simulations of specialist appraisers. The advance rate for lending against industrial PPE is generally 20% to 30% of book value, according to a large bank. In our data, the average industry-level PPE liquidation recovery rate is 35%. The advance rate for lending against inventory is generally 50% to 60% of book value for eligible inventory (see also OCC *Comptroller's*

[11] If the estimated liquidation value of an asset is greater than the debt value against it, then there is excess value in the asset that belongs to the bankruptcy estate. Such assets would be sold by the trustee, and the excess value would be used to pay other claim holders.

Handbook on Asset-Based Lending, or the variable *BorrowerBasePercentage* in DealScan when the variable *BorrowerBaseType* is "Eligible Inventory"),[12] where about 80% of inventory is eligible (e.g., work in progress inventory often ineligible), which implies 40% to 48% of total book inventory. In our data, the average industry-level inventory liquidation recovery is 44%. The advance rate for lending against receivables is generally 80% of book value for eligible receivables (see also the OCC handbook, or the variable *BorrowerBasePercentage* in DealScan when the variable *BorrowerBaseType* is "Eligible Accounts Receivable"), where about 80% of receivables are eligible (e.g., government receivable, foreign receivable are typically not eligible), which implies 64% of total book receivables. In our data, the average industry-level receivable liquidation recovery rate is 63%.

Comparison with PPE Sale Recovery Rates of Compustat Firms. In Kermani and Ma (2020), we compute the industry-level recovery rates implied by PPE sales among all Compustat firms. We find that they are similar to the PPE liquidation recovery rates in our data, with a significant positive correlation between the two measures across industries.

Determinants of Liquidation Recovery Rates. In Kermani and Ma (2020), we analyze determinants of liquidation recovery rates in detail. We find that they are strongly shaped by the physical attributes of assets used in an industry, measured independently among all firms in the industry using BEA data. Indeed, if there are no reallocation frictions—such as if PPE is costless to transport, fully durable, and fully standardized—then the data suggests that the recovery rate would be 100%. In addition, we find that better general economic conditions and industry conditions can improve recovery rates, especially when assets are less custom-designed (assets highly customized to a given firm do not seem to have much liquidation value in any case). Nonetheless, it would take substantial changes in macroeconomic or industry conditions to change PPE liquidation recovery rates by more than ten or twenty percentage points (even if no assets are custom-designed). Similarly, firm-specific conditions may affect liquidation recovery rates, but in normal circumstances they do not seem to make a qualitative difference. In particular, the liquidation value captures the value in alternative use, rather than the quality or the performance of the current business (e.g., the real estate of a book store making losses may have high liquidation value, while the customized equipment of a pharmaceutical company with higher cash flows may have little liquidation value). In sum, while economic conditions can affect liquidation recovery rates, they do not seem to offset the impact

[12] Asset-based debt (i.e., debt against the liquidation value of discrete, separable assets) typically has a borrowing base requirement, which specifies the maximum amount of debt allowed for borrowing against particular assets. In DealScan, the variable *BorrowerBaseType* specifies the assets pledged, and the variable *BorrowerBasePercentage* specifies the advanced rate against those asset.

of physical attributes: they do not easily erase differences across industries or lead to drastically different overall recovery rates.

Taken together, we do not find that our data systematically understates the liquidation recovery rates, relative to Chapter 7 proceeds, auction proceeds, or lenders' estimates (although it is difficult to rule out idiosyncratic issues in some particular cases). Given that the liquidation recovery rate data is most comprehensive for Chapter 11 firms, we investigate extensively whether it is reflective of non-financial firms more generally. The checks above and our empirical analyses suggest that it provides relevant information for firms in general in a given industry.

2.2 Debt Composition and Covenant

We collect data on the composition of debt outstanding from CapitalIQ, and debt issuance from DealScan for commercial loans and Mergent's Fixed Income Securities Database (FISD) for bonds. We classify debt in several ways. First, we classify debt into asset-based debt and cash flow-based debt as in Lian and Ma (2020), according to the economic determinants of creditors' claims and payoffs in the US institutional setting. Asset-based debt refers to debt against the liquidation value of discrete assets (assets that can be evaluated and repossessed on a standalone basis), such as commercial mortgages against commercial real estate, as well as asset-based loans against PPE, inventory, receivable, oil and gas reserves, etc. Asset-based debt generally ensures that it has clear and exclusive claims against the value of a particular asset by explicitly taking security interests in the asset, and can be identified accordingly. Lenders also commonly limit the size of asset-based debt by the estimated liquidation value of the particular assets pledged to them (hence the name). Cash flow-based debt refers to debt against the going-concern cash flow value of the firm as a whole, and can take the form of both loans (e.g., a significant fraction of syndicated loans) and bonds. It can be either secured by the firm as a whole ("substantially all assets" in legal parlance, and sometimes referred to as a "blanket lien," excluding particular assets pledged to asset-based debt), or unsecured. Debt capacity in this case is not related to liquidation values, but commonly tied to cash flows in the form of operating earnings (hence the name). In US Chapter 11 bankruptcy, which is most relevant for major non-financial firms, the payoffs of asset-based debt are primarily driven by the estimated liquidation values of discrete assets pledged to them, while the payoffs of cash flow-based debt are primarily driven by the going-concern value of the restructure firm. The definitions and default resolutions are discussed in more detail in Lian and Ma (2020). We also analyze the difference between this categorization

and secured vs. unsecured debt in Section 4.

The going-concern value of the firm and the liquidation value of discrete assets can be very different, given the role of human capital, organizational capital, and business model, as well as the high degree of asset specificity, as shown in Section 2.1. Section 2.1 also suggests that in the data, the liquidation recovery rates of discrete assets and the going-concern value of the firm are not very correlated. The terms "asset-based debt" and "cash flow-based debt" follow the common usage by creditors, and they can be thought of as shorthand references to debt claims based on the liquidation value of discrete assets and the going-concern cash flow value of the firm (one could come up with alternative shorthand references such as "liquidation value-based debt" and "going concern value-based debt"). The distinction of different types of debt is especially relevant when firms have multiple types of creditors (if there is only one creditor, then the payoff in default is driven by the firm's going-concern value if the firm is restructured and liquidation value if the firm is liquidated, regardless of whether the contract is explicitly tied to discrete assets). In our data, the average firm has six debt contracts outstanding according to CapitalIQ data (roughly three asset-based debt contracts and three cash flow-based debt contracts), and the number of claimants is larger if trade creditors are also taken into account. In practice, different lenders commonly specialize in different lending approaches: some have expertise in evaluating the liquidation value of discrete assets (Gopal, 2019), while others have expertise in analyzing and monitoring firms' operations (Berger, Minnis, and Sutherland, 2017).

Second, among cash flow-based debt, we further classify debt into those with strong and weak control. In the baseline analysis, we use loans as a proxy for strong control and bonds as a proxy for weak control, as loans have more concentrated ownership as well as stronger covenants and monitoring than bonds (Diamond, 1984, 1991; Holmstrom and Tirole, 1997). In additional analyses in Section 4, we can also use high priority (i.e., secured by blanket liens on "substantially all assets") as a proxy for strong control, and low priority (i.e., general unsecured or subordinated) as a proxy for weak control. Since it is difficult for borrowers to raise additional financing without the permission or support of lenders with blanket liens, such lenders can have strong power.

We collect data on financial covenants from DealScan for commercial loans and FISD for bonds. Financial covenants in loans generally require compliance on a quarterly basis throughout the life of the loan ("maintenance tests") while covenants in bonds generally require compliance if the borrower takes certain actions ("incurrence tests"). For loan covenants, we have some information on the threshold of compliance from DealScan, which allows us to estimate covenant tightness following Murfin (2012); for

bond covenants, we do not have data on the threshold.

2.3 Summary Statistics

Table 1, Panel A, shows summary statistics for industry-level liquidation recovery rates. For PPE, the average is 35%. The inter-quartile range is 24% to 44% (the top quartile includes industries such as transportation, wholesale, and hotels, while the bottom quartile includes industries such as personal services and education). For inventory, the average 44%. The inter-quartile range is 34% to 56% (the top quartile includes industries such as auto dealers, apparel stores, and supermarkets, while the bottom quartile includes industries such as restaurants, construction, and IT). For receivables, the average is 63%. The inter-quartile range is 55% to 71% (the top quartile includes industries such as utilities, medical devices, and mining, while the bottom quartile includes industries such as education and airlines).[13]

Table 1, Panel A, also shows summary statistics of the firm-level liquidation value (normalized by book assets) estimated for Compustat firms. This value is calculated by combining the industry-level liquidation recovery rates with the book value of each type of asset the firm has, as in Equation (1). We include PPE and working capital (inventory and receivable) in the baseline variable. The mean and median of the baseline variable is 23%; the inter-quartile range is 12% to 33%. When cash holdings are included, the mean and median is around 43%; the inter-quartile range is 30% to 54%. We can also include book intangibles to account for potential liquidation values from those intangible assets that do not have physical presence but are well-defined and separable (such as usage rights, licenses, patents, software, data).[14] The average firm-level liquidation value from book intangibles is about 2.5%, and all results are similar when they are included.

Finally, Table 1, Panel A, shows the summary statistics of the Chapter 11 going-concern value. This variable is calculated by industry as discussed in Section 2.1.1 (average Chapter 11 going-concern value normalized by total book assets at filing), and applied to firms more generally based on their industries. The mean and median Chapter 11 going-concern recovery rate is about 81%; the inter-quartile range is 68% to 100%.

Table 1, Panel B, shows the debt composition and covenant prevalence of non-financial

[13]Receivables may not have full liquidation recovery rates because of past due receivables, as well as foreign receivables, government receivables, and receivables from concentrated large customers, which are difficult to enforce. Some receivables may also be offset by payables to the same counterparties.

[14]According to accounting rules, intangible assets appear on firms' balance sheets (i.e., book intangibles) if they are acquired from outside. Many of such intangible assets are separable and can generate liquidation values on a standalone basis. On the other hand, other forms of intangibles, such as organizational capital, are not separable from the firm and do not generate liquidation values.

firms in our sample from Compustat.

3 The Firm: Liquidation Values and Beyond

In this section, we begin by providing an overview of the liquidation value and the Chapter 11 value at the firm level. We also show some basic relationships between liquidation values and borrowing.

3.1 Liquidation Values and Chapter 11 Values

As shown by the summary statistics in Section 2.3, the liquidation value from PPE and working capital is generally limited, adding to about 23% of book assets for the average firm (and 43% with cash holdings). Figure 2, Panel A, shows a breakdown of the liquidation value contributed by cash, working capital, and PPE for the average firm. Liquidation value from PPE is on average 9% of book assets, while liquidation value of inventory and receivable combined is about 14%. Figure 2, Panel B, shows the distribution of the liquidation value (red solid line for not including cash, and green dotted line for including cash). In comparison, the level of Chapter 11 going-concern value is much higher, as shown by the blue dashed line in Figure 2, Panel B.

3.2 Borrowing Relative to Liquidation Values

In Figure 3, we present heatmaps of firms' debt liabilities and total liabilities relative to liquidation values. Panel A and Panel B show that total borrowing exceeds the liquidation value of discrete assets for a number of firms. In particular, 48% of firms with positive leverage and 74% of non-investment grade firms have more debt than the estimated liquidation value of their PPE and working capital. If all cash holdings are also included in liquidation values, 34% of firms with positive leverage and 63% of non-investment grade firms have more debt than their liquidation values. The liquidation value including cash could be generous given that cash holdings are often for liquidity purposes (Alfaro, Bloom, and Lin, 2018), and may be used to pay employees and trade creditors rather than just debt holders.

Figure 3, Panel C, shows that total liabilities far exceed the liquidation value of assets for most firms. 56% of firms with positive liabilities and 85% of non-investment grade firms have higher total liabilities than the liquidation value of their PPE, working capital, and cash combined. Finally, Panel D shows that, on the other hand, asset-based debt—namely debt against the liquidation value of discrete assets—is almost always below the

liquidation value of such assets as one would expect from its definition.

Overall, the results suggest that firms' liquidation values appear limited, and not necessarily sufficient to support their debt and liabilities in general.

4 Liquidation Values, Chapter 11 Values, and Debt Characteristics

In this section, we present the main results of how debt structure and monitoring intensity vary based on liquidation values, Chapter 11 values, and amount of borrowing.

4.1 Debt Composition

We start with debt composition. As explained in Section 2, we assign debt into three categories: 1) asset-based debt (debt against the liquidation value of discrete assets like PPE and working capital), 2) cash flow-based debt with weak control (debt against the firm as a whole with less creditor intervention, such as bonds), and 3) cash flow-based debt with strong control (debt against the firm as a whole with more creditor involvement, such as loans). For liquidation values, we use firm-level liquidation values of PPE and working capital in the main analyses. We control for cash holdings but do not put it directly in liquidation values, since cash holdings can be fairly discretionary. We also perform robustness checks that measure liquidation values using the average liquidation value in an industry to further reduce the impact of firms' discretionary choices. For Chapter 11 going-concern values, we use the average Chapter 11 going-concern recovery rate (going-concern value normalized by total book asset at filing) in the two-digit SIC industry. For leverage, we use the ratio of total debt to book assets. In Internet Appendix Section IA3, we also perform robustness checks which show that the main results on debt composition are similar if we also include estimates of capitalized operating leases as another form of asset-based debt and another contributor to the liquidation value of discrete assets.

A. Asset-Based Debt

Figure 5 shows binscatter plots of the share of asset-based debt in total debt (Panel A) and the amount of asset-based debt normalized by book assets (Panel B), for firms with low liquidation values in blue circles and high liquidation values in red diamonds. The 20 bins are formed by book leverage, and the low vs. high liquidation value groups represent firms in the bottom and top terciles of liquidation values in each year. Each dot represents the mean value among all firms in the bin.

Figure 5, Panel A, shows that the share of asset-based debt in total debt is relatively high when firms borrow a small amount (book leverage below 5% or 10%), and then falls off when firms borrow more, especially for firms with low liquidation values. Correspondingly, Figure 5, Panel B, shows that the amount of asset-based debt relative to total assets increases roughly linearly with leverage for firms with high liquidation values, but plateaus as leverage increases for firms with low liquidation values. The results suggest some degree of pecking order: asset-based debt against generic, liquid assets could be less costly, so they are more prevalent when firms need a small amount of debt. However, when firms need to borrow more, they do not necessarily have many such assets, and the prevalence of asset-based debt declines.[15]

Table 3 reports results in regressions, which enable us to control for other firm characteristics that may affect debt choices. Column (1) shows that the share of asset-based debt increases with liquidation values. Column (2) shows that the share decreases with leverage, especially when liquidation values are low. Columns (3) and (4) show that the amount of asset-based debt increases with total debt, especially for firms with high liquidation values. For example, the result in column (4) suggests that for a firm in the 75th percentile of liquidation values in our sample, an additional dollar of borrowing is associated with 25 cents more asset-based debt. In comparison, the value is 8 cents for a firm in the 25th percentile of liquidation values. In addition, the prevalence of asset-based debt decreases with earnings (EBITDA) and with going-concern values more generally (the industry-level Chapter 11 value, as well as the firm's current market value).

B. Cash Flow-Based Debt with Weak Control

Figure 6 shows binscatter plots of the share of cash flow-based bonds in total debt (Panel A) and the amount normalized by book assets (Panel B), for firms with low liquidation values in blue circles and high liquidation values in red diamonds. The share of this type of debt is hump-shaped, and is highest for medium ranges of leverage. As we show next, this hump-shaped pattern is driven by the fact that firms with high leverage rely more on debt with strong monitoring. The plot also shows that the prevalence of this type of debt is also higher for firms with low liquidation values, and the impact of liquidation values is stronger as leverage increases. Table 4 presents these results in regressions. Table 4 also suggests that the prevalence of cash flow-based bonds increases

[15] In the data, we do not find that firms use up all the liquidation value of discrete assets for asset-based debt before taking on cash flow-based debt. One important reason is that many discrete assets can be specialized and illiquid, which are not easy to pledge directly. Another reason is some asset-based debt may involve fixed costs. For instance, to receive an asset-based revolver, a firm needs to set up a system to record and report the amount of receivable and inventory to lenders on a regular basis, and to have lenders conduct field exams of their assets, which can be cumbersome.

with firms' going-concern values (the industry-level Chapter 11 value, as well as the firm's current market value).

C. Cash Flow-Based Debt with Strong Control

Figure 7 shows binscatter plots of the share of cash flow-based loans in total debt (Panel A) and the amount normalized by book assets (Panel B), for firms with low liquidation values in blue circles and high liquidation values in red diamonds. This result suggests that firms with low liquidation values and high leverage rely more on cash flow-based debt with strong control. Interestingly, for firms in the bottom tercile of liquidation values, the reliance on cash flow-based loans increases substantially after book leverage exceeds 20%. This is close to the average firm-level liquidation value in this group. For the firms in the top tercile of liquidation values, on the other hand, the increase in the reliance on cash flow-based loans takes place at book leverage above around 35%. Again, this threshold is close to the average firm-level liquidation value in this group. This suggests that monitoring becomes more important when the firm's total borrowing surpasses the liquidation value of its assets. Table 5 presents results in regressions. Table 5 also shows that the prevalence of this type of debt is increasing in earnings, as well as in the going-concern value in normal times (the firm's current market value) and in distress times as reflected by the industry-level Chapter 11 value. As we discuss in Section 5, cash flow-based loans, despite being less than 25% of total debt even for firms with high leverage, can provide an important monitoring role for high leverage firms, which benefits cash flow-based debt in general (including bond holders).

D. Essence of Secured Debt

Our data can also shed light on the nature of secured debt. Although the academic literature typically associates secured debt with debt against separable or tangible assets (i.e., asset-based debt in our categorization), this is not necessarily the case in practice. Under US law, the essence of security (and correspondingly the legal definition of collateral) is priority. Creditors can take priority over the liquidation value of discrete assets (secured asset-based debt), or over the going-concern value of the firm (secured cash flow-based debt). On the other hand, unsecured debt and subordinated debt represent low priority debt claims which are marginal claimants.

In practice, asset-based debt is typically explicitly secured by discrete assets, to make it clear that it has priority over the liquidation value of such assets. In bankruptcy, asset-based debt would have a high priority claim (i.e., secured claim) up to the liquidation value of the assets pledged to it, and a low priority (i.e., unsecured deficiency claim) for the remaining face value (if the face value exceeds the liquidation value of assets pledged to

it).[16] Meanwhile, cash flow-based debt can take security in the form of "substantially all assets" (except for assets pledged to asset-based debt), sometimes referred to as "blanket liens." Such a claim has priority over the going-concern value of the firm. In Chapter 11, its collateral value is calculated based on the going-concern value of the firm (minus the liquidation value of discrete assets pledged to asset-based debt). Secured cash flow-based debt is often used to implement strong creditor control over the firm, given that substantially all of firm value is pledged to these creditors.

Figure IA1 and Table 6 show that secured cash flow-based debt displays very *different* properties than those observed for asset-based debt in Figure 5 and Table 3. First, secured cash flow-based debt is more prevalent among low liquidation value firms, while asset-based debt is more prevalent among high liquidation value firms. Second, the share of secured cash flow-based debt in total debt increases with leverage, while that of asset-based debt decreases with leverage. Third, secured cash flow-based debt increases with Chapter 11 going-concern values, like other proxies for cash flow-based debt with strong control. In contrast, asset-based debt weakly decreases with Chapter 11 going-concern values. Overall, the results show that secured debt has different components with different economic properties, consistent with observations in Ivashina, Laeven, and Moral-Benito (2020) and Lian and Ma (2020), and should not be uniformly viewed as borrowing against the liquidation value of separable or tangible assets.

Finally, several studies find that the share of secured debt in total debt is higher for firms with lower ratings (Rauh and Sufi, 2010; Benmelech, Kumar, and Rajan, 2020a). In our data, the average share of secured debt among investment grade and non-investment grade firms is 19% and 46% respectively, consistent with this observation. The average share of asset-based debt changes from 19% to 29%, primarily driven by lower firm value and higher volatility of low rated firms. Meanwhile, the average share of secured cash flow-based debt changes from 1% to 19%, in line with the results above, and accounts for a substantial part of the increase in secured debt among low rated firms.

E. Industry-Level Results

One possible concern is that the firm-level liquidation value can be affected by firms choices about asset composition. While choices with respect to asset composition and debt composition can be a reflection of the connections between asset attributes and debt structures in our framework, one might worry about other factors that affect both sides. Accordingly, in Table IA2 we present additional results where liquidation values are driven by industry-level features, and are not affected by the choices of a given firm.

[16] In other words, asset-based debt only has priority against the liquidation value of the particular assets pledged to it, but not priority against firm value in general.

The outcome variables in Panels A, B, C are the level of asset-based debt, cash flow-based bonds, and cash flow-based loans, respectively (normalized by book assets).

In columns (1) and (2), we use the average liquidation value (normalized by book assets) in each industry (two-digit SIC) throughout the sample period. In columns (3) and (4), we instrument the firm-level liquidation value using the physical attributes of plant, property, and equipment (PPE) in the industry constructed in Kermani and Ma (2020). These attributes capture the mobility, durability, and standardization/customization of fixed assets in each industry, and are strong instruments for PPE recovery rates as well as firm liquidation values. In all cases, we see similar findings as the main results in Tables 3 to 5. Asset-based debt is more prevalent when liquidation values are higher, and the sensitivity of asset-based debt to liquidation values is higher when leverage is higher. Cash flow-based loans and bonds are more prevalent when liquidation values are lower, and the sensitivity to liquidation value is also more pronounced when leverage is higher. Finally, cash flow-based loans (and bonds) are increasing in the industry's going-concern value, while asset-based debt is not.

F. Liquidation Values by Type of Asset

In the above, for parsimony we aggregated all asset-based debt into one group and studied the relationship between the liquidation value of the firm and the total amount of asset-based debt. In the following, we also take a step further and investigate the relationship between different components of asset-based debt and different components of the liquidation value. Columns (1) and (2) of Table IA3 examine the fraction of asset-based debt backed by working capital (i.e., inventory and receivable), or asset-based debt backed by PPE, to the liquidation value of working capital and PPE. We find that the liquidation value of working capital is mainly predictive of the share of asset-based debt backed by working capital, and not the share of asset-based debt backed by PPE. The reverse holds for the liquidation value of PPE: the liquidation value of PPE is predictive of the share of asset-based debt backed by PPE. Columns (3) and (4) repeat the same analysis, but normalize the amount of each type of debt by book assets. Again, we find similar results. This analysis provides further evidence that each type of asset-based debt depends primarily on the liquidation value of a particular type of asset, consistent with the standard design of asset-based debt.

4.2 Covenant Strictness

We then examine the tightness of financial covenants as a function of the firm's liquidation value, Chapter 11 value, and leverage.

We measure covenant tightness following the procedure of Murfin (2012). The measure captures the probability of violating a financial covenant, given the firm's current financial conditions and the thresholds of financial covenants. We match covenant thresholds set at loan issuance from DealScan with the borrower's financial conditions from Compustat. Specifically, following Murfin (2012), we represent the thresholds of financial ratios set by the covenants as $\underline{\mathbf{r}}$, which is a $K \times 1$ vector. The corresponding actual financial ratios of the firm is denoted by $\mathbf{r}$, which evolves as follows:

$$\mathbf{r}' = \mathbf{r} + \epsilon \sim N_K(\mathbf{0}, \Sigma), \tag{2}$$

where Σ is the covariance matrix of financial ratios, estimated as in Murfin (2012). The firm violates a financial covenant if it does not meet one of the K thresholds, i.e., there exists k such that $r_k < \underline{r_k}$. Covenant strictness is measured as the probability of violating at least one covenant, that is

$$p = 1 - F_K(\mathbf{r} - \underline{\mathbf{r}}), \tag{3}$$

where F_K is the multivariate normal CDF with mean 0 and variance Σ. Internet Appendix Section IA4 explains the details of the estimation.

We further assign financial covenants into two groups. The first group consists of performance covenants, which are tied to firms' operating performance, commonly measured using operating earnings (EBITDA). Examples include restrictions on maximum debt-to-earnings ratios and minimum interest coverage ratios (which are equivalent to maximum ratios of debt payments to earnings). Performance covenants are often viewed as playing a role as trip wires to facilitate the contingent allocation of control rights, which allow lenders to intervene in managerial actions if performance is poor (Christensen and Nikolaev, 2012).[17] The second group consists of other financial covenants, mainly book leverage-based financial covenants, such as maximum debt-to-asset ratios. They aim to ensure that firms have sufficient equity capital or sufficient liquidity, but their prevalence has declined substantially in recent decades (Demerjian, 2011).

Figure 8 and Table 7 show the variation of covenant tightness. Covenants are generally tighter when leverage is higher, consistent with prior studies of the agency theory of covenants (Bradley and Roberts, 2015). In addition, the tightness of performance

[17]It is not necessary to have moral hazard to justify the existence of financial covenants, such as restrictions on the ratio of debt to earnings. Restrictions on maximum debt to earnings ratios can arise if multiples of earnings approximate how much lenders can receive in default (e.g., Chapter 11), as explained in Lian and Ma (2020) (just as restrictions on maximum debt to liquidation values can arise if lenders are paid based on liquidation values in default Kiyotaki and Moore (1997). However, with moral hazard, earnings-based covenants can have additional functions for ameliorating moral hazard, as we illustrate in Section 5.

covenants is higher when liquidation values are lower, and tends to increase more with leverage for firms with low liquidation values. In other words, these covenants are stronger for firms with low liquidation values, where creditors' payoffs derive more from the firm's overall performance. This is in line with the results on cash flow-based debt with strong control in Table 5 and Table 6. Furthermore, covenant tightness increases with the Chapter 11 value of the firm. As we discuss further in Section 5, enforcing covenants requires effective threat (i.e., if borrowers do not comply with creditors' requests, creditors can accelerate the loan, likely resulting in bankruptcy). The credibility of the threat likely depends on the Chapter 11 value of the firm, which drives what creditors can get if they were to accelerate the loan and send the firm to bankruptcy. More generally, as we also saw in Table 5 and Table 6, indications of the strength of control rights tend to increase with firms' Chapter 11 value.

4.3 Additional Results

In the following we provide several additional results on debt attributes, including the interest rates and default recovery rates of different types of debt. We also perform further checks to examine whether asset-based debt plays a role in monitoring firms' operational performance.

A. Interest Rates

Figure 9, Panel A, shows a binscatter plot of interest rates on asset-based debt and book leverage for firms in the top and bottom terciles of liquidation values (controlling for year fixed effects and firm size). Figure 9, Panel B, investigates the same relationship, but for cash flow-based debt. These plots show several interesting patterns. First, firms with low liquidation values pay significantly higher interest rates when they borrow through asset-based debt. Second, the interest rate on cash flow-based debt is relatively more sensitive to firm leverage than the interest rate on asset-based debt. Both of these patterns are consistent with the observation that asset-based debt relies mainly on the liquidation value of discrete assets, whereas cash flow-based debt relies on the going-concern value of the entire firm (rather than the liquidation value of discrete assets). While these patterns provide useful information, one might be worried that they can be affected by the endogenous sorting of firms into different types of debt. For example, it can be the case that firms with low liquidation values but choose to borrow asset-based debt are riskier than firms with high liquidation values and borrow through asset-based debt (and therefore the differences in Figure 9, Panel A, is driven by the differences in the riskiness of these firms).

In Table 9, we address such concerns by exploiting the variations in the interest rate on different types of debt of the same firm within the same year, or even within the same loan package, similar to the empirical strategy of Benmelech, Kumar, and Rajan (2020b). In particular, in columns (1) to (4), we use interest rate information from CapitalIQ. In all of these regressions, we control for firm-year fixed effects, which absorb any time-varying characteristics of the firm. We use the interest rate on loans and bonds in column (1) and focus on loans in column (2). The results suggest that higher liquidation values are associated with significantly lower interest rates on asset-based debt relative to cash flow-based debt. The coefficient in column (2) indicates that a one standard deviation increase in firm-level liquidation values is associated with an almost 20bps reduction in the interest rate on asset-based loans. In columns (3) and (4), we repeat the same analysis for firms above and below median leverage. Comparing the results in column (3) and (4), we see that the differential impact of liquidation values on the interest rate of asset-based loans is larger for firms with higher leverage. Finally, in column (5), we use interest rate data from DealScan and compare the interest rate on loans issued within the same package.[18] Again we find that higher liquidation values are associated with significantly lower interest rates particularly for asset-based loans.

Overall, the results on interest rates are consistent with the idea that higher liquidation values from discrete assets make asset-based debt relatively cheaper. Correspondingly, higher liquidation values are associated with a higher prevalence of asset-based debt.

B. Debt Recovery Rates in Default

While the interest rate results show the relationship between the *ex ante* pricing of different types of debt and firm attributes, the results on debt recovery rates in bankruptcy can provide more direct evidence on the *ex post* importance of firms' liquidation values and going-concern values for payments to different debt claims in default resolutions.

In Table 10, we use debt recovery rates from Moody's Default Recovery Database (DRD) to investigate this issue. Not all firms in the DRD database are public firms. Therefore, we perform our analysis both for the entire sample (odd columns), and for the sample of public firms for which we can find data on their Chapter 11 liquidation analysis as well as pre-filing financial information (even columns). Accordingly, in the odd columns the independent variables include industry-average liquidation values and going-concern values (matched based on industries); in even columns the independent variables include firm-level liquidation values, going-concern values, and pre-filing firm financials. In columns (5) and (6), we replace the estimate of Chapter 11 going-concern

[18] Many corporate loan packages contain a combination of different loans, such as an asset-based loan and a cash flow-based loan.

values with the bottom quartile of average Q (i.e., market value of assets over book value of assets) in the industry. The idea is that the bottom quartile of industry Q should be informative about the going-concern values of firms in distress in the industry.

Overall, the results of Table 10 suggest that the recovery rate of asset-based debt is mainly affected by the liquidation value of the firm, whereas the recovery rate of cash flow-based debt is a function of the going-concern value of the firm. These results are consistent with the interest rate results shown earlier. They are also consistent with US bankruptcy laws. Moreover, they verify that asset-based lenders would be mainly concerned about the liquidation value of discrete assets pledged to them, while cash flow-based lenders are more worried about the going-concern value of the firm as a whole.

C. Bankruptcy Outcomes

In Internet Appendix Table IA4, we also study how bankruptcy outcomes (in particular, the frequency of liquidation) vary with firm characteristics. The prevalence of different bankruptcy outcomes can also affect the key determinants of debt claims' values in default.

We start with the full list of bankruptcy cases of US public and large private firms from 2000 to 2016 from BankruptcyData.com. BankruptcyData.com records the eventual outcome of the case. We define a dummy variable "Liquidation" if the case ended in Chapter 7 or was marked as "liquidated." Table IA4 shows the relationship between the liquidation dummy and several characteristics: firm size (log total assets at filing) as well as industry-average liquidation value, going-concern value, earnings, and cash holdings. We find that large firms have a significantly lower probability of liquidation. In addition, the incidence of liquidation is higher when liquidation values are higher, and when going-concern values are lower.

D. Comparison with Book Values of "Tangible Assets"

In Internet Appendix Table IA5, we also compare our measure of liquidation values with the book value of "tangible assets" often used in prior work. Since we aim to measure the overall liquidation value from firms' separable assets such as PPE and working capital, which is the basis for asset-based debt, we examine how different measures explain both the quantity and the interest rates of asset-based debt. We show comparisons with two commonly used measures of tangible assets, namely the book value of PPE in Panel A and the book value of PPE plus inventory in Panel B. For the amount of asset-based debt analyzed in columns (1) and (2), our measure provides information beyond the traditional book values. For interest rates analyzed in columns (3) and (4), we find that asset-based debt has lower interest rate when the firm has higher liquidation values (based on our

measure). On the other hand, interest rates on asset-based debt are weakly increasing in the traditional book value measures. One possible explanation for this result is that book values may also reflect credit demand, whereas our measure of liquidation value is better at capturing the credit supply for asset-based debt (i.e. lenders willingness to lend against those assets).

E. Asset-Based Debt and Monitoring

So far we have assumed that asset-based debt is not involved in the monitoring of the financial performance of the firm. As shown above, their recovery rates in default are primarily dependent on the liquidation value of discrete assets, rather than the going-concern value of the firm as a whole. They also set interest rates with a stronger focus on the former.

One may wonder if some lenders of asset-based debt, such as asset-based revolvers, may also be involved in some monitoring of firms' operating performance and managerial competence. Asset-based revolvers are revolving lines of credit mainly backed by working capital (i.e., inventory and receivables), which allow firms to borrow up to the liquidation value of working capital (commonly referred to as the "borrowing base"). The firm needs to pledge enough qualified working capital collateral to support its borrowing from such facilities. There are two reasons why lenders of these revolvers might be involved in monitoring. First, in many cases, the revolvers are part of a loan package that also includes cash flow-based term loans. In some of these cases, the lead lender of the asset-based revolver overlaps with the lead lender of the cash flow-based term loan. One might think that in these cases the revolver could be used to strengthen the bargaining power of the lender who enforces monitoring. Second, if the firm borrows from the revolver more than what is allowed by the borrowing base, the firm either has to reduce its borrowing from the revolver or post more collateral. Otherwise, the firm violates the borrowing base requirement and incurs technical default (just like violations of financial covenants), which could give the lender control rights. We investigate both of these possibilities in Internet Appendix Figures IA3 and IA4.

Internet Appendix Figure IA3 plots the frequency of having the same lead lenders for a cash flow-based loan and an asset-based loan in a loan package, as a function of firm leverage (Panel A) and firm size (Panel B), for firms with low vs. high liquidation values. The main takeaway is that the frequency of having overlaps in the lead lenders is significantly higher for firms with low liquidation values. This seems consistent with the main observation of the paper that firms with low liquidation values rely more on lending relations with more intense monitoring of firms' operational performance.

In order to evaluate the plausibility of the second channel, ideally we want to have a measure of the frequency of violating the borrowing base requirement. Unfortunately, DealScan only has data on loan facilities at origination (not subsequent borrowing amounts), while CapitalIQ does not have data on the borrowing base requirement associated with revolvers. Accordingly, we try to approximate the maximum borrowing base of a firm by the liquidation value of its working capital (inventory plus receivables).[19] We then construct a dummy that is equal to one if the firm's borrowing through revolvers backed by working capital is more than the liquidation value of its working capital. The results in Figure IA4 suggest that, for most levels of leverage, the probability of borrowing from a revolver more than the liquidation value of working capital (i.e., our proxy for borrowing more than the borrowing base) is generally low. It is slightly higher for firms with lower liquidation values. Correspondingly, the results indicate that the incidence of asset-based lenders being able to exercise control rights appears relatively infrequent. Correspondingly, the incidence of them having to worry about the firm value, beyond the liquidation value of the particular assets pledged them, is also low. Furthermore, even if some asset-based loans do get involved in monitoring of the firm's financial performance, this seems more likely to happen for firms with lower liquidation values.

4.4 Total Leverage

In Section 4.1, we focused on the relationship between liquidation values and debt composition. Another important question is the relationship between liquidation values and total borrowing. In Figure 10, we find that firms' liquidation values have a positive relationship with total leverage for small firms and firms with negative earnings (EBITDA), consistent with the observations of Rampini and Viswanathan (2013). Meanwhile, liquidation values do not have a strong association with total leverage for large firms and firms with positive earnings. Table 8 presents the results in regressions, which show similar findings.

Overall, the evidence is consistent with observations in Lian and Ma (2020). Small firms, which tend to have negative earnings and a higher probability of liquidation, rely primarily on asset-based debt. Their total debt capacity depends significantly on the liquidation value. On the other hand, large firms, which tend to have positive earnings and a lower probability of liquidation, rely substantially on cash flow-based debt. Their total debt capacity is not necessarily dependent on liquidation value, but commonly tied to the level of earnings. Our model in Section 5 also illustrates that when it is feasible to

[19] As mentioned in Section 2.1.2, our estimates of the recovery rates of each type of assets are largely consistent with the borrowing base used by lenders.

enforce debt based on control rights and firms' going-concern value, the liquidation value can affect debt composition, but may not be tied to total debt capacity.

5 Model

We now present a model that analyzes the connections among liquidation value, leverage, and debt attributes. The model fleshes out that monitoring is more intensive when liquidation values are low and leverage is high. The model also shows that monitoring would be undertaken by creditors who have high priority against the firm's business value in success and in restructuring, but not against the firm's liquidation value (a feature that resembles cash flow-based loans). In the model, debt with strict monitoring provides broader benefits and helps firms borrow beyond the liquidation value of discrete assets. The model is also designed to closely follow the features of US bankruptcy laws (e.g., automatic stay, payment determination rules) and debt contracts (e.g., covenants enable contingent allocation of control rights between borrowers and informed lenders).

5.1 Setup

There are three type of agents: entrepreneurs, informed investors, and uninformed investors. There is a continuum of entrepreneurs, each with access to an investment opportunity that requires one unit of investment. Entrepreneur i's total internal fund is $w_i < 1$, and therefore the rest of the project needs to be financed using external funds from uninformed and informed investors. The project outcome can be high (R) or low (L). The good outcome represents payoffs from successful operations. The bad outcome can represent business failure and liquidation. The probability of success (p) is determined by the entrepreneur's effort, at cost $\frac{1}{2}\gamma p^2$. There is an infinite supply of uninformed and informed investors, and all investors and entrepreneurs have access to a storage technology with return 1. Moreover, informed investors have access to a monitoring technology that enables them to pay a cost of c per incidence of monitoring and observe the entrepreneur effort p.

There are three periods. At $t = 0$, the financial contract between the entrepreneur and the informed or uninformed investors is signed, and investment decisions are made. The contract also specifies the state of the world in which the informed investors have the control right. We assume that the *expected cost for monitoring* has to be paid in advance (i.e., at $t = 0$) and the entrepreneur chooses effort (or the probability of success p) after

observing whether informed investors paid the monitoring cost or not.[20]

At $t = 1$, a noisy signal $s = p + \eta$ of the effort is observed, where $\eta \sim N(0, \sigma)$. The signal can be thought of as the firm's financial performance (such as earnings). The contract can specify a threshold s^*, below which informed investors have the control right to decide the project should be continued or stopped. This contractual provision can be thought of as a financial covenant which is based on observable financial performance of the firm. In addition, informal investors can figure out the true probability of success p through investigation, once they obtain control rights (i.e., following a low signal $s < s^*$). If the project is stopped, the return will be Q ($L < Q < 1$). We interpret this intervention as a restructuring, e.g., through Chapter 11, and Q can represent the going-concern value in Chapter 11.[21] On the other hand, if the firm continues, at $t = 2$ the final outcome of the project is realized and the total outcome of the project is R (successful) with probability p and L (failure) with probability $1 - p$.

The contract determines the investment of the entrepreneur, the informed investors, and the uninformed investors (w, i_i, i_u). It also allocates the payments among the entrepreneur, the informed investors, and the uninformed investors, when the firm continues and the outcome is high (R_e, R_i, R_u), when the outcome is low (L_e, L_i, L_u), and when the project is stopped (Q_e, Q_i, Q_u). Finally, the contract also specifies the threshold s^* below which informed investors have the control right.

Assumption 1. $L < Q < 1 < \frac{(R-L)^2}{2\gamma} + L$.

This assumption ensures that the project has positive net present value for some level of effort. In addition, the value of the project with restructuring is higher than the liquidation value, but less than the initial investment.

Assumption 2. *Contracts are restricted to those with* $L_i \leq Q_i$ *and* $L_u \leq Q_u$.

This ensures that the financial contract is consistent with US bankruptcy laws where investors in Chapter 11 (restructuring) should receive no less than what they would otherwise receive in Chapter 7 (liquidation).

[20] There are several ways to think about this assumption that monitoring costs are paid in advance. For instance, the teams and employees of informed lenders need to be formed in advance. Legal, diligence, and contractual work may also need to be performed in advance.

[21] Covenant violation gives creditors legal power to accelerate the loan, which can be a threat of sending the borrower to bankruptcy filing.

5.2 Model Solution

5.2.1 First Best

Before characterizing the optimal financial contract, we study the first best. The first best maximizes the total surplus:

$$\max_p pR + (1-p)L - \frac{1}{2}\gamma p^2 - 1,$$

which gives us

$$p^{FB} = \frac{R-L}{\gamma}.$$

Therefore, the optimal level of effort is increasing in the difference between the high outcome and low outcome $(R-L)$ and decreasing in the cost of effort γ.

We now consider the case when the firm is financed without informed investors, and the case when informed investors are required.

5.2.2 Without Informed Investors

We first consider the case with no informed investors or monitoring. In this case the entrepreneur's problem is to maximize profits conditional on the uninformed investor's participation constraint:

$$\begin{aligned} \max_p \ & p(R-R_u) + (1-p)(L-L_u) - \frac{1}{2}\gamma p^2 - 1, \\ \text{s.t. } & pR_u + (1-p)L_u \geq i_u. \end{aligned}$$

Proposition 1. *For any $w \in [1-L, 1]$, the first best is achieved without any informed investors and $R_u = L_u = i_u = 1-w$.*

This is simply because as long $R_u = L_u$, the marginal incentive of the entrepreneur is not affected by the presence of an outside investor. However, if $w < 1-L$ (or $i_u > L$), the first best cannot be achieved without any informed investor. This is because in that case, for the optimal contract we have $L_u = L$. And $\hat{p}$ and R_u is are solutions to:

$$\begin{cases} \hat{p} = \frac{R-R_u}{\gamma} \\ \hat{p}(R_u - L) = i_u - L. \end{cases}$$

Therefore, if $i_u > L$, we will have $R_u > L$, which results in a suboptimal level of effort $(\hat{p} < p^{FB})$.

5.2.3 With Informed Investors

The informed investors can choose a threshold s^*, which allows for the right of monitoring and intervention if $s < s^*$, and the threat to stop the project if the effort is below a pre-specified level p^*. The optimal choice of p^* and s^* requires:

$$\max_{p^*,s^*} \; p^*R + (1-p^*)L - \frac{1}{2}\gamma p^{*2} - \mathbb{P}[s < s^*|p^*]c, \tag{4}$$

subject to the incentive compatibility (IC) of the entrepreneur and the informed investors (at both $t = 0$ and $t = 1$), and the participation constraint (PC) of all the agents.

The entrepreneur's incentive compatibility requires:

$$\forall p < p^* : \mathbb{P}[s > s^*|p]p(R - R_i - R_u) - \frac{1}{2}\gamma p^2 \leq p^*(R - R_i - R_u) - \frac{1}{2}\gamma p^{*2}. \tag{5}$$

This is because the project is only stopped if the effort is below p^* and is identified by the informed investors who have the right to stop the project (i.e. $s \leq s^*$).

The incentive compatibility of informed investors at $t = 1$ requires that they stop the project whenever $p < p^*$ and continue the project if $p >= p^*$. The only choice of (R_i, L_i, Q_i) that satisfies both conditions is:

$$p^*R_i + (1-p^*)L_i = Q_i. \tag{6}$$

If informed investors do not pay the monitoring cost ex ante, the entrepreneur will recognize that and will choose the level of effort that maximizes:

$$\mathbb{P}[s > s^*|p]p(R - R_i - R_u) - \frac{1}{2}\gamma p^2.$$

This is because if informed investors do not pay the monitoring cost, the entrepreneur will choose a level of effort below p^*. In that case, given (6), the optimal strategy of the informed investors is to stop the project whenever they have the right to do so (i.e., $s < s^*$).

Note that the optimal level of effort of the entrepreneur if the informed investors do not monitor is the same as the choice of effort that maximizes the left hand side of (5). This is because in both cases the project is stopped whenever $s < s^*$ and continued otherwise. We now define $\tilde{p}$ as:

$$\tilde{p} = \arg\max_{p} \; \mathbb{P}[s > s^*|p]p(R - R_i - R_u) - \frac{1}{2}\gamma p^2.$$

The incentive compatibility of informed investors at $t = 0$ requires:

$$\mathbb{P}[s < s^*|\tilde{p}]Q_i + \mathbb{P}[s > s^*|\tilde{p}]\,[\tilde{p}R_i + (1-\tilde{p})L_i] \leq p^*R_i + (1-p^*)L_i - \mathbb{P}[s < s^*|p^*]c.$$

That is, the total payment to informed investors in the case of not monitoring should be less than or equal to the payment when they do perform monitoring.

The financial contract should also satisfy the participation constraint of the entrepreneur:

$$p^*R_e - \frac{\gamma}{2}p^{*2} \geq w,$$

the informed investors:

$$p^*R_i + (1-p^*)L_i \geq i_i + \mathbb{P}[s < \bar{s}|p^*]c,$$

and the uninformed investors:

$$p^*R_u + (1-p^*)L_u \geq i_u.$$

Since we assume the market for capital is competitive, the participation constraint of the informed and uniformed investors can be reduced to:

$$p^*(R_i + R_u - L) = (1 - w - L) + \mathbb{P}[s < s^*|p^*]c.$$

And the optimality of s^* requires that:

$$\mathbb{P}[s > s^*|\tilde{p}]\tilde{p}(R - R_i - R_u) - \frac{1}{2}\gamma\tilde{p}^2 = p^*(R - R_i - R_u) - \frac{1}{2}\gamma p^{*2}.$$

Otherwise the total cost of monitoring $\mathbb{P}[s < s^*|p^*]c$ can be reduced without violating any of our constraints. The restriction on the set of permissible contracts also requires:

$$L_u \leq Q_u, L_i \leq Q_i.$$

Finally, among all the possible financial contracts, we choose the contract that requires the minimum amount of investment by informed investors (i_i).[22]

Proposition 2. *For any level of entrepreneur wealth $w \in [\underline{w}, 1-L]$, the optimal contract with informed and uninformed investors is:*

[22]This can be rationalized by assuming the cost of capital for informed investor is slightly more than the cost of capital for uninformed investors.

$p^*, R_i + R_u, s^*$ and $\tilde{p}$ are the solution to:

$$\begin{cases} p^* = \frac{R-L}{\gamma} - \frac{c}{\gamma}\frac{\partial}{\partial p^*}\mathbb{P}[s < s^*|p^*] \\ \mathbb{P}[s > s^*|\tilde{p}]\tilde{p}(R - R_i - R_u) - \frac{1}{2}\gamma\tilde{p}^2 = p^*(R - R_i - R_u) - \frac{1}{2}\gamma p^{*2} \\ p^*(R_i + R_u - L) = (1 - w - L) + \mathbb{P}[s < s^*|p^*]c \\ \frac{\partial}{\partial \tilde{p}}\left[\mathbb{P}[s > s^*|\tilde{p}]\tilde{p}(R - R_i - R_u) - \frac{1}{2}\gamma\tilde{p}^2\right] = 0, \end{cases}$$

and $R_i = \frac{\mathbb{P}[s<s^*|p^*]}{\mathbb{P}[s>s^*|\tilde{p}]}\frac{c}{p^*-\tilde{p}}$, $i_i = p^*R_i - \mathbb{P}[s < s^*|p^*]c$, $L_i = 0$, $Q_i = p^*R_i$. $i_u = 1 - w - i_i$, $L_u = L$, $R_u = \frac{i_u - L}{p^*} + L$, and $Q_u = Q - Q_i$.[23] *$\underline{w}$ is the minimum level of entrepreneur wealth, for which conditional on the optimal choice of monitoring threshold s^* and optimal choice of effort p^*, the project has positive net present value.*[24]

In the limit of $w \to 1 - L$, the solution to the above equations converge to $\mathbb{P}[s < s^*|p^*] = 0$ and $i_i = 0$. This confirms the smooth transition from the case without informed investors to the case with informed investors for the values of w around $1 - L$.

Figure 11 shows the variation of $\mathbb{P}[s < s^*|p^*]$ in Panel A and i_i in Panel B with the change in entrepreneur wealth for a scenario with low liquidation values and for a scenario with high liquidation values.[25] In the optimal solution, as leverage increases above the liquidation value, the amount of investment by informed investors, and the tightness of the covenant increases. An increase in covenant tightness ensures that despite having lower skin in the game, the entrepreneur has incentives to exert the optimal level of effort. The increase in informed investors' investment i_i also ensures that they do not have any incentive to deviate from monitoring the firm. Moreover, comparing the case with low liquidation values with the case with high liquidation values, for the same level of firm leverage, lower liquidation values are associated with a higher reliance on informed

[23] The second order conditions that need to be satisfied are:

$$s^* - p^* < \frac{\sigma^2}{p^* - \frac{R-L}{\gamma}}$$
$$\frac{1}{\sigma}\phi\left(\frac{s^* - \tilde{p}}{\sigma}\right)(R - X)\left(2 + \tilde{p}\frac{s^* - \tilde{p}}{\sigma^2}\right) < \gamma$$

[24] That is:

$$\underline{w} = \underset{w}{argmin}|p^*(w)R + [1 - p^*(w)]\,L - \frac{1}{2}\gamma p^*(w)^2 - \mathbb{P}[s < s^*(w)|p^*(w)]c - 1 \geq 0$$

[25] The choice of parameters for the low liquidation value case is: $R = 2$, $L = 0.25$, $c = 0.1$ and $\gamma = 1.9$, and that for the high liquidation value case is: $R = 1.75$, $L = 0.5$, $c = 0.1$ and $\gamma = 1.35$. This set of parameters ensures the net present values of the two projects are almost the same. In both cases, we have $\sigma = 2$.

investors and tighter covenants. Note that for this solution to be feasible, we also require:

$$Q \geq p^* R_i + L$$

Otherwise, we cannot ensure that there are enough resources to satisfy both the informed investors' incentive compatibility at $t = 0$ and the requirement that the uninformed investors' payments are always more than what they would otherwise receive in Chapter 7 liquidation (i.e., Assumption 2).

5.3 Discussion

The above model, despite its relative simplicity, sheds light on the relationship between liquidation values and debt composition. First, consistent with Figure 7, firms rely significantly more on loans with monitoring for levels of leverage above their liquidation values. Relatedly, consistent with the result in Table 7 and Figure 8, the tightness of covenants increases with leverage and decreases with liquidation values. Second, the model shows that as long as covenants can be enforced and monitoring costs are reasonably small, liquidation values do not necessarily determine the total borrowing capacity of the firm, but only the composition of its debt. This is consistent with our empirical finding on the lack of correlation between liquidation values and total leverage among large firms. Third, consistent with the data, monitoring debt recovers most of its value in Chapter 11 restructuring. Nonetheless, it is not backed by the intrinsic value of discrete assets, and can be impaired if the firm is liquidated.

The model is also useful for studying the interactions among different types of debt. Loans with strong control, despite being a small fraction of the capital structure, can provide a monitoring service that other uninformed investors benefit from. In return, other uninformed investors provide protection to them in the case of Chapter 11. This interaction is key for solving the time inconsistency problem of informed investors and ensures that they do not have incentives to continue projects with low net present value.[26] Moreover, consistent with the empirical evidence in Schwert (2020), the model predicts that the interest rate on debt from informed investors is significantly higher than the interest rate on debt form uninformed investors. The higher interest rate of informed lenders is not necessarily a sign of market power, but instead a compensation to informed lenders for the monitoring costs.

Overall, the model points to the role of control right institutions and property right

[26] See Park (2000) and Repullo and Suarez (1998) for alternative models that has similar prediction for the priority of the debt with monitoring.

institutions in determining firms' borrowing capacity. Better property right institutions may help lenders avoid paying monitoring costs. However, given the low level of liquidation values for firms in most industries, the development and effectiveness of control right institutions that enable corporate restructuring can be important for firms' ultimate debt capacity. Covenants help allocate control rights and enforce monitoring, consistent with results in Chava and Roberts (2008) and Roberts and Sufi (2009).

Finally, we note several caveats in interpreting this model. First, the above model does not explicitly distinguish between asset-based debt and cash flow-based debt with weak control, since the focus of the model is the role of monitoring and creditor control. We can further decompose the uninformed debt into a part that is collateralized by the liquidation value of discrete assets and a remaining part. That is, one can think of $i_u = i_{ABL} + i_B$ (where i_{ABL} denotes asset-based debt and i_B denotes bonds), and $i_{ABL} = R_{ABL} = Q_{ABL} = L_{ABL} \leq L_u = L$. With this partion, the asset-based debt (i_{ABL}) and cash flow-based debt with weak monitoring and control (i_B) will have the empirical properties documented in Section 4.1. Practically, in the US corporate credit market, asset-based debt provides lenders with strong protection of value through the liquidation value of separable assets. They may enjoy slightly lower interest rates (Luck and Santos, 2019; Benmelech, Kumar, and Rajan, 2020a), and would be more prevalent for firms with more standardized, liquid assets. Indeed, tying payoffs (in default) to the liquidation value of standardized, liquid assets is a primary way to reduce the need for understanding the firm's business operations. It is also possible that asset-based debt can help solve dynamic commitment problems that we are not considering here (Donaldson, Gromb, and Piacentino, 2019b; Demarzo, 2019). Additionally, cash flows are verifiable in our model; if they are not, asset-based debt would also play a primary role.

Second, in the current model, restructuring is only an outside option that makes the threat to enforce high effort credible. Therefore, as long as the restructuring value (Q) is large enough, it does not affect the firm's borrowing capacity or interest rate. However, in practice, restructuring does happen in equilibrium, and the value of the firm in restructuring is an important determinant of the recovery rate (and therefore the interest rate) of cash flow-based debt. This feature of the data can be captured by adding a luck component in the probability of success, which is not under the firm's control (i.e., $p = e + \nu$ where e is the entrepreneur effort and ν is the luck component). In that setting, for low realizations of ν, restructuring can be an optimal outcome. Therefore, restructuring does happen with some probability.

Third, the current model does not allow for renegotiation of payments to investors, e.g., promised payments to informed investors might change following covenant violations.

Accordingly, while we are concerned with both ex ante and ex post incentive compatibility of informed investors, we do not require the contract to be renegotiation-proof.

6 Conclusion

In this paper, we collect detailed data on the liquidation value of discrete assets and going-concern value in distress to study the nature of debt enforcement for US non-financial firms. We find that the liquidation value of PPE and working capital accounts for only 23% of book assets. We further document firms' debt features as a function of their liquidation values, industry-level Chapter 11 going-concern values, and the amount of borrowing. The results indicate that monitoring intensity is higher when liquidation values are lower and leverage is higher. Total leverage depends on liquidation values of discrete assets mainly in settings where covenants based on financial performance are difficult to enforce and likelihood of liquidations is higher. We summarize the empirical results in a simple model that illustrates the role of debt enforcement based on creditor control rights.

Overall, a key feature of non-financial firms' assets is they are often highly specific and the liquidation values are limited. Given this nature of firms' assets, only having institutions that enforce property rights (e.g., ability to seize hard assets) may be insufficient. Financial development ultimately requires establishing control right institutions that help restructure distressed firms, and allow creditors to enforce monitoring and control rights. With the development of such institutions, the essence of debt enforcement is not always to rely on the liquidation value of discrete assets, but on the going-concern value of the firm via restructuring.

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Main Figures and Tables

Figure 1: Examples of Summary Tables in Liquidation Analysis

This figure shows two examples of summary tables from the liquidation analysis. Panel A shows the example of a chemical company LyondellBasell (case number 09-10023). Panel B shows the example of a communications product company Sorenson Communications (case number 14-10454).

Panel A. LyondellBasell

Obligor Debtors
Liquidation Analysis

Exhibi

(MILLIONS)	NBV	Low	High	Midpoint
Cash & Equivalents & Short Term Investments	$238.1	$238.1	$238.1	$238.1
Trade Accounts Receivable	1,248.1	748.9	873.7	811.3
Other Receivables	268.1	8.4	57.0	32.7
Intercompany Receivables	30,474.1	0.0	0.0	0.0
Inventory	1,872.5	1,295.9	1,511.0	1,403.5
Prepaids and Other Current Assets	305.4	0.0	0.0	0.0
Property, Plant & Equipment, net	9,366.5	1,577.4	1,577.4	1,577.4
Investments and Long-Term Receivables	27.5	0.2	1.8	1.0
Intercompany Investments	43,823.1	336.1	373.1	354.6
Intangible Assets, net	1,254.1	427.6	427.6	427.6
Insurance Proceeds	0.0	0.0	229.6	114.8
Other Long-Term Assets	72.2	61.6	63.6	62.6
Gross Proceeds	$88,949.4	$4,694.2	$5,352.9	$5,023.5
Costs Associated with Liquidation:				
Payroll/Overhead		(93.9)	(107.1)	(100.5)
Liquidation Costs of PP&E		(157.7)	(157.7)	(157.7)
Chapter 7 Trustee Fees		(140.8)	(160.6)	(150.7)
Chapter 7 Professional Fees		(70.4)	(80.3)	(75.4)
Net Estimated Proceeds before EAI Assets		$4,231.3	$4,847.2	$4,539.2

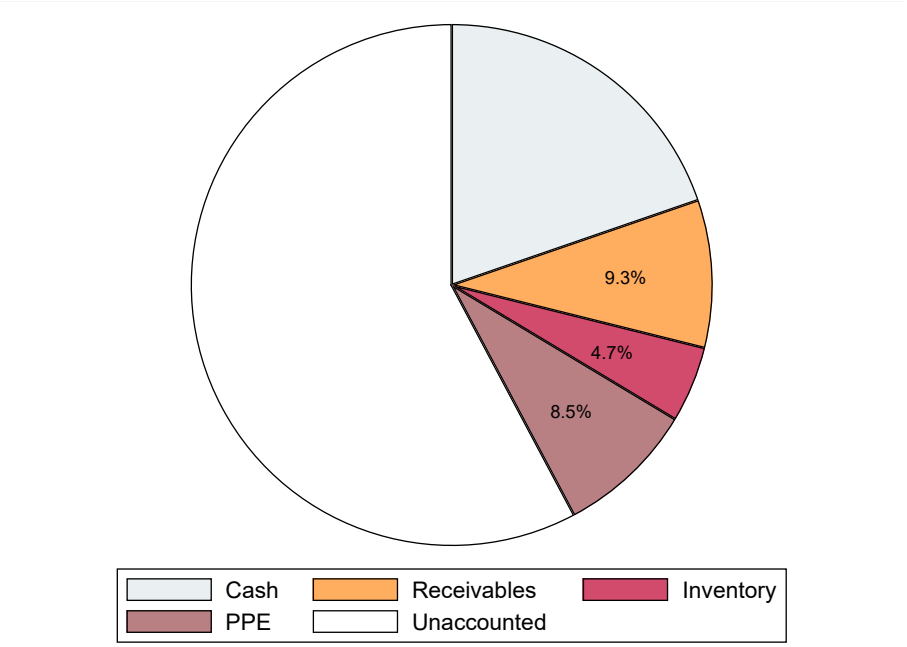
Panel B. Sorenson Communications

Gross Assets Available for Distribution		**Unaudited Balances**	**Estimated Asset Recovery %**		**Estimated Recovery $**	
($ in 000's)	**Notes**	**Jan. 31, 2014**	**Low**	**High**	**Low**	**High**
Cash & Cash Equivalents	A	$ 94,596	100%	100%	$ 94,596	$ 94,596
Accounts Receivable	B	138,727	75%	100%	104,046	138,727
Prepaid and Other Current Assets	C	8,351	5%	10%	418	835
Property, Plant and Equipment, net	D	72,584	6%	12%	4,389	8,779
Goodwill, net	E	214,900	0%	0%	-	-
Intangible Assets	F	98,765	17%	50%	16,348	49,043
Other Assets, Miscellaneous	G	16,901	0%	3%	-	550
Income from Wind-Down Operations	H	-			-	30,276
Total Assets and Gross Proceeds		**$ 644,824**	**34%**	**50%**	**$ 219,796**	**$ 322,805**

Figure 2: Liquidation Values and Chapter 11 Going-Concern Values

The pie chart in Panel A shows the composition of liquidation values for the average non-financial firm in Compustat. It includes the value of cash, as well as the liquidation value of working capital (receivable and inventory) and plant, property, and equipment (PPE). The figure in Panel B shows the distributions of non-financial firms' liquidation values, both including and excluding cash, along with the distribution of industry-average Chapter 11 going-concern values based on the two-digit SIC of each firm.

Panel A. Average Liquidation Values



Panel B. Liquidation Values vs. Chapter 11 Going-Concern Values

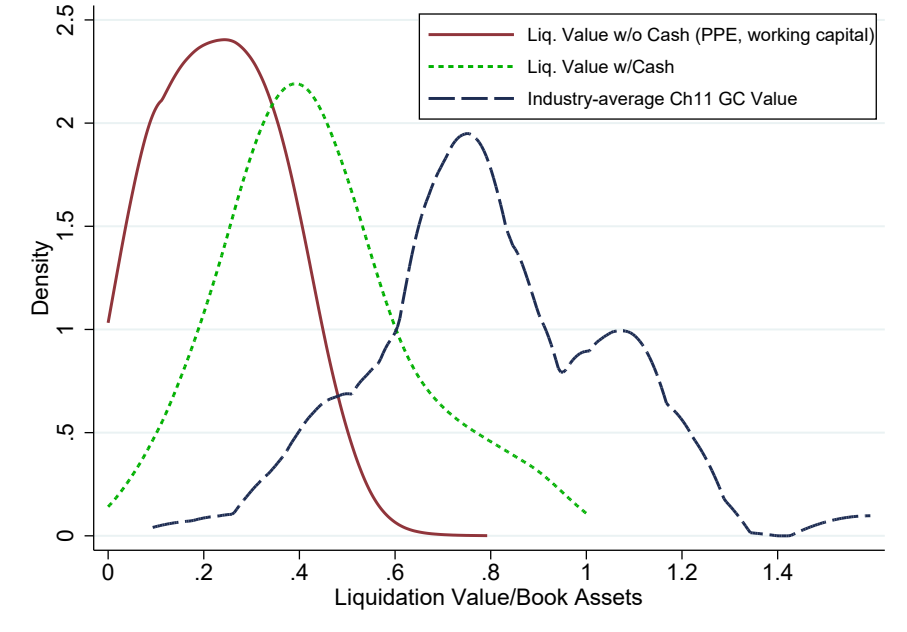
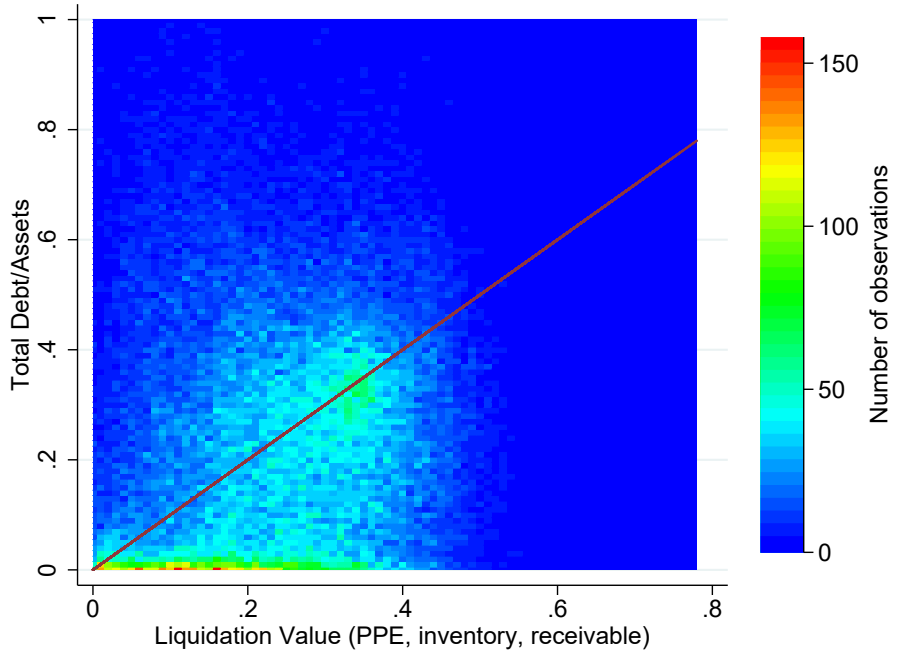


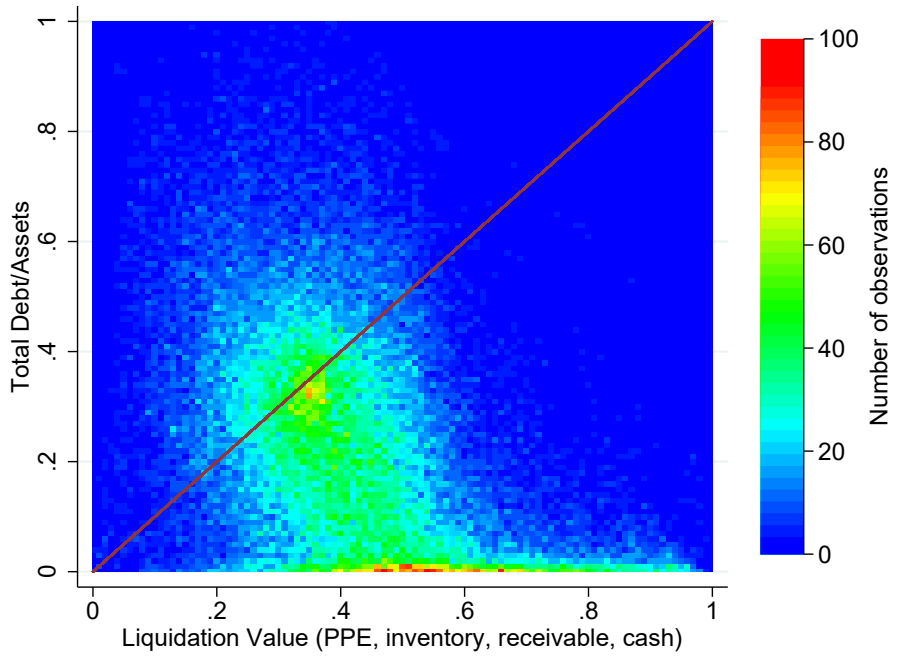
Figure 3: Liquidation Values and Borrowing

The heat map in Panel A shows the distribution of book leverage against liquidation values excluding cash (normalized by total assets). The heat map in Panel B shows the distribution of book leverage against liquidation values including cash. The heat map in Panel C shows the distribution of firms' total liabilities as a share of assets against liquidation values including cash. The heat map in Panel D details the shows the distribution of total asset-based debt as a share of total assets against liquidation values excluding cash. Sample period is 2003 (beginning of CapitalIQ data for constructing debt composition) to 2016.

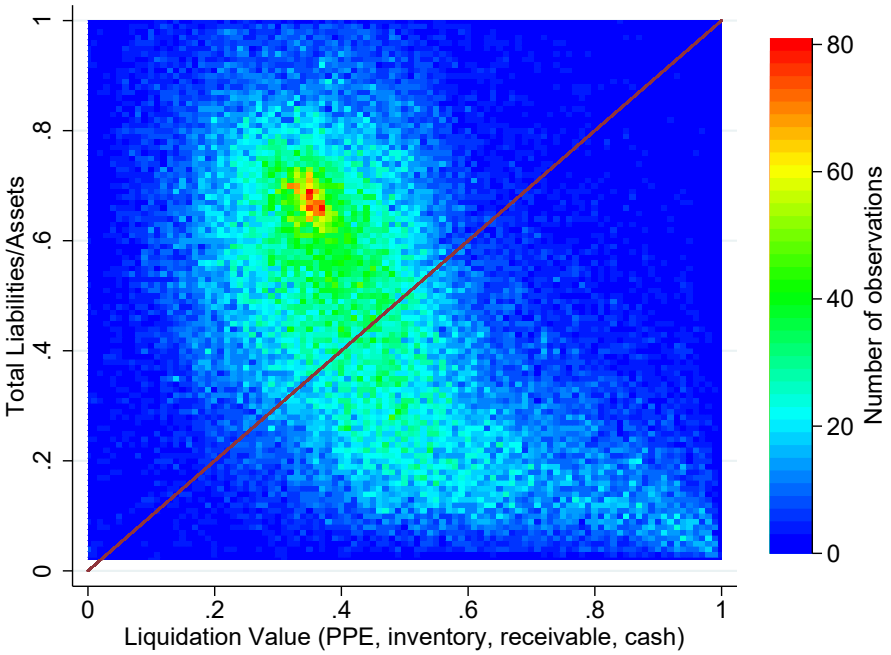
Panel A. Book Leverage and Liquidation Values Excluding Cash



Panel B. Book Leverage and Liquidation Values Including Cash



Panel C. Total Liabilities and Liquidation Values Including Cash



Panel D. Asset-Based Debt and Liquidation Values Excluding Cash

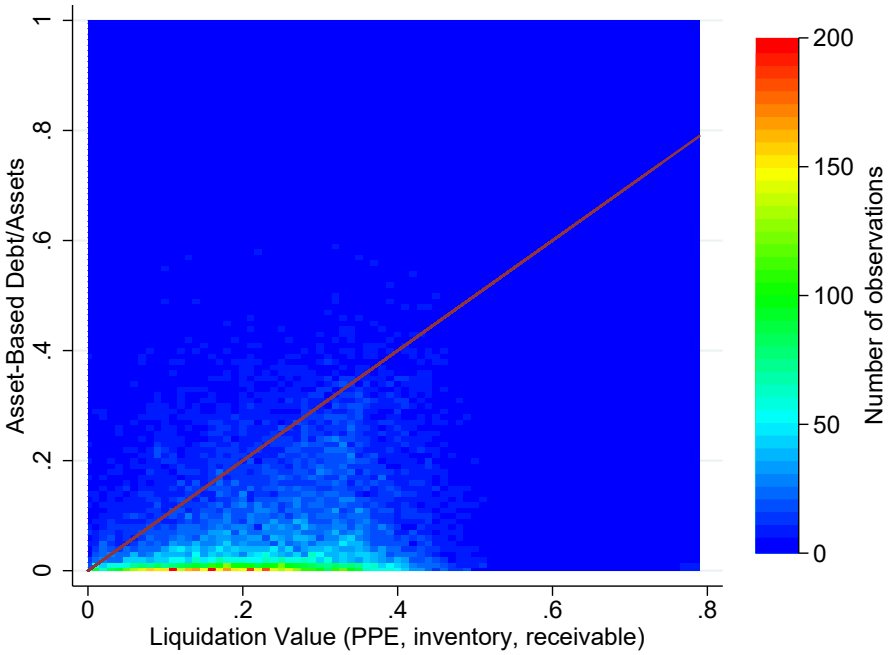
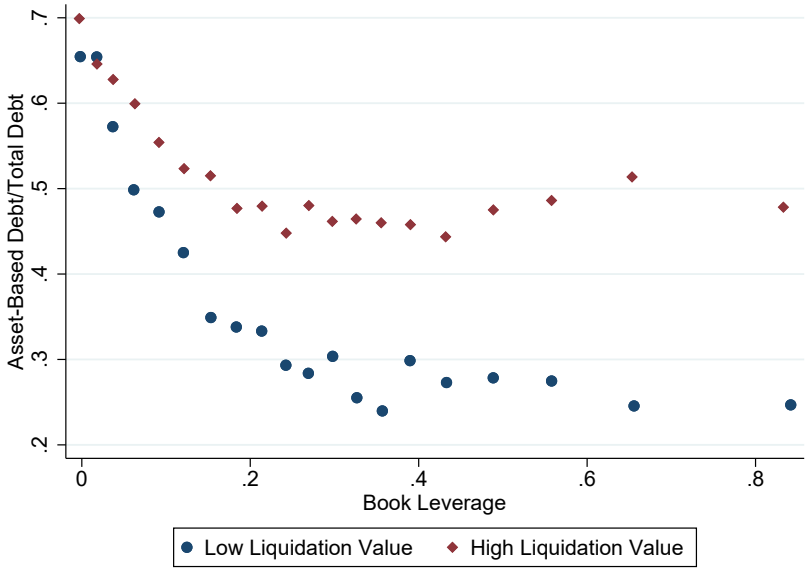


Figure 5: Asset-Based Debt

The figure in Panel A provides a binned scatterplot of asset-based debt as a share of total debt against book leverage in twenty equal-sized bins for firms with high and low liquidation value. The figure in Panel B provides a binned scatterplot of asset-based debt as a share of total assets against book leverage in twenty equal-sized bins for firms with high and low liquidation values. Firms in the top tercile of liquidation value each year are categorized within the high liquidation value group, and firms in the bottom tercile of liquidation value each year are categorized within the low liquidation value group. Year fixed effects are included. Firms with book leverage outside of 0 and 1 are omitted. Sample period is 2003 (beginning of CapitalIQ data for constructing debt composition) to 2016.

Panel A. Share in Total Debt: Asset-Based Debt



Panel B. Divide by Total Assets: Asset-Based Debt

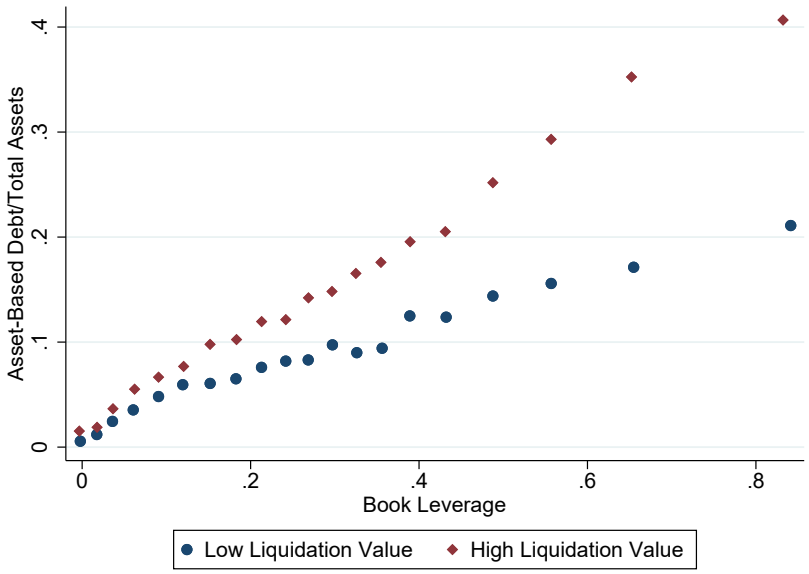
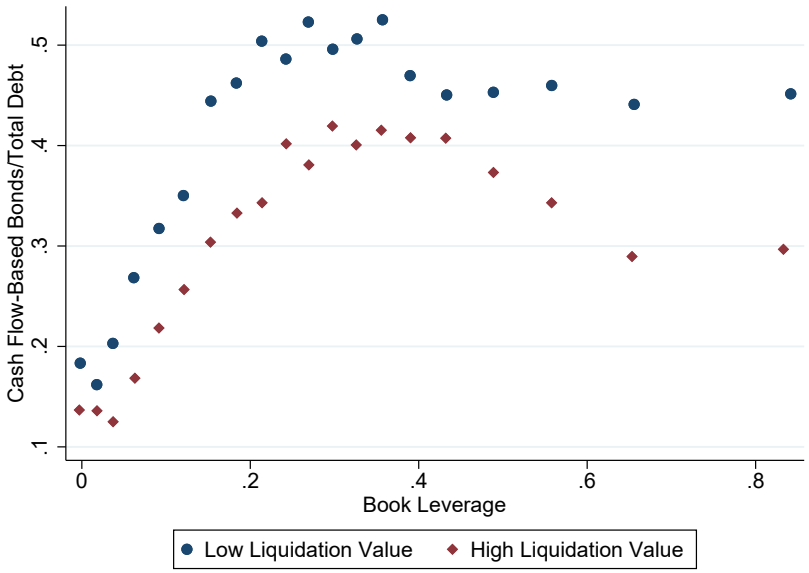


Figure 6: Cash Flow-Based Debt with Weak Control (Bonds)

The figure in Panel A provides a binned scatterplot of cash flow-based bonds as a share of total debt against book leverage in twenty equal-sized bins for firms with high and low liquidation value. The figure in Panel B provides a binned scatterplot of cash flow-based bonds as a share of total assets against book leverage in twenty equal-sized bins for firms with high and low liquidation values. Firms in the top tercile of liquidation value each year are categorized within the high liquidation value group, and firms in the bottom tercile of liquidation value each year are categorized within the low liquidation value group. Year fixed effects are included. Firms with book leverage outside of 0 and 1 are omitted. Sample period is 2003 (beginning of CapitalIQ data for constructing debt composition) to 2016.

Panel A. Share in Total Debt: Cash Flow-Based Bonds



Panel B. Divide by Total Assets: Cash Flow-Based Bonds

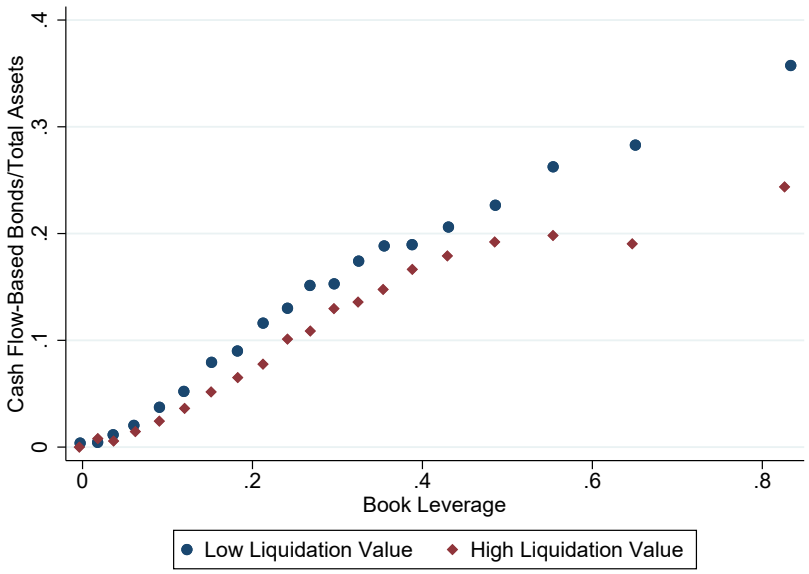
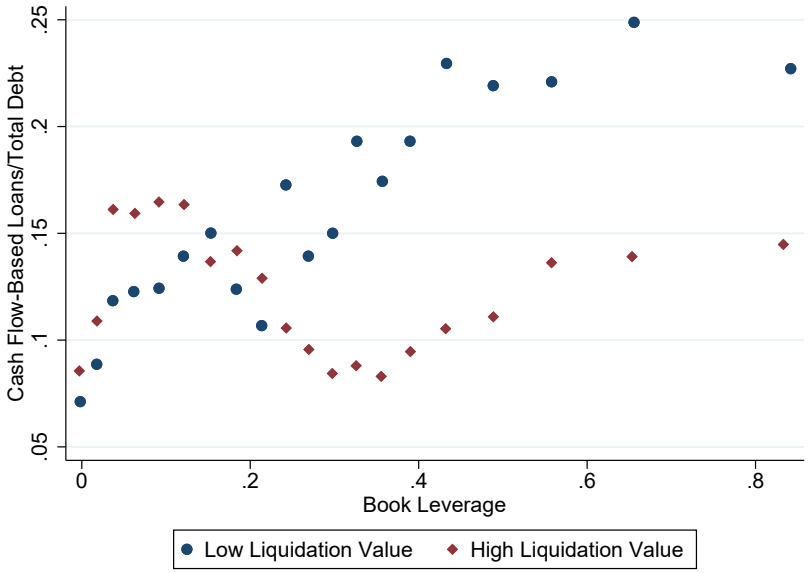


Figure 7: Cash Flow-Based Debt with Strong Control (Loans)

The figure in Panel A provides a binned scatterplot of cash flow-based loans as a share of total debt against book leverage in twenty equal-sized bins for firms with high and low liquidation value. The figure in Panel B provides a binned scatterplot of cash flow-based loans as a share of total assets against book leverage in twenty equal-sized bins for firms with high and low liquidation values. Firms in the top tercile of liquidation value each year are categorized within the high liquidation value group, and firms in the bottom tercile of liquidation value each year are categorized within the low liquidation value group. Year fixed effects are included. Firms with book leverage outside of 0 and 1 are omitted. Sample period is 2003 (beginning of CapitalIQ data for constructing debt composition) to 2016.

Panel A. Share in Total Debt: Cash Flow-Based Loans



Panel B. Divide by Total Assets: Cash Flow-Based Loans

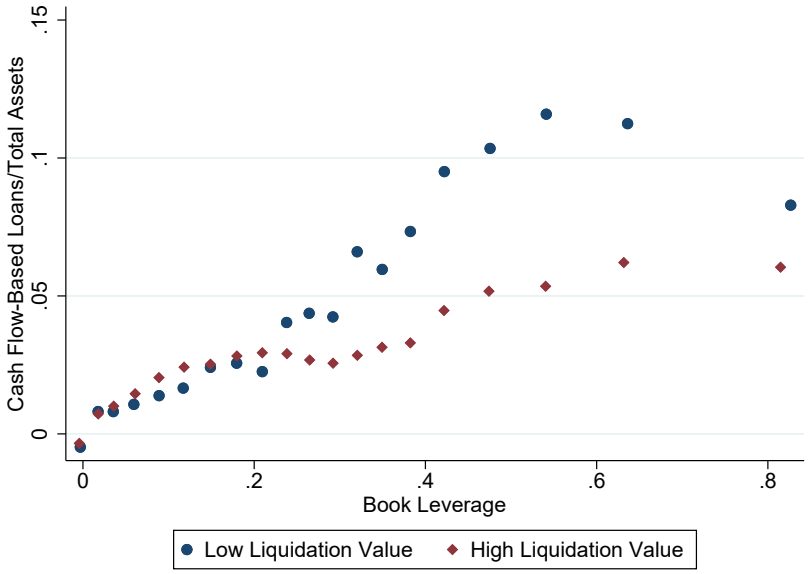


Figure 8: Strictness of Earnings-Based Covenants

The figure provides a binned scatterplot of non-zero earnings-based loan covenant tightness against book leverage in twenty equal-sized bins for firms with high and low liquidation value. The loan covenant tightness measure is constructed using loan covenant thresholds data from Dealscan and firm balance sheet data from Compustat following the procedure of Murfin (2012). It captures the tightness for EBITDA, debt to EBITDA, senior debt to EBITDA, interest coverage, fixed charge coverage, cash interest coverange, and debt service coverage covenants. Firms in the top tercile of liquidation value each year are categorized within the high liquidation value group, and firms in the bottom tercile of liquidation value each year are categorized within the low liquidation value group. Year fixed effects and loan size controls are included. Firms with book leverage outside of 0 and 1 are omitted. Sample period is 1996 to 2016.

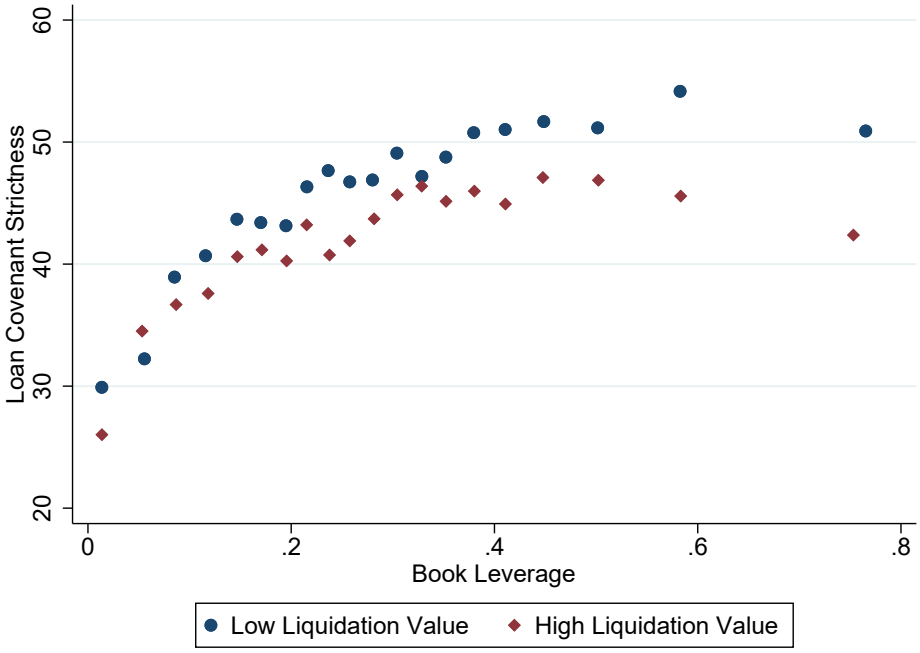
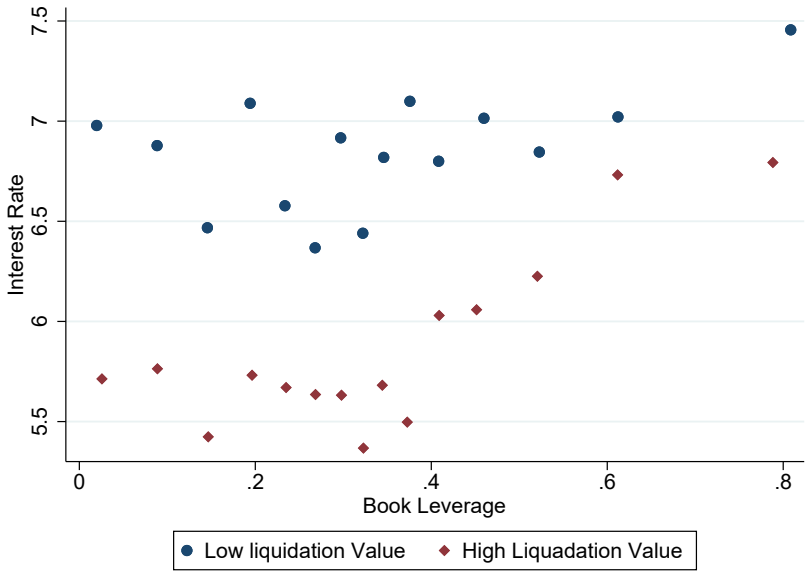


Figure 9: Interest Rates

The figure provides a binned scatterplot of interest rates against book leverage in twenty equal-sized bins for firms with high and low liquidation values. Interest rate data comes from CapitalIQ. Firms in the top tercile of liquidation value each year are categorized within the high liquidation value group, and firms in the bottom tercile of liquidation value each year are categorized within the low liquidation value group. Year-quarter fixed effects are included. Firms with book leverage outside of 0 and 1 are omitted. Sample period is 2003 (beginning of CapitalIQ data) to 2016.

Panel A. Interest Rates of Asset-Based Debt



Panel B. Interest Rates of Cash Flow-Based Debt

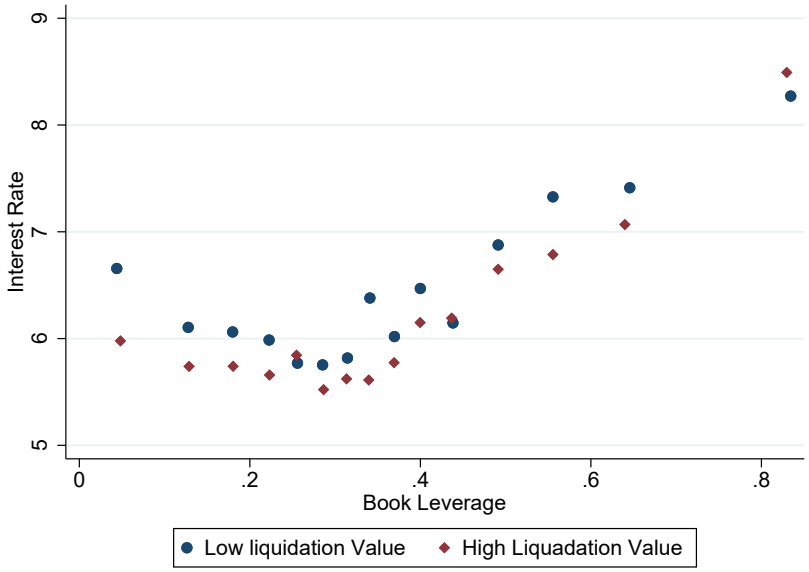
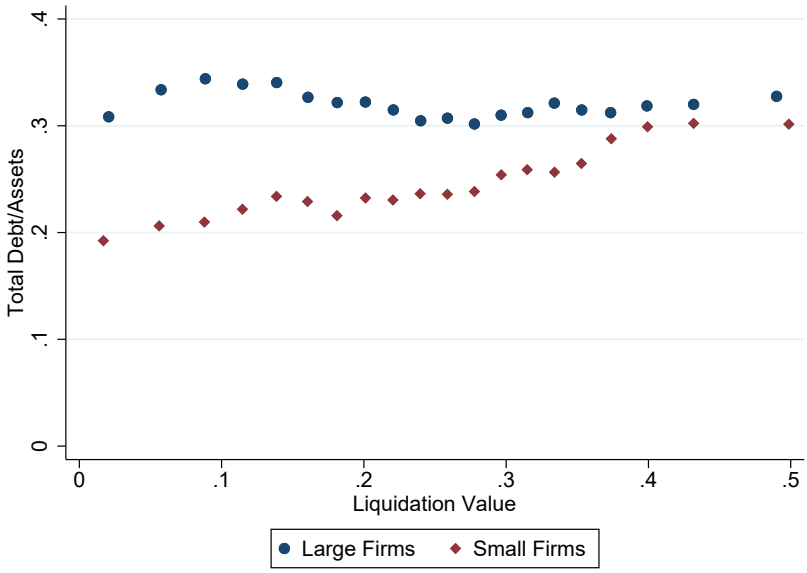


Figure 10: Liquidation Values and Total Leverage

Panels A and B provide binned scatterplots of book leverage against liquidation values in twenty equal-sized bins for firms with high and low total assets and positive and negative EBITDA, respectively. Firms with assets above Compustat median in each year are categorized within the "Large Firms" group, and firms with assets below Compustat median are categorized within the "Small Firms" group. Year fixed effects are included. Firms with book leverage outside of 0 and 1 are omitted. Sample period is 1996 to 2016.

Panel A. Large vs. Small Firms



Panel B. Firms with Positive vs. Negative Earnings

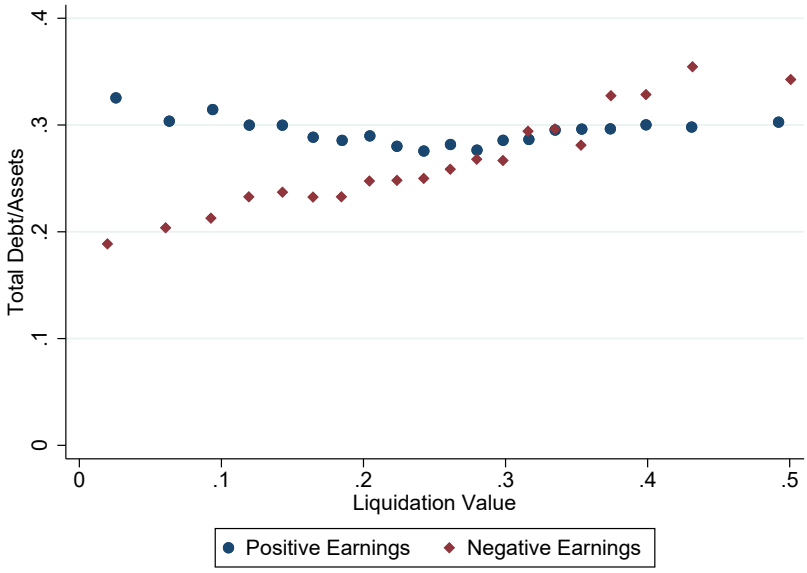
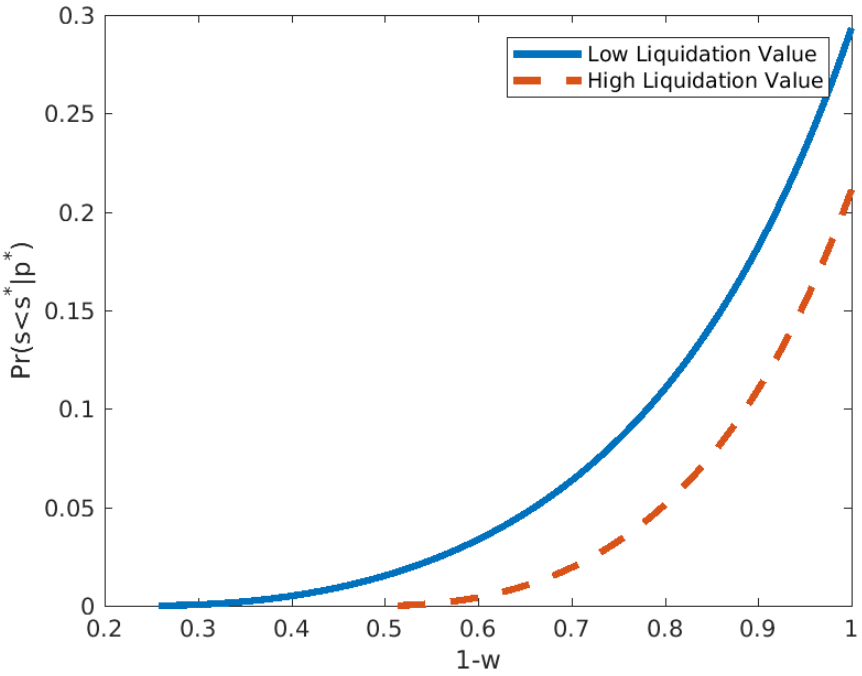


Figure 11: Model Solutions

Panel A plots covenant tightness (probability of violation) as a function of book leverage (one minus the entrepreneur's wealth) for firms with low liquidation value (solid line) and high liquidation value (dashed line). Panel B shows investment of informed investors as a function of book leverage for firms with low liquidation value (solid line) and high liquidation value (dashed line).

Panel A. Covenant Tightness $\mathbb{P}[s < s^*|p*]$



Panel B. Investment by Informed Investors i_i

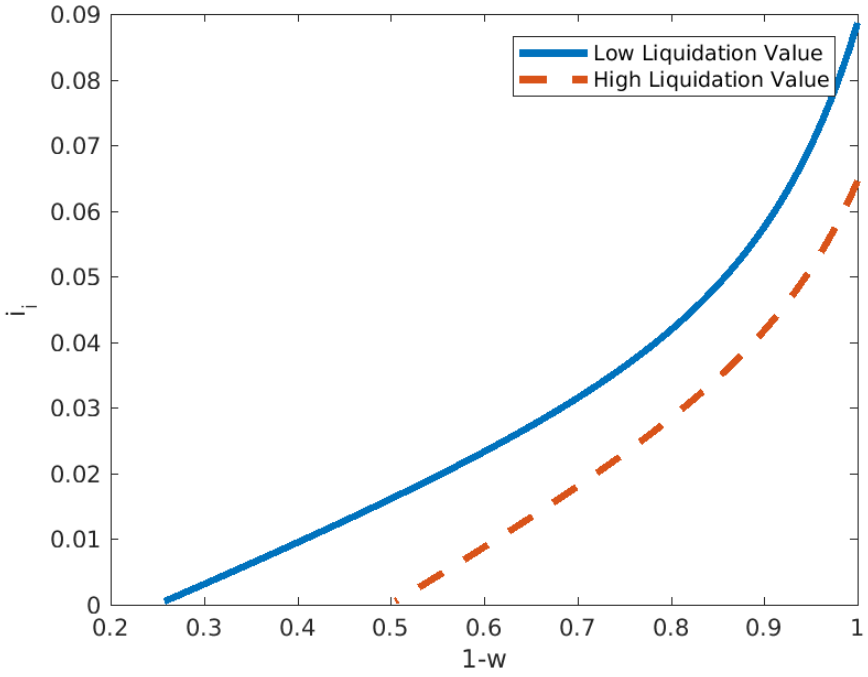


Table 1: Summary Statistics

Panel A shows industry-average (two-digit SICs) liquidation recovery rates of PPE, inventory, and receivables, as well as firm-level liquidation value estimates. The baseline firm-level liquidation value estimate includes the liquidation value of PPE, Inventory, and receivables, and is normalized by book assets. It is calculated by combining the industry-average recovery rate and the book value of each type of asset. The value including cash holdings adds cash balances. Chapter 11 going-concern value is the industry-average Chapter 11 value (normalized by total assets at filing). Panel B shows statistics of total debt and debt composition, as well as financial covenant prevalence. Asset-based, cash flow-based, secured, unsecured, and total debt are constructed from CapitalIQ capital structure data. The loan covenants are identified using Dealscan data. Earnings-based covenants consist of EBITDA, debt to EBITDA, senior debt to EBITDA, interest coverage, fixed charge coverage, cash interest coverange, and debt service coverage covenants. Other financial covenants include debt to equity, debt to net worth, debt to tangible networth, current ratio, quick ratio, and capital expenditures covenants. The baseline sample period for firm-level Compustat data and DealScan covenant data is 1996 to 2016, except for CapitalIQ debt composition data which is available since 2003 (so the debt statistics in Panel B cover 2003 to 2016).

Panel A. Liquidation Recovery Rates					
Industry-level	mean	sd	p25	p50	p75
PPE	35.34	16.69	24	33	44
Inventory	44.26	15.66	34	44	56
Receivables	61.60	13.64	55	63	71
Firm-level	mean	sd	p25	p50	p75
Baseline	22.93	13.36	12	23	33
Including cash holdings	43.59	19.91	30	41	54
Ch11 going-concern	80.52	25.48	68	78	100
Panel B. Debt Composition and Covenant Prevalence					
Debt and Debt Composition	mean	sd	p25	p50	p75
Total debt / Assets	0.28	0.22	0.10	0.25	0.40
Asset-based debt / Total debt	0.45	0.43	0.00	0.32	0.99
Cash flow-based debt / Total debt	0.49	0.43	0.00	0.51	0.97
Cash flow-based loans / Total debt	0.14	0.29	0.00	0.00	0.09
Cash flow-based bonds / Total debt	0.35	0.40	0.00	0.09	0.76
Secured cash flow-based debt / Total debt	0.10	0.25	0.00	0.00	0.00
Unsecured cash flow-based debt / Total debt	0.39	0.42	0.00	0.20	0.88

Table 2: Cross Check with Chapter 7 Liquidation Proceeds

The table compares the total estimated liquidation value in Chapter 11 cases with the liquidation value in Chapter 7 cases. Panel A reports the average total liquidation value, normalized by total assets at filing. Column (1) uses the gross liquidation receipts from the trustee report. Columns (2) and (3) sum the gross liquidation receipts from the trustee report with 50% of asset-based debt and secured debt, respectively. Columns (4) and (5) sum the gross liquidation receipts from the trustee report with 100% of asset-based debt and secured debt, respectively. In Panel B, the table reports OLS regression coefficients of total liquidation value of each case (normalized by total assets at filing) on a Chapter 7 dummy. Year and industry fixed effects are included. Standard errors clustered by year are reported in parentheses, and asterisks denote significance levels (***=1%, **=5%, *=10%).

Panel A. Raw Statistics					
	Total Liquidation Value/Total Assets				
Assumptions	Basic	Medium v1	Medium v2	High v1	High v2
	(1)	(2)	(3)	(4)	(5)
Chapter 7 Avg	0.12	0.33	0.32	0.48	0.49
Chapter 11 Est Avg	0.31				
Panel B. Comparison with Chapter 11 Liquidation Analysis Estimates					
	Total Liquidation Value/Total Assets				
	(1)	(2)	(3)	(4)	(5)
	Basic	Medium v1	Medium v2	High v1	High v2
Chapter 7	-0.170***	-0.077*	-0.084**	-0.018	-0.023
	(0.024)	(0.033)	(0.028)	(0.043)	(0.036)
Time fixed effects	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes

Table 3: Asset-Based Debt

This table reports firm-level annual regressions where the outcome variable is asset-based debt as a share of total debt in columns (1) and (2), and asset-based debt in total assets in columns (3) and (4). Liquidation value is firm-level liquidation value (including PPE and working capital, normalized by book assets). In columns (2) and (4), both liquidation value and book leverage are demeaned using sample means. EBITDA is normalized by lagged total assets, and cash holdings are normalized by total assets. Market value of assets is book value of assets minus book value of equity plus market value of equity. Year fixed effects are included. Standard errors are double-clustered by firm and year and reported in parentheses, and asterisks denote significance levels (***=1%, **=5%, *=10%). Sample period is 2003 to 2016.

	Share of Total Debt		Share of Total Asset	
	(1)	(2)	(3)	(4)
Liquidation value	0.310***	0.449***	0.132***	0.224***
	(0.051)	(0.059)	(0.019)	(0.029)
Book leverage	-0.280***	-0.288***	0.358***	0.353***
	(0.024)	(0.023)	(0.014)	(0.014)
Liquidation value × Book leverage		1.315***		0.810***
		(0.183)		(0.094)
Ch 11 recovery rate	-0.098***	-0.088***	-0.034***	-0.028***
	(0.020)	(0.019)	(0.007)	(0.007)
EBITDA	0.051***	0.061***	0.001	0.007
	(0.016)	(0.016)	(0.005)	(0.005)
Market/book value of assets	-0.025***	-0.024***	-0.007***	-0.006***
	(0.004)	(0.004)	(0.001)	(0.001)
Past 12m equity return vol	-0.010	-0.014	-0.001	-0.004
	(0.010)	(0.011)	(0.004)	(0.004)
Cash	0.027	-0.001	-0.049***	-0.067***
	(0.031)	(0.029)	(0.011)	(0.010)
Log(assets)	-0.092***	-0.093***	-0.023***	-0.023***
	(0.003)	(0.003)	(0.001)	(0.001)
Observations	29923	29923	31015	31015
Within R^2	.228	.234	.273	.288
Time fixed effects	Yes	Yes	Yes	Yes

Table 4: Cash Flow Debt with Weak Control (Bonds)

This table reports firm-level annual regressions where the outcome variable is cash flow-based bonds as a share of total debt in columns (1) and (2), and cash flow-based bonds in total assets in columns (3) and (4). Liquidation value is firm-level liquidation value (including PPE and working capital, normalized by book assets). In columns (2) and (4), both liquidation value and book leverage are demeaned using sample means. EBITDA is normalized by lagged total assets, and cash holdings are normalized by total assets. Market value of assets is book value of assets minus book value of equity plus market value of equity. Year fixed effects are included. Standard errors are double-clustered by firm and year and reported in parentheses, and asterisks denote significance levels (***=1%, **=5%, *=10%). Sample period is 2003 to 2016.

	Share of Total Debt		Share of Total Asset	
	(1)	(2)	(3)	(4)
Liquidation value	-0.042	-0.113	0.005	-0.048
	(0.055)	(0.070)	(0.021)	(0.034)
Book leverage	0.262***	0.267***	0.420***	0.424***
	(0.035)	(0.035)	(0.022)	(0.023)
Liquidation value × Book leverage		-0.668***		-0.472***
		(0.210)		(0.121)
Ch 11 recovery rate	0.056**	0.051**	0.014**	0.011*
	(0.020)	(0.020)	(0.006)	(0.006)
EBITDA	-0.106***	-0.111***	-0.021***	-0.025***
	(0.017)	(0.017)	(0.005)	(0.005)
Market/book value of assets	0.011***	0.010**	0.005***	0.004***
	(0.003)	(0.004)	(0.001)	(0.001)
Past 12m equity return vol	0.033**	0.036**	0.001	0.002
	(0.014)	(0.015)	(0.005)	(0.006)
Cash	0.192***	0.206***	0.102***	0.112***
	(0.030)	(0.030)	(0.010)	(0.010)
Log(assets)	0.108***	0.109***	0.026***	0.026***
	(0.004)	(0.004)	(0.002)	(0.002)
Observations	29906	29906	31005	31005
Within R^2	.276	.278	.435	.441
Time fixed effects	Yes	Yes	Yes	Yes

Table 5: Cash Flow Debt with Strong Control (Loans)

This table reports firm-level annual regressions where the outcome variable is cash flow-based loans as a share of total debt in columns (1) and (2), and cash flow-based loans in total assets in columns (3) and (4). Liquidation value is firm-level liquidation value (including PPE and working capital, normalized by book assets). In columns (2) and (4), both liquidation value and book leverage are demeaned using sample means. EBITDA is normalized by lagged total assets, and cash holdings are normalized by total assets. Market value of assets is book value of assets minus book value of equity plus market value of equity. Year fixed effects are included. Standard errors are double-clustered by firm and year and reported in parentheses, and asterisks denote significance levels (***=1%, **=5%, *=10%). Sample period is 2003 to 2016.

	Share of Total Debt		Share of Total Asset	
	(1)	(2)	(3)	(4)
Liquidation value	-0.270***	-0.347***	-0.106***	-0.131***
	(0.041)	(0.046)	(0.014)	(0.020)
Book leverage	0.081***	0.086***	0.128***	0.130***
	(0.021)	(0.020)	(0.016)	(0.016)
Liquidation value × Book leverage		-0.722***		-0.213***
		(0.145)		(0.061)
Ch 11 recovery rate	0.047***	0.041**	0.015***	0.013**
	(0.015)	(0.015)	(0.004)	(0.004)
EBITDA	0.067***	0.062***	0.016***	0.014***
	(0.009)	(0.009)	(0.003)	(0.003)
Market/book value of assets	0.009**	0.009**	0.001	0.001
	(0.003)	(0.003)	(0.001)	(0.001)
Past 12m equity return vol	-0.040**	-0.037**	-0.008**	-0.007**
	(0.014)	(0.013)	(0.003)	(0.003)
Cash	-0.199***	-0.184***	-0.066***	-0.062***
	(0.025)	(0.024)	(0.006)	(0.006)
Log(assets)	-0.012***	-0.012***	-0.003***	-0.002***
	(0.002)	(0.002)	(0.001)	(0.001)
Observations	29923	29923	30679	30679
Within R^2	.027	.031	.112	.115
Time fixed effects	Yes	Yes	Yes	Yes

Table 6: Secured Cash Flow-Based Debt

This table reports firm-level annual regressions where the outcome variable is secured cash flow-based debt as a share of total debt in columns (1) and (2), and secured cash flow-based debt in total assets in columns (3) and (4). Liquidation value is firm-level liquidation value (including PPE and working capital, normalized by book assets). In columns (2) and (4), both liquidation value and book leverage are demeaned using sample means. EBITDA is normalized by lagged total assets, and cash holdings are normalized by total assets. Market value of assets is book value of assets minus book value of equity plus market value of equity. Year fixed effects are included. Standard errors are double-clustered by firm and year and reported in parentheses, and asterisks denote significance levels (***=1%, **=5%, *=10%). Sample period is 2003 to 2016.

	Share of Total Debt		Share of Total Asset	
	(1)	(2)	(3)	(4)
Liquidation value	-0.300***	-0.365***	-0.116***	-0.147***
	(0.038)	(0.044)	(0.015)	(0.021)
Book leverage	0.258***	0.262***	0.162***	0.165***
	(0.022)	(0.022)	(0.017)	(0.017)
Liquidation value × Book leverage		-0.607***		-0.269***
		(0.113)		(0.065)
Ch 11 recovery rate	0.027**	0.022*	0.014***	0.012**
	(0.011)	(0.011)	(0.005)	(0.005)
EBITDA	0.006	0.001	0.007**	0.005**
	(0.008)	(0.007)	(0.003)	(0.002)
Market/book value of assets	-0.004	-0.005*	-0.002*	-0.002*
	(0.003)	(0.003)	(0.001)	(0.001)
Past 12m equity return vol	0.029***	0.031***	0.010**	0.011**
	(0.008)	(0.008)	(0.004)	(0.004)
Cash	-0.125***	-0.112***	-0.046***	-0.040***
	(0.017)	(0.017)	(0.006)	(0.006)
Log(assets)	-0.012***	-0.012***	-0.004***	-0.004***
	(0.002)	(0.002)	(0.001)	(0.001)
Observations	29813	29813	30809	30809
Within R^2	.076	.079	.147	.152
Time fixed effects	Yes	Yes	Yes	Yes

Table 7: Loan Covenant Tightness

This table reports regressions of loan covenant tightness at loan issuance. The loan covenant tightness measures are constructed using loan covenant thresholds data from Dealscan and firm balance sheet data from Compustat following the procedure of Murfin (2012). The earnings-based covenants in columns (1) and (2) include EBITDA, debt to EBITDA, senior debt to EBITDA, interest coverage, fixed charge coverage, cash interest coverage, and debt service coverage covenants. The other financial covenants in columns (3) and (4) include debt to equity, debt to net worth, debt to tangible net worth, current ratio, quick ratio, and capital expenditure covenants. In columns (2) and (4), both liquidation value and book leverage are demeaned using sample means. Year fixed effects are included. Standard errors are double-clustered by firm and year and reported in parentheses, and asterisks denote significance levels (***=1%, **=5%, *=10%). Sample period is 1996 to 2016.

	Earnings-based loan cov.		Other loan cov.	
	(1)	(2)	(3)	(4)
Liquidation value	-14.567***	-15.687***	5.339	5.358
	(2.366)	(2.361)	(3.388)	(3.422)
Book leverage	24.461***	24.294***	9.781***	9.780***
	(1.416)	(1.397)	(2.665)	(2.662)
Liquidation value × Book leverage		-16.292		0.291
		(9.850)		(18.111)
Ch 11 recovery rate	1.433*	1.402*	1.819	1.821
	(0.783)	(0.779)	(1.391)	(1.391)
EBITDA	-14.283***	-14.370***	-1.893	-1.893
	(3.360)	(3.402)	(2.773)	(2.773)
Market/book value of assets	-1.053**	-1.058**	-1.175**	-1.175**
	(0.374)	(0.379)	(0.421)	(0.427)
Past 12m equity return vol	-1.456	-1.418	4.934***	4.934***
	(1.246)	(1.240)	(1.380)	(1.382)
Cash	-9.437***	-9.048***	-11.918**	-11.926**
	(2.030)	(2.037)	(4.621)	(4.680)
Log(loan amount)	1.609***	1.601***	0.609	0.609
	(0.223)	(0.224)	(0.386)	(0.385)
Log(assets)	-1.856***	-1.842***	-2.651***	-2.651***
	(0.219)	(0.220)	(0.525)	(0.525)
Observations	6394	6394	3585	3585
Within R^2	.208	.209	.071	.071
Time fixed effects	Yes	Yes	Yes	Yes

Table 8: Liquidation Values and Total Leverage

The table reports firm-level annual regressions on the relationship between liquidation value and total book leverage. Small firms are firms with total assets below Compustat median in each year. Industry-average liquidation value is the average of firm-level liquidation value in each two-digit SIC in the sample period. Standard errors are double-clustered by firm and time and are reported in parentheses, and asterisks denote significance levels (***=1%, **=5%, *=10%). Sample period is 1996 to 2016.

	Book Leverage					
	(1)	(2)	(3)	(4)	(5)	(6)
Liquidation value	-0.037	-0.001	-0.049*			
	(0.031)	(0.022)	(0.028)			
Industry-avg. liq. value				0.037	0.155***	0.039
				(0.042)	(0.039)	(0.043)
Small × Liquidation val	0.267***		0.200***			
	(0.034)		(0.043)			
Negative EBITDA × Liquidation val		0.333***	0.208***			
		(0.028)	(0.041)			
Small firm × Ind-avg liquidation val				0.254***		0.212***
				(0.047)		(0.054)
Negative EBITDA × Ind-avg liquidation val					0.170***	0.088
					(0.051)	(0.054)
Small firm	-0.140***		-0.128***	-0.130***		-0.122***
	(0.011)		(0.014)	(0.012)		(0.014)
Negative EBITDA		-0.111***	-0.036**		-0.074***	-0.018
		(0.011)	(0.017)		(0.013)	(0.015)
Observations	82615	77111	77111	86931	81060	81060
Within R^2	.04	.02	.045	.033	.013	.035
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Table 9: Interest Rates

This table shows the relationship between liquidation value and interest rates. The sample for columns (1) to (4) is debt records in CapitalIQ, which include all types of debt firms have. We use the initial observation (i.e., observation around issuance) for each debt. The sample for column (5) is DealScan loan issuance. ABL takes value one if the debt is an asset-based debt. Liquidation value is the liquidation value of PPE and working capital of the issuer firm. We include firm-year fixed effects and interest rate type-year fixed effects. Standard errors are double-clustered by firm and time and reported in parentheses, and asterisks denote significance levels (***=1%, **=5%, *=10%). The sample period is 2003 to 2016 for CapitalIQ, and 1996 to 2016 for DealScan.

	CapitalIQ				Dealscan
	Loans & Bonds	Loans			Loans
		All	Low leverage	High leverage	
	(1)	(2)	(3)	(4)	(5)
abl=1 × Liquidation value	-1.507**	-1.429**	-1.140**	-1.949*	-0.966***
	(0.522)	(0.581)	(0.507)	(1.071)	(0.303)
abl=1	0.050	0.480***	0.590***	0.376**	-0.404***
	(0.072)	(0.089)	(0.083)	(0.132)	(0.039)
bond	0.790***				
	(0.099)				
note	0.288**				
	(0.131)				
Observations	46573	23035	12527	10508	12429
Within R^2	.02	.018	.024	.013	.042
Interest rate-year fixed effects	Yes	Yes	Yes	Yes	Yes
Firm-year fixed effects	Yes	Yes	Yes	Yes	Yes

Table 10: Recovery Rates

This table shows the relationship between firm characteristics and recovery rates for different types of debt. The recovery rates data is constructed from Moody's Default Recovery Database. Each observation is a defaulted debt instrument. Columns (1), (3), and (5) use industry-level variables and controls. Columns (2), (4), and (6) use firm-level variables and controls for the subsample of observations in Moody's data that we can match with Compustat firms. Firm-level liquidation value is the liquidation value prior to default calculated based on industry-average recovery rates and book value of each type of assets (normalized by book assets). Industry-level liquidation value is the industry average of firm-level liquidation value using all Compustat firms in each industry. Firm-level Ch 11 recovery rate is Chapter 11 value estimate for the firm if we can find match the firm with a case in our bankruptcy dataset (normalized by book assets at filing), and otherwise the industry-average Chapter 11 recovery rate. Market value of asset is calculated as the book value of assets minus the book value of equity plus the market value of equity. Subordinated is a dummy for subordinated debt. Bond is a dummy for bonds. Percent above is the fraction of debt claim more senior. Log amount is log of the debt claim's face value. Firm-level controls in columns (2), (4), and (6) include EBITDA (normalized by lagged assets), market value/book value of assets, past 12 months stock returns, and cash holdings (normalized by assets), prior to default. Default year fixed effects are included. Standard errors are double-clustered by industry and time and reported in parentheses, and asterisks denote significance levels (***=1%, **=5%, *=10%).

	Asset-Based Debt		Cash Flow-Based Debt			
	(1)	(2)	(3)	(4)	(5)	(6)
Industry-level liquidation value	37.376**		7.798		23.603	
	(14.829)		(24.586)		(25.170)	
Liquidation value		40.201***		17.846		11.270
		(13.193)		(22.074)		(22.699)
Industry-level Ch 11 recovery rate	-11.829		-7.010			
	(7.242)		(7.681)			
Ch 11 recovery rate		4.249		25.957***		
		(8.827)		(8.548)		
Market/book value of assets industry -level 25th perc.					31.936**	30.585*
					(14.166)	(15.699)
Secured	-2.994	-24.243	15.575***	24.025***	13.366***	21.566***
	(3.096)	(15.853)	(4.528)	(7.197)	(4.313)	(7.498)
Subordinated	-5.714	0.000	-15.792**	-11.755**	-15.748**	-11.497**
	(11.172)	(0.000)	(5.882)	(4.280)	(5.701)	(4.378)
% of debt claims more senior	-62.001***	-52.289***	-25.247***	-23.557***	-27.604***	-20.708**
	(11.179)	(15.447)	(8.814)	(6.988)	(8.487)	(9.439)
Bond	-27.585**	-29.014***	-5.900	-2.407	-6.184	-6.715
	(9.767)	(8.566)	(4.386)	(6.560)	(4.779)	(7.118)
Log(assets)		0.762		5.053**		4.228**
		(1.715)		(1.799)		(1.869)
EBITDA		8.931		12.989		7.746
		(14.103)		(7.759)		(11.503)
Market/book value of assets		-4.568		-6.694**		-5.778*
		(3.862)		(2.649)		(3.112)
Past 12m equity return vol		5.540		1.733		2.452
		(5.883)		(7.367)		(7.567)
Cash		-0.591		4.677		-1.001
		(26.843)		(21.013)		(27.023)
Observations	975	399	2304	1038	2290	1048
Within R^2	.298	.379	.232	.304	.241	.264
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Internet Appendix

IA1 Additional Figures and Tables

Figure IA1: Secured Cash Flow-Based Debt and Liquidation Value

The figure in Panel A provides a binned scatterplot of secured cash flow-based debt as a share of total debt against book leverage in twenty equal-sized bins for firms with high and low liquidation values. The figure in Panel B provides a binned scatterplot of secured cash flow-based debt as a share of total assets against book leverage in twenty equal-sized bins for firms with high and low liquidation value. Firms in the highest tercile of liquidation value are categorized within the high liquidation value group and firms in the lowest tercile of liquidation value are categorized within the low liquidation value group. Year fixed effects are included. Firms with book leverage outside of 0 and 1 are omitted. Sample period is 2003 to 2016.

Panel A. Share in Total Debt: Secured Cash Flow-Based Debt

Panel B. Divide by Total Assets: Secured Cash Flow-Based Debt

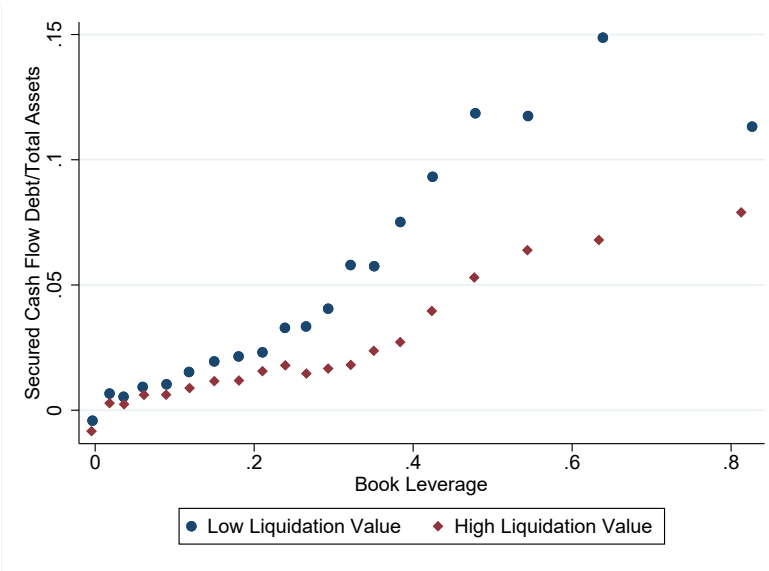
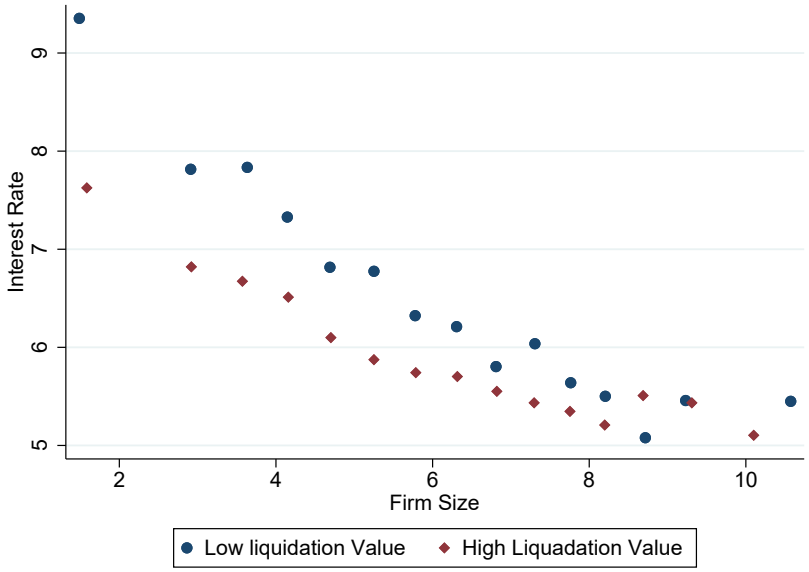


Figure IA2: Interest Rates and Firm Size

The figure provides a binned scatterplot of interest rates against firm size (log total assets) in twenty equal-sized bins for firms with high and low liquidation values. Interest rate data comes from CapitalIQ. Firms in the top tercile of liquidation values in Compustat each year are categorized within the high liquidation value group, and firms in the bottom tercile of liquidation values in Compustat each year are categorized within the low liquidation value group. Year-quarter fixed effects are included. Firms with book leverage outside of 0 and 1 are omitted. Sample period is 2003 (beginning of CapitalIQ data) to 2016.

Panel A. Interest Rates on Asset-Based Debt



Panel B. Interest Rates on Cash Flow-Based Debt

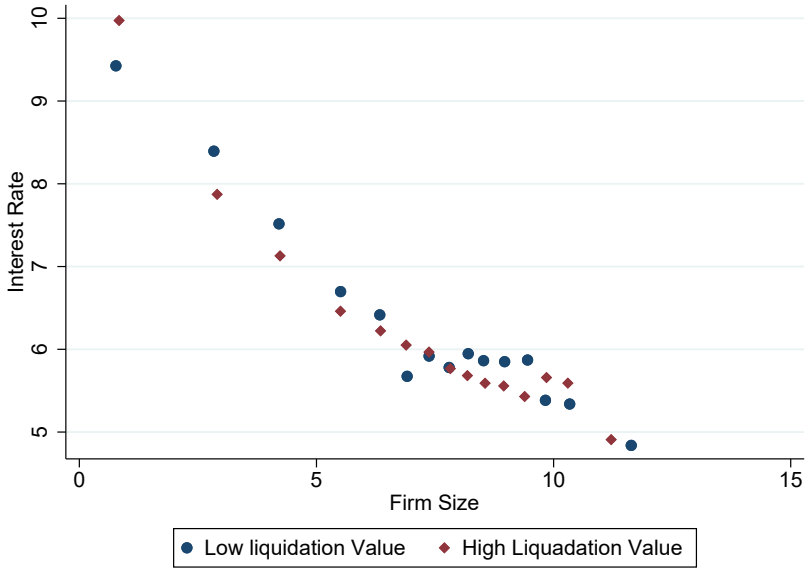
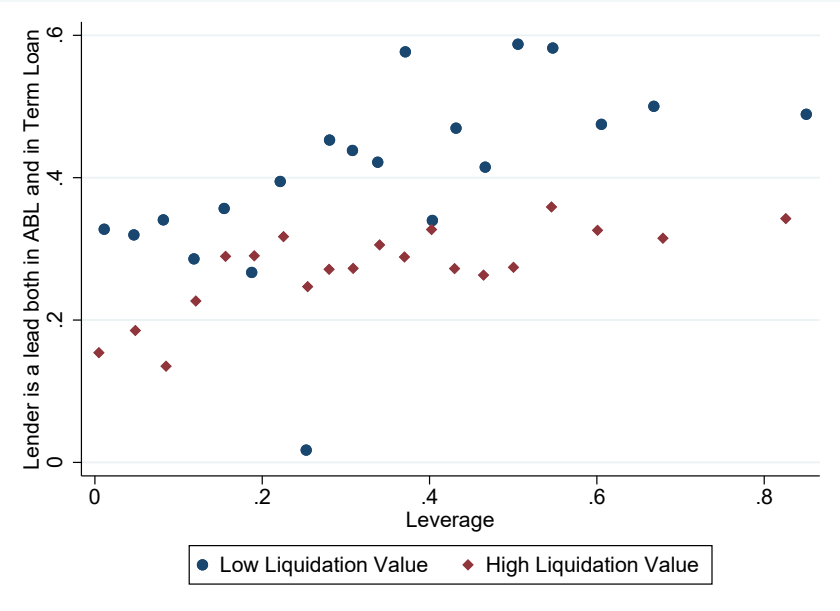


Figure IA3: Frequency of Having Same Lead Lenders
in Asset-Based Loans and Cash Flow-Based Loans

The figure provides a binned scatterplot of the share of DealScan loan packages where the same lender is a lead lender for an asset-based revolver and a cash flow-based term loan, against book leverage in Panel A and firm size (log total assets) in Panel B, in twenty equal-sized bins for firms with high and low liquidation values. Loan lender data comes from Dealscan. Firms in the top tercile of liquidation values in Compustat each year are categorized within the high liquidation value group, and firms in the bottom tercile of liquidation values in Compustat each year are categorized within the low liquidation value group. Year fixed effects are included. Firms with book leverage outside of 0 and 1 are omitted. Sample period is 1996 to 2016.

Panel A. By Book Leverage



Panel B. By Firm Size

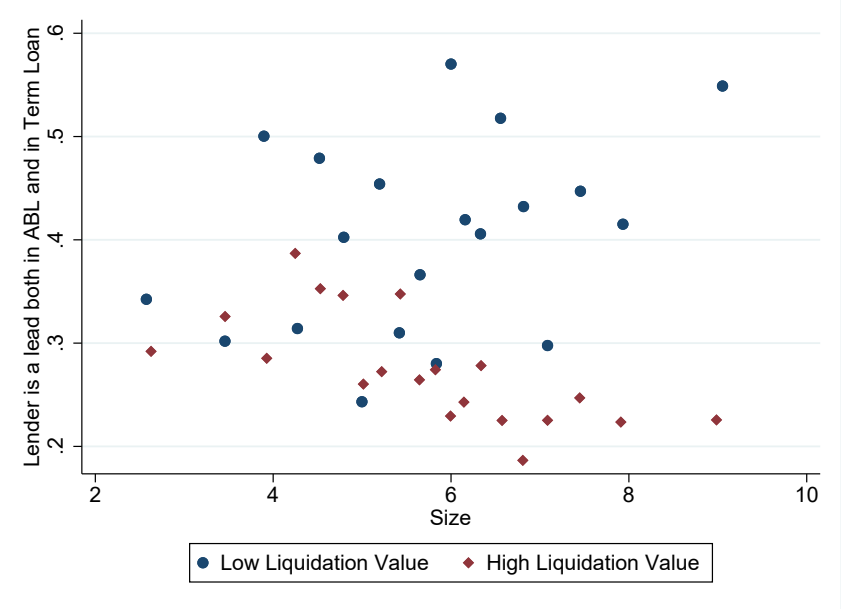


Figure IA4: Firms Liquidation Values and Probability of Borrowing Base Violations

The figure provides a binned scatterplot of the share of firms with debt against working capital greater than the estimated liquidation values of working capital assets, as a function of book leverage in twenty equal-sized bins, for firms with high and low liquidation values. The amount of debt against working capital is constructed using debt-level data from CapitalIQ. Firms in the top tercile of liquidation values in Compustat each year are categorized within the high liquidation value group, and firms in the bottom tercile of liquidation values in Compustat each year are categorized within the low liquidation value group. Year fixed effects are included. Firms with book leverage outside of 0 and 1 are omitted. Sample period is 2003 (beginning of CapitalIQ data) to 2016.

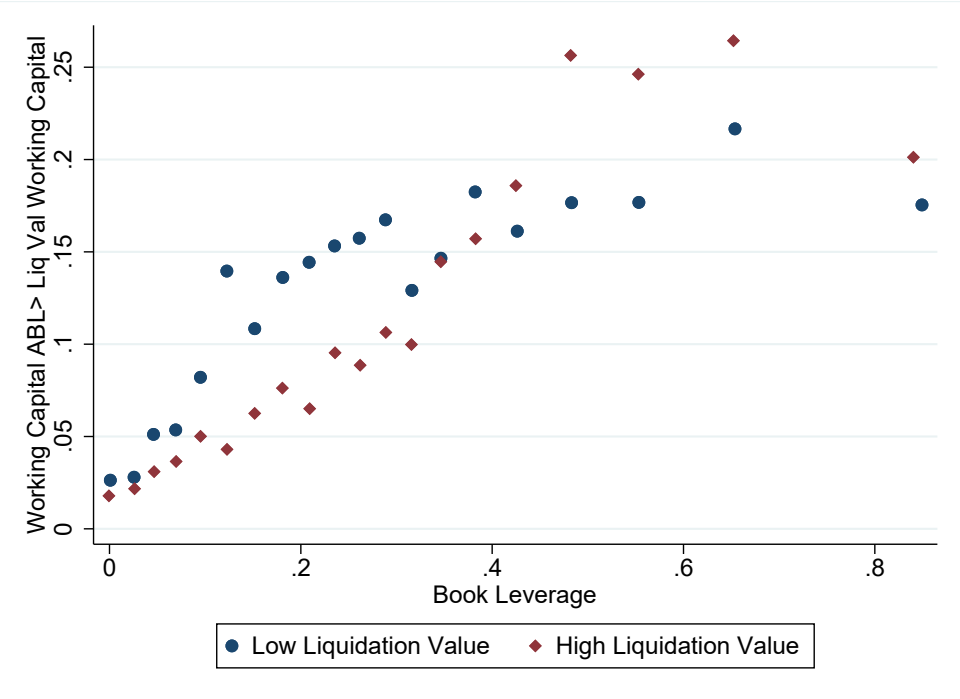


Table IA1: Industry List

The table shows the number of cases for each two-digit SIC industry for which we can find liquidation recovery rates of receivable, inventory, or PPE. The cases are from the list of public and large private bankruptcy filings between 2000 and 2016 from BankruptcyData.com. We exclude financial firms (SIC between 6000 and 6999) and public administration (SIC greater than 9000).

2-digit SIC	Industry	N
9	Fishing/Hunting/Trapping	1
10	Metal Mining	5
12	Bituminous Coal and Lignite Mining	6
13	Oil/Gas Extraction	48
14	Mining/Quarrying-Nonmetals	2
15	Building Constr. Gen. Contractors/Op. Builders	3
17	Constr. Special Trade Contractors	1
20	Food/Kindred Products	9
22	Textile Mill Products	4
23	Apparel & Similar Materials	4
24	Lumber/wood Products	2
25	Furniture & Fixtures	3
26	Paper & Allied Products	11
27	Printing, Publishing & Allied Industries	19
28	Chemicals & Allied Products	24
30	Rubber & Miscellaneous Plastics Products	11
32	Stone, Clay, Glass, & Concrete Products	3
33	Primary Metal Industries	10
34	Fabricated Metal Products	7
35	Industrial & Commercial Machinery & Computer Equip	7
36	Electronic Equip, except Computer Equip	21
37	Transportation Equip	19
38	Measuring/Analyzing/Controlling Instruments	4
39	Misc. Manufacturing Industries	6
41	Local/Suburban Transit & Interurban Highway Transportation	2
42	Motor Freight Transportation & Warehousing	2
44	Water Transportation	8
45	Transportation by Air	9
47	Transportation Services	3
48	Communications	26
49	Electric, Gas & Sanitary Services	7
50	Wholesale Trade-Durable Goods	2
51	Wholesale Trade-Nondurable Goods	5
52	Building Materials, Hardware, Garden Supply, & Mobile Home Dealers	1
53	General Merchandise Stores	3
54	Food Stores	3
55	Automotive Dealers & Gas Service Stations	2
56	Apparel & Accessory Stores	6
57	Home Furniture, Furnishings, & Equip Stores	3
58	Eating/Drinking Places	9
59	Misc. Retail	7
70	Hotels, Rooming Houses, Camps, & other Lodging	7
72	Personal Services	2
73	Business Services	29
78	Motion Pictures	8
79	Amusement & Recreation Services	5
80	Health Services	7
82	Educational Services	1
Total		387

Table IA2: Industry-Level Variations in Liquidation Values

This table reports firm-level annual regressions where the outcome variable is asset-based debt (normalized by total assets) in Panel A, cash flow-based bonds in Panel B, and cash flow-based loans in Panel C. Columns (1) and (2) use industry-average liquidation value (including PPE and working capital, normalized by book assets). Columns (3) and (4) instrument firm-level liquidation value using PPE recovery rates predicted by industry-level physical attributes of PPE from Kermani and Ma (2020), which include mobility (transportation cost in PPE production cost), durability (PPE depreciation rate), and standardization/customization (design cost in PPE production cost). In columns (2) and (4), both liquidation value and book leverage are demeaned using sample means. The firm control variables are the same as those in Tables 3 to 5. Year fixed effects are included. Standard errors are double-clustered by firm and year and reported in parentheses, and asterisks denote significance levels (***=1%, **=5%, *=10%). Sample period is 2003 to 2016.

Panel A. Asset-Based Debt

	(1)	(2)	(3)	(4)
Industry-avg liquidation value	0.068**	0.117***		
	(0.026)	(0.034)		
Industry-avg liquidation value × Book leverage		0.757***		
		(0.139)		
Liquidation value			0.047	0.082
			(0.047)	(0.052)
Liquidation value × Book leverage				0.935***
				(0.219)
Book leverage	0.364***	0.368***	0.355***	0.363***
	(0.014)	(0.014)	(0.014)	(0.014)
Ch 11 recovery rate	-0.039***	-0.036***	-0.039***	-0.035***
	(0.007)	(0.007)	(0.007)	(0.007)
Observations	32464	32464	31015	31015
Within R^2	.271	.277	.27	.282

Panel B. Cash Flow-Based Debt with Weak Control

	(1)	(2)	(3)	(4)
Industry-avg liquidation value	0.073**	0.063		
	(0.028)	(0.038)		
Industry-avg liquidation value × Book leverage		-0.157		
		(0.174)		
Liquidation value			0.068	0.056
			(0.043)	(0.049)
Liquidation value × Book leverage				-0.302
				(0.207)
Book leverage	0.418***	0.417***	0.423***	0.420***
	(0.022)	(0.021)	(0.022)	(0.022)
Ch 11 recovery rate	0.023***	0.022***	0.018**	0.017**
	(0.006)	(0.006)	(0.007)	(0.007)
Observations	32454	32454	31005	31005
Within R^2	.433	.434	.434	.438

Panel C. Cash Flow-Based Debt with Strong Control

	(1)	(2)	(3)	(4)
Industry-avg liquidation value	-0.093***	-0.113***		
	(0.019)	(0.024)		
Industry-avg liquidation value × Book leverage		-0.278**		
		(0.099)		
Liquidation value			-0.085**	-0.102***
			(0.029)	(0.033)
Liquidation value × Book leverage				-0.361**
				(0.128)
Book leverage	0.128***	0.127***	0.129***	0.127***
	(0.016)	(0.016)	(0.016)	(0.016)
Ch 11 recovery rate	0.014**	0.012**	0.016***	0.014**
	(0.005)	(0.005)	(0.005)	(0.005)
Observations	32107	32107	30679	30679
Within R^2	.1	.103	.112	.112

Table IA3: Liquidation Values by Type of Asset

This table reports firm-level annual regressions where the outcome variable is debt against working capital (inventory and receivables) or PPE, normalized by total asset-based debt in columns (1) and (2), and normalized by total assets in columns (3) and (4) All regressions include liquidation values of working capital and of PPE, and all the firm-level control variables are the same as those in Tables 3 to 5. Year fixed effects are included. Standard errors are double-clustered by firm and year and reported in parentheses, and asterisks denote significance levels (***=1%, **=5%, *=10%). Sample period is 2003 to 2016.

	Share of asset-based debt		Share of assets	
	Working Capital	PPE	Working Capital	PPE
	(1)	(2)	(3)	(4)
Working capital liquidation value	0.586***	-0.040	0.134***	-0.003
	(0.061)	(0.038)	(0.015)	(0.005)
PPE liquidation value	-0.087	0.343***	0.045*	0.061***
	(0.095)	(0.048)	(0.021)	(0.008)
EBITDA	0.031	-0.030**	0.006*	-0.006***
	(0.019)	(0.013)	(0.003)	(0.001)
Market/book value of assets	-0.008	-0.010***	-0.004***	-0.001***
	(0.005)	(0.003)	(0.001)	(0.000)
Ch 11 recovery rate	0.059**	-0.048**	-0.010*	-0.010***
	(0.023)	(0.018)	(0.005)	(0.002)
Past 12m equity return vol	-0.005	-0.029**	0.002	-0.004***
	(0.014)	(0.013)	(0.003)	(0.001)
Cash	-0.560***	0.118***	-0.073***	0.000
	(0.033)	(0.026)	(0.006)	(0.002)
log(assets)	-0.024***	0.002	-0.010***	-0.000
	(0.004)	(0.003)	(0.001)	(0.000)
Book leverage	0.035	-0.051***	0.069***	0.005***
	(0.028)	(0.014)	(0.006)	(0.002)
Observations	23510	23408	31288	31201
Within R^2	.108	.027	.121	.054
Year fixed effects	Yes	Yes	Yes	Yes

Table IA4: Bankruptcy Outcomes

This table studies the relationship between firm characteristics and frequency of liquidation in bankruptcy. The outcome variable is a dummy that is equal to one if the bankruptcy outcome is Chapter 7 or "liquidated." Liquidation value is industry-average liquidation value based on the Compustat sample, merged with bankruptcy cases data based on the industry. Log(assets) is log total assets at filing. Ch 11 recovery rate is the industry-average Ch 11 value (normalized by assets at filing). Cash is industry-average cash holdings (normalized by total assets) and EBITDA is industry-average EBITDA (normalized by lagged assets). Firm leverage is winsorized at the 2.5% level. Filing year and judge fixed effects are included. Standard errors are double-clustered by industry and time and are reported in parentheses, and asterisks denote significance levels (***=1%, **=5%, *=10%). Sample includes all public and large private bankruptcy filings from 2000 to 2016 in the Bankruptcy.Com dataset.

	Liquidation		
	(1)	(2)	(3)
Industry-average liquidation value	0.682***	0.680**	0.651***
	(0.182)	(0.247)	(0.107)
Industry-average Ch 11 recovery rate	-0.064	-0.096*	-0.129
	(0.050)	(0.052)	(0.077)
log(assets prior to bankruptcy)	-0.038***	-0.063***	-0.064***
	(0.010)	(0.004)	(0.021)
Industry-average cash holdings	0.805***	0.840***	0.972***
	(0.147)	(0.176)	(0.248)
Industry-average EBITDA	-0.036	0.005	0.055
	(0.042)	(0.042)	(0.072)
Firm leverage		-0.047***	-0.042***
		(0.003)	(0.006)
log(firm sale)		-0.013**	0.004
		(0.006)	(0.015)
Filed for Ch. 11=1			-0.460***
			(0.044)
Observations	1409	1018	858
Within R^2	.08	.155	.194
Filing year fixed effects	Yes	Yes	Yes
Judge fixed effects	No	No	Yes

Table IA5: Comparison with Book Values of "Tangible Assets"

This table reports firm-level annual regressions in columns (1) and (2) where the outcome variables are asset-based debt normalized by total assets in column (1) and asset-based debt as a share in total debt in column (2), and debt-level regressions in columns (3) and (4) where the outcome variable is the interest rate. Panel A shows the relationship between these outcomes and our liquidation value measure, as well as the book value of tangible assets using PPE (normalized by total book assets). Panel B shows the relationship between these outcomes and our liquidation value measure, as well as the book value of tangible assets using the book value of PPE plus inventory. Column (3) restricts the sample to asset-based debt in CapitalIQ. Regressions in both panels control for EBITDA (normalized by lagged total assets), cash holdings (normalized by total assets), market value of assets (book value of assets minus book value of equity plus market value of equity), Chapter 11 going-concern, past 12 months equity volatility, and book leverage. Regressions in columns (1) and (2) also control for log(firm assets), and regressions in columns (3) and (4) also control for bond and loan indicators and log(debt amount). Standard errors are double-clustered by firm and year and reported in parentheses.

Panel A. PPE

	Asset-based debt as share of		Interest rates	
	Assets	Debt		
	(1)	(2)	(3)	(4)
Liquidation value	0.114***	0.250***	-1.954***	
	(0.021)	(0.054)	(0.345)	
PPE	0.025**	0.083***	0.479**	
	(0.011)	(0.027)	(0.193)	
Asset-based debt indicator=1 × Liquidation value				-1.782***
				(0.524)
Asset-based debt indicator=1 × PPE				0.306
				(0.271)
Asset-based debt indicator=1				0.375*
				(0.179)
Book leverage	0.352***	-0.299***		
	(0.014)	(0.024)		
Observations	31015	29923	21943	46573
Controls	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	No	No	No	Yes
Within R^2	.274	.23	.085	.02

Panel B. PPE Plus Inventory

	Asset-based debt as share of		Interest rates	
	Assets	Debt		
	(1)	(2)	(3)	(4)
Liquidation value	0.100***	0.200***	-2.073***	
	(0.024)	(0.061)	(0.390)	
PPE plus inventory	0.027**	0.090***	0.330	
	(0.011)	(0.029)	(0.228)	
Asset-based debt indicator=1 × Liquidation value				-1.541**
				(0.670)
Asset-based debt indicator=1 × PPE plus inventory				0.026
				(0.444)
Asset-based debt indicator=1				0.422**
				(0.191)
Book leverage	0.354***	-0.293***		
	(0.014)	(0.024)		
Observations	31015	29923	21943	46573
Controls	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	No	No	No	Yes
Within R^2	.274	.23	.084	.02

IA2 Data on Liquidation Recovery Rates and Going-Concern Values

IA2.1 Liquidation Recovery Rate Details

Below we show excerpts of detailed discussions for the summary liquidation value estimates shown in the example of Lyondell Chemical in Figure 1. They explain the procedures for the liquidation recovery rate estimates of different types of assets.

Figure IA5: Lyondell Chemical Example: Facility-Level Information for All PPE

This figure shows excerpt of the discussion about PPE liquidation value estimates in the liquidation analysis of Lyondell (Panel A) and excerpt of the facility-level estimate in the accompanying appendix.

Panel A. Excerpt of PPE Discussion in Liquidation Analysis

Property, Plant, and Equipment ("PP&E")

- PP&E includes all owned land, land improvements and buildings, battery limit process units, off sites, support assets and construction in progress.
- Appendix I is a report prepared by American Appraisal Associates, Inc. that includes projected liquidation values of PP&E as of April 1, 2010 that were used for this Liquidation Analysis.

Panel B. Excerpt of Facility-Level Estimate in Liquidation Analysis Appendix

LYONDELLBASELL INDUSTRIES AF S.C.A.
SUMMARY OF LIQUIDATION VALUE IN PLACE
AS OF APRIL 1, 2010
CURRENCY- USD

LIQUIDATION VALUE IN PLACE

PLANT CODE	PLANT NAME	LOCATION	SEGMENT	GRAND TOTAL
CHEMICALS SEGMENT				
4102	BASELL MEXICO	POLYOLEFINAS MEXICO	CHEMICALS	973,000
4100	BASELL MEXICO	BASELL MEXICO	CHEMICALS	21,000
BCO	BAYPORT EO	PASADENA, TX	CHEMICALS	23,875,000
BLO	BAYPORT PO @ 17.4% OWNERSHIP	PASADENA, TX	CHEMICALS	12,388,000
	BERRE	BERRE, FRANCE	CHEMICALS	24,442,000
RBO	BOTLEK	BOTLEK, NETHERLANDS	CHEMICALS	138,328,000
CIO	BRUNSWICK	BRUNSWICK, GA	CHEMICALS	4,415,000
CHO	CHANNELVIEW - NORTH	CHANNELVIEW, TX	CHEMICALS	155,927,000
CXO	CHANNELVIEW - SOUTH	CHANNELVIEW, TX	CHEMICALS	18,801,000
CXO	CHANNELVIEW SOUTH- PO/SM 2	CHANNELVIEW, TX	CHEMICALS	26,252,000
CVOX	CHANNELVIEW SOUTH- PO/SM 1 @ 17.4% OWNERSHIP	CHANNELVIEW, TX	CHEMICALS	3,721,000
CXO	CHANNELVIEW SOUTH- BDO	CHANNELVIEW, TX	CHEMICALS	9,211,000
CLO	CLINTON	CLINTON, IA	CHEMICALS	41,805,000
FLO	FOS-SUR-MER	FOS-SUR-MER, FRANCE	CHEMICALS	45,974,000
CCO	CORPUS CHRISTI	CORPUS CHRISTI, TX	CHEMICALS	88,349,000
0	VERENNES	VERENNES	CLOSED	0
JAX	JACKSONVILLE	JACKSONVILLE, FL	CHEMICALS	9,067,000
LPO	LA PORTE	LA PORTE, TX	CHEMICALS	64,340,000
LAO	LA PORTE ACETYLS	LA PORTE, TX	CHEMICALS	31,798,000
RMO	MAASVLATKTE @ 50% OWNERSHIP	MAASVLATKTE, NETHERLANDS	CHEMICALS	32,486,000
MIO	MORRIS	MORRIS, IL	CHEMICALS	24,638,000
1001	MUENCHSMUENSTER	MUENCHSMUENSTER, GERMANY	CHEMICALS	46,524,000
NEO	NEWARK	NEWARK, NJ	CHEMICALS	336,000
CBP	PIPELINE	MARKHAM-MONT BELVIEU, TX	CHEMICALS	98,163,000
TCO	TUSCOLA	TUSCOLA, IL	CHEMICALS	5,296,000
1001	WESSELING	KNAPSACK, GERMANY	CHEMICALS	409,707,000
TOTAL CHEMICALS SEGMENT				**1,316,837,000**

Figure IA5: Lyondell Chemical Example: Facility-Level Information for All PPE (Cont.)

PLANT CODE	PLANT NAME	LOCATION	SEGMENT	GRAND TOTAL
POLYMERS SEGMENT				
	BASELL POLYOLEFINS KOREA	SEOUL, ROK	POLYMERS	0
BYO	BAYPORT POLYMER	PASADENA, TX	POLYMERS	36,765,000
1000	BAYREUTH	BAYREUTH, GERMANY	POLYMERS	16,938,000
	BERRE	BERRE, FRANCE	POLYMERS	110,074,000
1301	BRINDISI	BRINDISI, ITALY	POLYMERS	76,841,000
1201	CARRINGTON	CARRINGTON, UK	POLYMERS	10,848,000
CBO	CHOCOLATE BAYOU POLYMERS	ALVIN, TX	POLYMERS	28,853,000
CLO	CLINTON	CLINTON, IA	POLYMERS	96,414,000
4005	EDISON	EDISON, NJ	POLYMERS	8,717,000
FPO	FAIRPORT	FAIRPORT, OH	POLYMERS	1,714,000
1300	FERRARA	FERRARA, ITALY	POLYMERS	30,654,000
1001	FRANKFURT	FRANKFURT, GERMANY	POLYMERS	16,278,000
4005	JACKSON	JACKSON, TN	POLYMERS	6,398,000
1001	KNAPSACK	KNAPSACK, GERMANY	POLYMERS	44,376,000
LPO	LA PORTE	LA PORTE, TX	POLYMERS	44,115,000
LKO	LAKE CHARLES POLYMER	LAKE CHARLES, LA	POLYMERS	43,770,000
2100	CLYDE PP	CLYDE, AUSTRALIA	POLYMERS	8,102,000
3110	GEELONG LABORATORY	GEELONG, AUSTRALIA	POLYMERS	22,000
3100	GEELONG PP	GEELONG, AUSTRALIA	POLYMERS	19,186,000
3000	MELBOURNE OFFICE	MELBOURNE, AUSTRALIA	POLYMERS	282,000
5000	PETROKEN	ENSENADA, ARGENTINA	POLYMERS	13,923,000
5100	PINDA	PINDA, BRAZIL	POLYMERS	343,000
4014	MANSFIELD	MANSFIELD, TX	POLYMERS	9,443,000
MTO	MATAGORDA	MATAGORDA, TX	POLYMERS	86,656,000
1201	MILTON KEYNES	MILTON KEYNES, UK	POLYMERS	8,532,000
1400	MOERDIJK	MOERDIJK, NETHERLANDS	POLYMERS	38,669,000
MIO	MORRIS	MORRIS, IL	POLYMERS	74,834,000
1001	MUENCHSMUENSTER	MUENCHSMUENSTER, GERMANY	POLYMERS	112,442,000
1601	TARRAGONA	TARRAGONA, SPAIN	POLYMERS	27,076,000
1300	TERNI	TERNI, ITALY	POLYMERS	37,679,000
VTO	VICTORIA	VICTORIA, TX	POLYMERS	24,349,000
8505	BAP GUANGZHOU	GUANGZHOU, PRC	POLYMERS	3,027,000
8503	BAP SUZHOU	SUZHOU, PRC	POLYMERS	2,876,000
8000	BAP THAILAND	BANGKOK, THAILAND	POLYMERS	3,777,000
8500	BASELL ASIA PACIFIC	HONG KONG, PRC	POLYMERS	13,000
LJI	LYONDELL JAPAN	TOKYO, JAPAN	POLYMERS	3,000
SIN	LYONDELL SOUTH ASIA	SINGAPORE	POLYMERS	1,000
TOTAL POLYMERS SEGMENT				**1,043,990,000**

Figure IA6: Lyondell Chemical Example: Other Assets

This figure shows excerpt of the discussion about inventory, receivable, and cash liquidation value estimates in the liquidation analysis of Lyondell.

Panel A. Excerpt of Inventory Discussion in Liquidation Analysis

Inventory

- The Debtors' inventories are comprised of raw materials, work-in-process ("WIP") and finished goods, as well as supplies and materials.
- Types of inventory products include polymers (polyethylene and polypropylene), chemicals (ethylene and propylene), and refining products (such as gasoline, diesel, and jet fuel).
- The recovery analysis was performed by reviewing the external field examination and bank appraisal by entity for the period ending September 30, 2009, which was in effect at the end of 2009.
- The September 30, 2009 gross recovery advance rates for raw materials, WIP and finished goods were discounted by approximately 7% for ineligibles to reflect the recovery ranges for each entity whose inventory secures bank financing.
- The "supplies and materials" component of inventory is assumed to have a recovery range of 50% to 75% for all entities.
- The recovery ranges vary by entity and type of inventory, as presented in the table below.
- The products produced in EAI are primarily polymers and chemicals, and the inventory liquidation assumptions for EAI approximate those of Basell USA Inc.

	Lyondell Chemical Company	Basell USA Inc.	Equistar Chemicals, LP	Houston Refining LP	Millennium Petrochemicals, Inc. (Virginia)
Raw Materials	68.7% - 78.7%	60.9% - 70.9%	69.9% - 79.9%	71.6% - 81.6%	57.3% - 67.3%
Work-In-Process	54.5% - 64.5%	68.7% - 78.7%	64.7% - 74.7%	67.6% - 77.6%	57.3% - 67.3%
Finished Goods	67.3% - 77.3%	68.7% - 78.7%	79.6% - 89.6%	67.6% - 77.6%	73.2% - 83.2%

Panel B. Excerpt of Cash and Receivable Discussion in Liquidation Analysis

Cash and Cash Equivalents and Short-Term Investments

- The Liquidation Analysis assumes that operations during the liquidation period would not generate additional cash available for distribution except for net proceeds from the disposition of non-cash assets.
- The liquidation value for all entities is estimated to be approximately 100% of the net book value as of December 31, 2009.

Trade Accounts Receivable

- The analysis of accounts receivable assumes that a chapter 7 trustee would retain certain existing staff of the Debtors to handle an aggressive collection effort for outstanding trade accounts receivable for the entities undergoing an orderly liquidation.
- Collectible accounts receivable are assumed to include all third-party trade accounts receivable.
- A range of discount factors based on the January 1, 2010 U.S. asset backed facilities effective advance rates were applied to receivables to estimate liquidation values.
- Collections during a liquidation of the Debtors may be further compromised by likely claims for damages for breaches of (or the likely rejection of) customer contracts, and attempts by customers to set off outstanding amounts owed to the Debtors against such claims.
- The liquidation values of trade accounts receivable were estimated at 60.0% to 70.0% of the net book value as of December 31, 2009 for purposes of this Liquidation Analysis.

IA2.2 Chapter 11 Going-Concern Value: Plan-Based Estimates vs. Market-Based Estimates

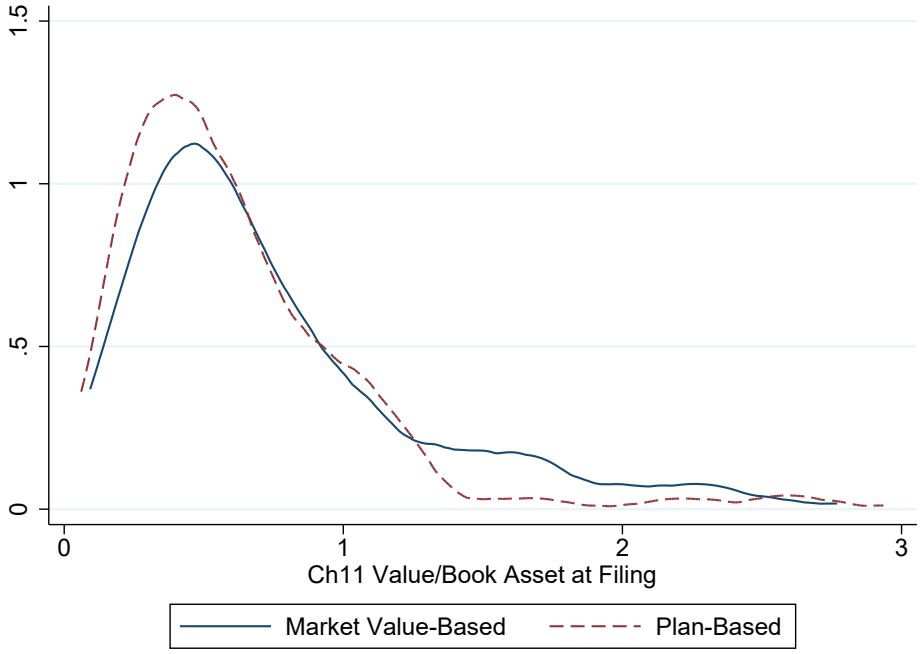
As explained in Section 2.1, for Chapter 11 going-concern value, we use information from both firm value estimates based on post-emergence market trading information and enterprise value estimates from the valuation analysis section in Chapter 11 plans. In particular, we use market value-based estimates when they are available (market value of equity plus book value of debt, or acquisition value if the firm is acquired), and plan-based estimates otherwise. We normalize the going-concern value by total book assets at filing. Figure IA7, Panel A, shows the distribution of the market-value based estimate and the distribution of the plan-based estimate, which look similar.

For 108 cases where both estimates are available, we also find that they are quite similar on average, consistent with prior findings of (Gilson et al., 2000). The median difference of market value-based estimate minus plan-based estimate is about 0.08 (inter-quartile range -0.08 to 0.26). The median ratio of these two values is about 1.14 (inter-quartile range 0.86 to 1.6). Figure IA7, Panel B, shows the distribution of the difference between the two estimates, which has most of its mass around zero. Overall, the data suggests that the Chapter 11 going-concern estimates are reasonably reliable.

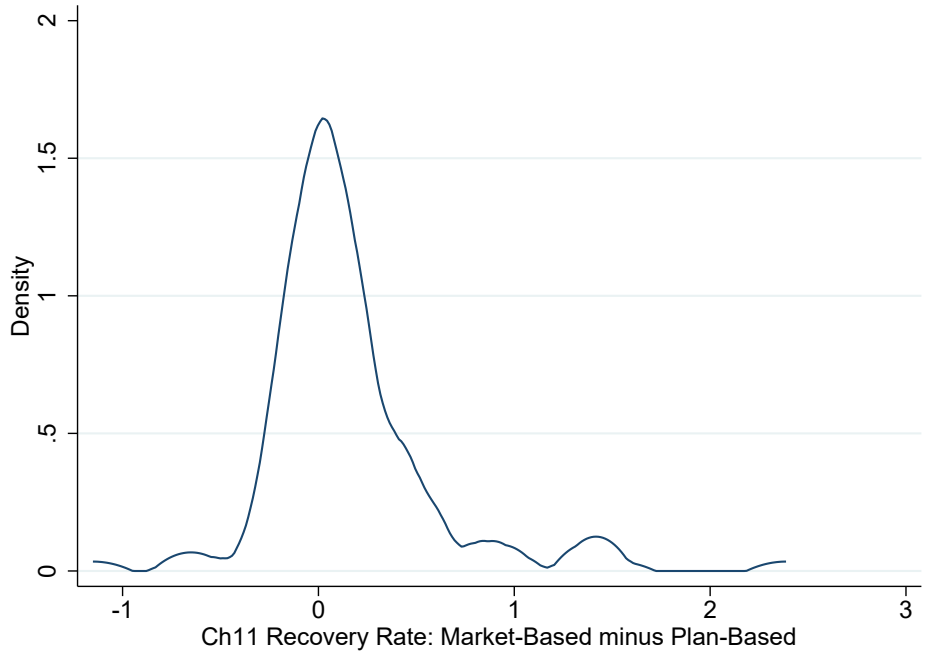
Figure IA7: Bankruptcy Recovery Rate Distributions

Panel A shows the distribution of Chapter 11 going-concern value based on post-emergence market values (trading information by summing the market value of equity and book value of debt, or acquisition value) in blue solid line, and the distribution of Chapter 11 going-concern value based on plan estimates in red dashed line. Both values are normalized by total book assets at filing. Panel B shows the distribution of market value estimates minus plan estimates.

Panel A. Market and Plan Recovery Rates



Panel B. Market and Plan Recovery Rate Differences



IA3 Additional Results Incorporating Operating Leases

One may also view operating leases as akin to asset-based debt, in the sense that the lessor has the ownership of certain discrete assets the firm uses, and can repossess these assets when the lease ends (Eisfeldt and Rampini, 2009). In this section, we perform robustness checks that include estimates of the capitalized value of operating leases as asset-based debt. In this case, the estimated present value of future rental payments would be both the operating lease liability and the operating lease asset. The effective recovery rate is assumed to be 100% if the lessor were to repossess the asset. [27]

We estimate the capitalized rental payments using two methods. The first method follows Rampini and Viswanathan (2013) and multiplies firms' annual rental expenses by ten. The second method utilizes capitalized operating leases provided by firms themselves, which became available in 2019 after the change in accounting rule, as discussed in Section 2.1.1. We obtain firms' estimates of capitalized operating leases in 2019 from CapitalIQ, and as well as rental payments as of fiscal year 2018 (given some firms' final data for fiscal 2019 have not been recorded in Compustat). For each firm, we calculate the ratio of capitalized operating leases relative to rental payments. We take the average ratio in each two-digit SIC industry, and use this ratio for all prior firm-years in our sample. In particular, we multiply this ratio by firms' rental expenses in these prior years.

We add the capitalized operating leases to asset-based debt, total debt, and total assets. We then compute total leverage including operating leases, as well as debt composition (relative to total debt and total assets) using these new values. We also add operating leases to the total liquidation value of the firm (and normalize the liquidation value using the new total assets). Indeed, since operating leases by design are directly included in both the liquidation value and the amount of asset-based debt, this could contribute to a mechanical positive association between asset-based debt (including operating leases) and liquidation value (including operating leases).

The results are presented in Table IA6 below. The regression specifications follow those in columns (3) and (4) of Tables 3 to 5, and the left hand side is different types of debt normalized by assets. The only difference here is we include capitalized operating leases in liquidation values, total assets, total leverage, and asset-based debt. The results are similar to those in Tables 3 to 5, if not stronger (by design) as explained above. Asset-based debt increases strongly with liquidation values, while cash flow-based bonds and loans decrease with liquidation values.

[27] The results are robust to assuming an alternative recovery rate of 70%.

Table IA6: Results Including Operating Leases

In this table, we include capitalized operating leases in total liquidation value, asset-based debt, total leverage, and total assets. We use two methods to estimate capitalized operating leases as described above. Year fixed effects are included. Standard errors are double-clustered by firm and year and reported in parentheses, and asterisks denote significance levels (***=1%, **=5%, *=10%). Sample period is 2003 to 2016.

Panel A. Method 1

	Asset-Based Debt		Cash Flow-Based Bonds		Cash Flow-Based Loans	
	(1)	(2)	(3)	(4)	(5)	(6)
Liquidation value	0.518***	0.500***	-0.140***	-0.138***	-0.315***	-0.301***
	(0.015)	(0.015)	(0.015)	(0.014)	(0.021)	(0.021)
Book leverage	0.473***	0.466***	0.119***	0.120***	0.330***	0.336***
	(0.012)	(0.012)	(0.015)	(0.015)	(0.019)	(0.021)
Liquidation value × Leverage w/ lease		0.890***		-0.134***		-0.682***
		(0.036)		(0.026)		(0.040)
Ch 11 recovery rate	-0.012	-0.007	0.014***	0.013***	-0.003	-0.007
	(0.007)	(0.006)	(0.004)	(0.004)	(0.006)	(0.006)
Observations	31015	31015	30679	30679	31005	31005
Within R^2	.601	.626	.115	.118	.39	.418
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Panel B. Method 2

	Asset-Based Debt		Cash Flow-Based Bonds		Cash Flow-Based Loans	
	(1)	(2)	(3)	(4)	(5)	(6)
Liquidation value	0.396***	0.396***	-0.126***	-0.132***	-0.214***	-0.210***
	(0.018)	(0.018)	(0.014)	(0.015)	(0.023)	(0.024)
Book leverage	0.425***	0.425***	0.126***	0.125***	0.368***	0.369***
	(0.013)	(0.013)	(0.016)	(0.016)	(0.021)	(0.021)
Liquidation value × Leverage w/ lease		0.001		-0.007***		0.005
		(0.012)		(0.002)		(0.009)
Ch 11 recovery rate	-0.028***	-0.028***	0.015***	0.014***	0.010	0.011
	(0.007)	(0.007)	(0.004)	(0.004)	(0.007)	(0.007)
Observations	29298	29298	28979	28979	29289	29289
Within R^2	.454	.454	.115	.116	.404	.404
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

IA4 Estimating Financial Covenant Tightness

We construct covenant tightness measures following Murfin (2012).[28] The main idea is to compare covenant threshold values from Dealscan (such as max. debt to EBITDA) with the firm's financial ratio values around the time of the issuance, to calculate the slack of the loan covenant (i.e., distance between the covenant threshold and the actual financial ratio at issuance). Using these slack values along with an industry-year-specific covariance matrix of changes in log firm financial ratio values, we can calculate the probability of covenant violation, which we use as the measure of covenant tightness.

First, we construct a firm-quarter dataset with calculates the logs of the relevant financial ratios using Compustat balance sheet data.[29] For the tightness of earnings-based loan covenant, we include cash interest coverage, debt to EBITDA, debt service coverage, EBITDA, fixed charge coverage, interest coverage, and senior debt to EBITDA covenants. For the tightness of other financial covenants, we include debt to equity, debt to tangible net worth, net worth, current ratio, quick ratio, and capital expenditure covenants. We take the log of the actual financial ratios, and calculate the changes in firms' log financial ratios. We then create a positive-definite covariance matrix of changes in the log of financial ratios. Because shocks to firms' financial ratios may differ among firms, we calculate the covariance matrices for each one-digit SIC industry and backwards-rolling ten-year period combination, following the approach in Murfin (2012). These covariance matrices are essential because violating a single covenant triggers a technical default. In addition, prior to creating each covariance matrix, observations where any of the changes in the log of an financial ratio is missing are dropped. Finally, the changes in log of financial ratios are winsorized at the 1% level.

We merge the firm-quarter log financial ratios with loan covenant thresholds from Dealscan one quarter prior to the start date of each loan. For covenants with maximum thresholds, we calculate the slack between the log of the covenant threshold and the log of the financial ratio. For covenants with minimum thresholds, we calculate the slack between the log of the covenant threshold's inverse and the log of the financial ratio's inverse. Slack variables are set to an arbitrarily large number if the loan does not include a financial covenant.

The final step of this construction is to calculate the multivariate normal probability of covenant violation. First, we remove loan observations that do not have covenants relevant for the measure of covenant tightness, or those violate covenants prior to the start date (i.e., have a negative slack value). Using their respective covariance matrices of changes in financial ratios, we calculate each loan's multivariate normal probability that each relevant slack variable is greater than or equal to zero, for each one-digit SIC industry-year combination. The covenant tightness measure, a measure for the probability of covenant violation, is one minus the calculated multivariate normal probability. Loans without the relevant covenants, which are excluded from the probability calculation, have covenant tightness values of zero.

[28] We thank Justin Murfin for sharing his code.

[29] For the thresholds that require a minimum ratio, such as minimum EBIDTA, we take the inverse of the financial value, which allows the slack between the covenant threshold and the financial ratio to be positive.