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TWO TALES OF DEBT

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ABSTRACT

We analyze the heterogeneous nature of corporate debt contracts, some focusing on liquidation values of discrete assets whereas others on going-concern values of the business. Using hand-collected data on firm attributes, we present several findings. First, firms on average have limited liquidation values. Second, companies with lower liquidation values have more debt backed by going-concern values and more intensive monitoring of firm performance. They have higher interest rates only for debt against discrete assets. Third, secured debt is not always tied to liquidation values of discrete assets. We present a model that matches the empirical findings, which demonstrates how creditor monitoring and covenants 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 contracts 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, 2020). 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. For this type of debt, lenders mainly focus on assessing liquidation values of the assets pledged to them, which can be relied on even if the firm is gone, and set borrowing limits accordingly. In another approach, creditors lend against the value of the firm as an operating business (i.e., going-concern value)—this value may benefit from human capital, organizational structure, and business relations, and may not be captured by 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 play an important role.

These two approaches of debt enforcement are also reflected in the rich collection of corporate debt contracts in the US.[1] In particular, firms' debt contracts can be backed by different aspects of the firm, as exemplified by the priority rules in bankruptcy. For instance, in Chapter 11 a debt contract secured by a piece of equipment has the highest priority claim against the value of the equipment (i.e., it obtains a senior claim up to the transaction or liquidation value of the equipment). On the other hand, a debt contract secured by a blanket lien on the firm as a whole has the highest priority claim against the going-concern value of the firm (i.e., it obtains a senior claim up to the firm's going-concern value, minus the liquidation value of any discrete assets pledged separately). These different types of debt can also differ substantially in creditor monitoring and represent lending technologies that require different creditor expertise. The multiple forms of debt contracts and multifaceted priority rules echo the observation of debt heterogeneity emphasized by Rauh and Sufi (2010), and paint a more intricate picture than classic benchmarks such as Townsend (1979).

Why do firms use different types of debt, some of which focus on the liquidation value of discrete assets while others focus on the going-concern value of the company as a whole? What determines the prevalence of each type? What ultimately shapes firms' total debt capacity? We address these questions using a new hand-collected dataset that

[1] Commercial mortgages, equipment loans, and loans against working capital are standard examples of lending against discrete assets, while a substantial portion of business loans and most corporate bonds in the US are backed by the cash flow value of the firm as a whole (Lian and Ma, 2020).

documents the liquidation values of discrete assets and going-concern values of firms in different industries. We use these variations in firm attributes to demonstrate how the focus of debt enforcement shifts and why. Empirically, we show that the two approaches of debt enforcement account for a number of debt features, including debt composition, monitoring mechanisms, interest rates, and creditor recovery rates in default. We then present a model that explains the usage of different types of debt, their contractual provisions, and why they take priority against different aspects of the firm. Overall, the empirical evidence and the theory point towards an integrated view of debt contract features where the multifaceted priority rules, combined with provisions like covenants, strengthen creditors' incentives to monitor firm performance and help firms borrow beyond the liquidation value of discrete assets.

Measuring the liquidation values of various types of assets across industries is an essential but challenging task. We hand collect this information from one of the most systematic disclosure sources, based on Chapter 11 filings between 2000 and 2016. We obtain estimated liquidation recovery rates (i.e., liquidation value as a fraction of net book value) for each main asset category (fixed asset, inventory, receivable, etc.), which reflect projected liquidation values if the firm were to cease operations and liquidate its assets in a piecemeal manner.[2] We take the average liquidation 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. In addition, we also use the Chapter 11 cases to collect firms' going-concern values in restructuring. We use 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 values of different assets, we cross check with prior work that documents equipment liquidation values using auctions data in a particular industry (Ramey and Shapiro, 2001) and with realized liquidation proceeds in Chapter 7 cases. These checks verify that our data is consistent with market-based transactions. We also cross check with liquidation value benchmarks that creditors use in ex ante lending decisions for non-financial firms

[2]These estimates commonly derive from appraisals by specialists in asset valuations and conducting liquidations, who perform on-site field exams and simulate live liquidations. Later we also analyze default recovery rates of debt from Moody's, which do not directly measure liquidation values of firms' assets because most cases in Moody's data are restructurings not liquidations, payments to non-debt stakeholders (e.g., tax claims, trade creditors) are often not included, and payments to debt also depend on seniority etc.

in general, and with proceeds from sales of fixed assets 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, measured independently based on industry-wide data from the BEA. These checks verify that our data lines up with the relevant 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 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 biases.

Among Compustat firms, we find that the estimated liquidation value of fixed assets (property, plant, and equipment, or PPE) plus working capital (inventory and receivable) is on average 23% of total book assets, and 44% if we additionally include all cash holdings. This compares to total liabilities of 49% for the average Compustat firm, and 69% for the average non-investment grade firm. In other words, liquidation values per se are limiting for supporting firms' liabilities. Meanwhile, the average Chapter 11 going-concern recovery rate is 81%, with an inter-quartile range of 68% to 100%.

After documenting the properties of firms' assets, we investigate key features of firms' debt contracts in detail, including debt composition, strictness of financial covenants, interest rates, and creditor recovery rates in default. We show how they vary as a function of firms' liquidation values, going-concern values, and borrowing amount. We demonstrate that all of these debt features reflect the relevance of the two approaches of debt enforcement. For most non-financial firms, a first-order issue is to preserve going-concern values, and doing so may require some creditors to monitor firm performance; meanwhile, another set of creditors focus on assessing the liquidation value of liquid assets, which they can rely on regardless of firm performance. The two approaches entail different lender expertise, and the dichotomy can also enhance monitoring incentives.

For debt composition, we organize debt into three groups. We start with whether creditors have claims against discrete assets or against the business as a whole (commonly referred to as "asset-based debt" and "cash flow-based debt" by creditors, and we follow their terminology).[3] In bankruptcy, payoffs of the former are primarily driven by the value of the particular assets pledged to them, while payoffs of the latter depend on the cash flow value of the firm as a whole. US bankruptcy laws impose the automatic stay, which prevents asset-based debt from seizing assets or using such actions as threats to obtain more than what its claim is entitled to. In ex ante lending decisions,

[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 terms lenders use.

asset-based debt also stipulates borrowing limits given by the liquidation value of the particular assets pledged. We then further decompose cash flow-based debt into a part with light monitoring such as bonds, and a part with strong monitoring such as loans (which often impose stringent financial covenants and exercise creditor control rights as highlighted by Roberts and Sufi (2009) among others).[4]

For asset-based debt, where creditors have claims against discrete assets (e.g., equipment loans), the prevalence increases with liquidation values and decreases with industry-average Chapter 11 going-concern values. Its share in total debt is high for the first 5% to 10% of book leverage, and falls substantially as firms take on more debt, especially for firms with low liquidation values. For cash flow-based bonds, where creditors have claims against the firm as a whole but do not typically have active interventions of firms' actions, the prevalence decreases with liquidation values and increases with going-concern values. The share in total debt is highest for the medium range of leverage. For cash flow-based loans, where creditors have claims against the firm as a whole and engage in active monitoring and control, the prevalence decreases with liquidation values and increases with going-concern values. Such debt is most common when firms have high levels of leverage. Overall, debt composition displays some pecking order: firms rely more on asset-based debt against liquid and generic assets for the initial amount of borrowing (which can have a slight cost advantage, but many firms do not have a large amount of such assets), then use more cash flow-based debt with weak control for medium levels of borrowing, and eventually have a greater prevalence of cash flow-based debt with strong control for high levels of leverage. Results are similar if we use industry-average liquidation values (instead of firm-level liquidation values).

Furthermore, our framework sheds new light on the classic issue of secured debt. As mentioned at the beginning, secured debt is not necessarily about discrete or tangible assets (in contrast to the conventional notion in the economics literature). In the US, having security (or "collateral") allows creditors to obtain priority and seniority: creditors can take priority against the 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 blanket liens is to implement strong control over the company, so they can be viewed as another 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 liquidation values, increases with leverage (especially for firms with low liquidation values), and increases with industry-average Chapter 11 going-concern

[4]Throughout this paper, we use the terms "monitoring" and "control rights" to refer to monitoring of firms' operating performance and control over business decisions.

values. 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 the intensity of creditor monitoring. We measure covenant tightness following Murfin (2012), and estimate the probability of covenant violations based on covenant thresholds specified at loan issuance. We find that financial covenants in loans, especially performance covenants (generally specified as a function of firms' operating earnings), are tighter when liquidation values are lower and when leverage is higher. Financial covenants also tend to be tighter when the industry-level Chapter 11 going-concern values are higher.

Additionally, we analyze other debt characteristics to corroborate the nature of different types of debt and what their lenders focus on. We show that the interest rates of asset-based debt decrease with liquidation values, but this pattern does not hold for cash flow-based debt. We also find that the default recovery rate of asset-based debt has a significant positive dependence on liquidation values of discrete assets, but not on firms' Chapter 11 going-concern values. The default recovery rate of cash flow-based debt displays the opposite pattern. These results are in line with the payment determination and priority rules under US bankruptcy laws.

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

We provide a simple model of creditor monitoring which illuminates the empirical findings and closely follows the US institutional settings. In the model, an entrepreneur invests in a project that can result in success or failure (liquidation). The probability of success 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 the contract can allocate control rights of the project to an informed lender as a function of the signal. This design can be thought of as a financial covenant. Upon a low realization of the signal, the informed lender can investigate and find out the true effort of the entrepreneur. If low effort is detected upon investigation, the informed lender can threat an intervention, which can be interpreted as Chapter 11 restructuring.

The model offers several takeaways that are consistent with the data. First, the model shows that monitoring and creditor control are more important when liquidation values are low and leverage is high. Second, monitoring is undertaken by a subset of cash flow-based debt. In particular, the model pinpoints that such creditors have high priority against the firm's business value in success and in restructuring, but not against the liquidation value. This ensures that the informed lender has the skin in the game to pay for the monitoring cost, and at the same time has time-consistent incentives to intervene

if low effort is detected. Third, as long as covenants can be enforced and monitoring is not too costly, liquidation values affect debt composition but not necessarily total debt capacity. 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 way to obtain debt capacity beyond liquidation values in several classic models is to threat seizing assets, which is not consistent with the automatic stay under US bankruptcy laws.

The empirical evidence and the model suggest that financial development requires not just secure property rights, but also institutional structures that preserve firms' going-concern values (e.g., restructuring-oriented bankruptcy systems, creditor monitoring, covenant enforcement). Better property right institutions (e.g., enhancing creditors' ability to seize tangible assets) can help lenders avoid paying monitoring costs. However, given the low liquidation values of firms in most industries, control right institutions (e.g., enhancing creditors' ability to monitor firm performance) are ultimately essential for firms' access to debt financing.

1.1 Literature Review

Our work relates to several strands of literature. First, our analysis is related to, and in large part motivated by, prior studies on different perspectives of debt enforcement. One branch of work focuses on pledging tangible assets that creditors can seize (Hart and Moore, 1994, 1998; Kiyotaki and Moore, 1997; Rampini and Viswanathan, 2010, 2013; Demarzo, 2019), which has influenced empirical analyses of both firms and households (Benmelech, Garmaise, and Moskowitz, 2005; Almeida and Campello, 2007; Benmelech and Bergman, 2009; Mian and Sufi, 2011; Chaney, Sraer, and Thesmar, 2012).[5] Another branch of work points to the importance of creditor monitoring and control rights (Diamond, 1984; Aghion and Bolton, 1992; Dewatripont and Tirole, 1994; Holmstrom and Tirole, 1997; Kaplan and Strömberg, 2003; Diamond, Hu, and Rajan, 2019), and documents 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 providing new data on firms' liquidation values and going-concern values, and demonstrating how they shape the relevance of different approaches of debt enforcement both empirically and in a parsimonious model.

[5]The properties of asset-based debt in our data are in line with classic studies of such debt, which often focus on industries including commercial real estate and airlines where liquidation values are high and asset-based debt is prominent. Nonetheless, the majority of non-financial firms may not have high liquidation values and rely much more on borrowing against firm value as an operating business.

Second, our work connects to research on debt structure, which has covered a number of issues, including loans versus bonds (Denis and Mihov, 2003; De Fiore and Uhlig, 2011, 2015; Crouzet, 2018), interactions among creditors (Bolton and Scharfstein, 1996; Repullo and Suarez, 1998; Park, 2000), secured debt (Donaldson, Gromb, and Piacentino, 2020; Benmelech, Kumar, and Rajan, 2020a), interest rates (Luck and Santos, 2020; Benmelech, Kumar, and Rajan, 2020b), and implications of asset-based and cash flow-based debt (Lian and Ma, 2020; Ivashina, Laeven, and Moral-Benito, 2020). In addition, some early work studies how liquidation costs affect debt choices of firms emerging from bankruptcy (Alderson and Betker, 1995). We utilize information from bankruptcy filings, extract the industry-level features, and show the explanatory power for debt contracts of firms in general (i.e., firms with varying degrees of leverage outside bankruptcy). Our empirical and theoretical analyses also provide an integrated framework for a number of debt characteristics (e.g., debt composition, financial covenants, interest rates, default recovery rates) that are often analyzed one at a time.

Third, our work relates to studies on law and finance that investigate the importance of bankruptcy regimes and legal institutions for enforcing debt contracts (Gertner and Scharfstein, 1991; Porta, Lopez-de Silanes, Shleifer, and Vishny, 1998; Acemoglu and Johnson, 2005; Beck and Levine, 2005; Djankov, McLiesh, and Shleifer, 2007; Haselmann, Pistor, and Vig, 2010; Becker and Josephson, 2016), and for real outcomes (Strömberg, 2000; Ponticelli and Alencar, 2016; Iverson, 2018; Bernstein, Colonnelli, and Iverson, 2019; Corbae and D'Erasmo, 2020; Iverson, Madsen, Wang, and Xu, 2020). Liquidation values of separable and tangible assets can be especially important for debt contracts in earlier stages of financial development, where restructuring-based bankruptcy systems are less developed and verifiablity of financial performance is limited (Gan, 2007; Benmelech, 2009). Our results suggest that further advancement of financial development requires improvements in institutions which can facilitate creditor monitoring of firm performance and restructuring of companies in financial distress to preserve firms' going-concern values.[6]

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

[6]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).

2 Data and Definition

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

2.1 Liquidation Values 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 values in restructuring, from Chapter 11 filings between 2000 and 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 Chapter 11 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 a comprehensive set of information, including 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 Values

In US Chapter 11, firms continue to operate, but they are also 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 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.[7] To our knowledge, the liquidation analysis in Chapter 11 cases provides the most comprehensive reporting of liquidation values covering all types of assets across different industries (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,

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

receivable, etc.) and for the firm overall.[8] 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 (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.[9]

Figure 1 shows two examples of the liquidation analysis summary tables, from a chemical company Lyondell 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 presents excerpts from notes to Lyondell's liquidation analysis, which show that the liquidation value of PPE comes from plant-level appraisals by American Appraisal Associates, and the liquidation value of inventory and receivable uses lenders' assessment for credit facilities against working capital assets. Both firms continue to operate after Chapter 11, but the filings provide unique disclosures of the liquidation value assessments of their 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 in 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 liquidation recovery rate, i.e., liquidation value as a fraction of book value, whereas

[8] 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).

[9] Whether different pieces of these discrete assets are likely to be sold together or 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.

most other data sources do not have information about book values or recovery rates. Having liquidation 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 indirect proxies of asset specificity in previous work (Rauch, 1999; Benmelech, 2009; Kim and Kung, 2017), our data allows for assessment of magnitudes, such as comparisons of liquidation values with going-concern values or with debt values.

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 i and year t as:

$$LiqVal_t^k = \sum_j \lambda_i^j NBV_t^{kj}, \tag{1}$$

where λ_i^j 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 roughly 40% of the cross-industry variation in PPE liquidation recovery rates. We also analyze variations of liquidation recovery rates due to time-varying macroeconomic conditions or industry conditions (Shleifer and Vishny, 1992). We find that macro conditions and industry conditions 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.[10]

Our data covers assets owned by firms. Some assets firms use may be under operating leases, instead of being owned (Benmelech and Bergman, 2008; Eisfeldt and Rampini, 2009).[11] In Internet Appendix Section IA3, we perform robustness checks of our main results, assuming operating lease liabilities are akin to asset-based debt and the leased assets contribute to the liquidation value of discrete assets (lessors can eventually repossess the particular assets they lease to firms when leases end). In addition,

[10]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.

[11]For capital leases (instead of operating leases), it is typically viewed that the lessee is likely to have ultimate ownership of the leased asset (e.g., buy the asset at the end of the lease). In this case, the leased asset always shows up on the asset side of the lessee's balance sheet, and the lease shows up on the liability side and is included in asset-based debt in our classification.

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 3.5% among Compustat firms (inter-quartile range 1.6% to 8.1%), which is reasonably small.[12] 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 40% of R^2 in the variation of the ratio of leased assets to owned assets.[13] This is in line with our observation above that the features of firms' assets have general similarities within an industry.

Going-Concern Values in Restructuring

We also hand collect data on firms' going-concern values in Chapter 11 restructuring. Specifically, we collect data on the estimated firm going-concern values from the valuation analysis in Chapter 11. We also collect data on the post-emergence market values (market value of equity plus book value of debt, within one year of Chapter 11 confirmation) for firms that emerged as public companies, and enterprise values in acquisition for firms that were acquired. We normalize the going-concern value 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 estimates from the Chapter 11 valuation analysis otherwise. On average, the valuation analysis estimate is similar to the post-emergence market value when both types of data are available (i.e., the average difference is close to zero), 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, which indicates that the going-concern value estimates from the Chapter 11 valuation analysis seem reasonably reliable. Finally, we take the average of going-concern recovery rates in each industry. The Chapter 11 recovery rates also vary across industries because firms in some industries can perform well in Chapter 11 restructuring, while firms in other industries may experience more disruptions in operations or are more difficult to restructure (the extreme being financial intermediaries as discussed in Ma and Scheinkman (2020)).

[12] 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.

[13] 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 low (average below 10%) for most other industries.

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 0.05 (p-value 0.76), -0.21 (p-value 0.17), and 0.08 (p-value 0.61), 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 Compustat per year), etc., we have many 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 Chapter 11 may occur when the firm, its industry, or the economy experiences unfavorable conditions, which may contribute to lower liquidation values. The third type of concern is that the reported liquidation 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 proceeds from 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 liquidation recovery rates by five percentage points), but do not seem to make a qualitative difference. About 12% of our data comes from NBER recessions and 33% from industry recessions (i.e., industry revenue growth in the bottom quartile), so it does not overwhelmingly represent conditions in economic downturns. 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 IA2. 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 type 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).[14] 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 IA2, 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 IA2 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

[14] 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.

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 Handbook on Asset-Based Lending*, or the variable *BorrowerBasePercentage* in DealScan when the variable *BorrowerBaseType* is "Eligible Inventory"),[15] 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

[15] 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.

among all firms in the industry using BEA data. Indeed, if there are no reallocation frictions—i.e., 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 liquidation 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 of physical attributes: they do not easily erase differences across industries or lead to drastically different overall liquidation 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 in the rest of the paper suggest that it provides relevant information for firms in general in a given industry.

2.2 Debt Characteristics

Debt Composition

We collect data on the composition of non-financial firms' outstanding debt from CapitalIQ. CapitalIQ's debt detail dataset provides comprehensive information for individual debt contracts (including amount outstanding and descriptions of contract features), covering most Compustat firms since 2003.

We classify debt as follows. 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 in the US institutional setting. Asset-based debt refers to debt against discrete assets, 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), where the liquidation value is assessed in ways similar to our data as discussed in Section 2.1. Cash flow-based debt refers to debt against the firm as a whole, and can take the form of both loans (e.g., many syndicated loans) and bonds. It can be either secured by the firm as a whole ("substantially all assets" in contractual parlance, and often referred to as "blanket liens," excluding particular assets pledged to asset-based debt), or unsecured. Debt capacity in this case is not related to liquidation values of discrete assets, but commonly tied to cash flows generated by the business in the form of operating earnings (hence the name) as a reflection of the firm's going-concern values.[16] Overall, the terms "asset-based debt" and "cash flow-based debt" follow the common usage by creditors, and can be thought of as shorthand references to debt claims based on the liquidation value of discrete assets and the going-concern value of the firm (one could come up with alternative abbreviations such as "liquidation value-based debt" and "going concern value-based debt", but in this paper we follow the terms commonly used by lenders.). We also analyze the difference between this categorization and secured vs. unsecured debt in detail in Section 3.1.

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 documents that the liquidation recovery rates of discrete assets and the going-concern value of the firm are not very correlated. The distinction of different types of debt, with priority over different aspects of the firm, is especially relevant when firms have multiple sets 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 and other non-debt liabilities 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

[16]The classification procedures and default resolutions are also discussed in detail in Lian and Ma (2020). In US Chapter 11, which is most relevant for major non-financial firms, payoffs of asset-based debt are primarily driven by the value of discrete assets pledged to them, while payoffs of cash flow-based debt are primarily driven by the going-concern value of the firm, which we verify in Section 3.3.

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 and stronger monitoring than bonds (Diamond, 1984, 1991; Berlin and Loeys, 1988; Holmstrom and Tirole, 1997). In additional analyses in Section 3, we can also use high priority (i.e., secured by blanket liens on the firm as a whole) as a proxy for strong 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.

Covenant Tightness

We collect data on financial covenants in commercial loans from DealScan. We focus on loan covenants because they are more active and more stringent compared to bond covenants. In particular, financial covenants in loans generally require compliance on a quarterly basis throughout the life of the loan (whereas financial covenants in bonds mainly require compliance if the borrower takes certain actions). DealScan provides information about the threshold of compliance, which allows us to estimate covenant tightness following Murfin (2012). Covenant information in DealScan becomes widely available since 1996.

Interest Rates and Default Recovery Rates of Debt

We collect data on interest rates for all outstanding debt from CapitalIQ. We also collect additional interest rate data for loan issuance from DealScan.

We collect data on default recovery rates for different debt instruments from Moody's Default and Recovery Database. The default recovery rates of debt are different from the liquidation recovery rates of firms' assets discussed in Section 2.1. The default recovery rates of debt are different from the liquidation recovery rates of firms' assets discussed in Section 2.1. In particular, the liquidation recovery rates capture the properties of firms' assets, and we use them to calculate firms' liquidation values on the asset side. The default recovery rates of debt, on the other hand, depend on not just firms' asset features but also their capital structures and payments to non-debt claims (e.g., tax claims, trade creditors). In addition, the debt default recovery rates cannot directly separate firms' liquidation values and going-concern values. The default recovery rate of an individual debt instrument is also a function of its seniority and other contract features. In Section 3.3, we show that the default recovery rates of asset-based debt are primarily sensitive to liquidation values of discrete assets, whereas the default recovery rates of cash flow-based debt are primarily sensitive to firms' going-concern values, in line with the payment determination rules in bankruptcy in the US.

2.3 Summary Statistics

Table 1, Panel A, shows summary statistics of industry-level liquidation recovery rates for different types of assets. 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).[17]

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 a 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).[18] The average firm-level liquidation value from book intangibles is about 2.5%, and all results are similar when they are included. Figure 2, Panel A, shows a breakdown of liquidation values contributed by different types of assets 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%.

The last row of Table 1, Panel A, shows 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%. Figure 2, Panel B, plots the distribution of the Chapter 11 going-concern value (dashed

[17] 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.

[18] 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.

blue line) compared to the distribution of the liquidation value (solid red line for not including cash, and dotted green line for including cash), and the former tends to be much higher.

Finally, Table 1, Panel B, shows summary statistics for total book leverage and debt composition among non-financial firms in our sample from Compustat.

2.4 Borrowing Relative to Liquidation Values

In Figure 3, we document the distribution of firms' liabilities relative to their liquidation values. Panel A plots the cumulative distribution function (CDF) of total debt relative to the liquidation value of fixed assets and working capital. It shows that total debt exceeds the liquidation value of fixed assets and working capital for many firms, including 52% of firms with positive leverage and 81% of non-investment grade firms. In addition, liquidations in practice can have overhead costs that are roughly 5% to 10% of asset liquidation values, which we have not subtracted from the liquidation value estimates (i.e., the liquidation values we use represent "gross liquidation values" which refer to proceeds from asset sales, instead of "net liquidation values" which further subtract overhead costs).

Panel B plots the CDF of total liabilities relative to cash plus the liquidation value of fixed assets and working capital (solid red line). Total liabilities include non-debt liabilities which are also important claims against the firm (e.g., trade credit, employee compensation, taxes) and share the pie with debt holders.[19] The liquidation value including cash could be generous given that cash holdings often serve liquidity purposes (Alfaro, Bloom, and Lin, 2019) and discretionary cash holdings may fluctuate. We find that 71% of firms with positive leverage and 94% of non-investment grade firms have more liabilities than the liquidation value of their PPE and working capital plus cash. These fractions are also sizable. In comparison, the dashed blue line in Panel B shows the CDF of total liabilities relative to industry-average Chapter 11 going-concern value. In this case about 70% of firms have a ratio below one, and even fewer firms (6%) have total debt above the industry-average Chapter 11 going-concern value.

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

[19]Some non-debt liabilities like taxes can be formally more senior than debt claims (and employees and critical vendors are also often paid during bankruptcy before debt holders are paid). Regular trade creditors are typically treated as general unsecured creditors in bankruptcy.

3 Liquidation Values, Chapter 11 Values, and Debt Characteristics

In this section, we present the main results of how debt characteristics vary based on liquidation values, Chapter 11 values, and the amount of borrowing. The analyses demonstrate how the two approaches of debt enforcement shape a number of debt features, including debt composition, financial covenants, interest rates, and creditor recovery rates in default.

3.1 Debt Composition

We start with debt composition. As explained in Section 2, we organize debt into three categories: 1) asset-based debt (debt against discrete assets like PPE and working capital), 2) cash flow-based debt with weak control (debt against the firm as a whole with light creditor intervention, such as bonds), and 3) cash flow-based debt with strong control (debt against the firm as a whole with more intensive 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 them directly in liquidation values, since cash holdings can be fairly discretionary. We also perform robustness checks 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 show that the main results are similar if we also include operating leases as another form of asset-based debt and another contributor to the liquidation value of discrete assets.

A. Asset-Based Debt

Figure 4 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 4, 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 falls off when firms borrow more, especially for firms with low liquidation values. Corre-

spondingly, Figure 4, 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 and 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.[20]

Table 2 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 the amount of asset-based debt increases with total indebtedness, especially for firms with high liquidation values. In addition, the prevalence of asset-based debt decreases with going-concern values (industry-level Chapter 11 values and current firm market values).

B. Cash Flow-Based Debt with Weak Control

Figure 5 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 3 presents these results in regressions. Table 3 also suggests that the prevalence of cash flow-based bonds increases 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 6 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. For firms in the bottom tercile of liquidation

[20] 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.

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. Table 4 presents results in regressions, which also shows that the prevalence of this type of debt decreases with liquidation values, and increases with going-concern values (the industry-level Chapter 11 value, as well as the firm's current market value). As we discuss in Section 4, 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 analyses can also shed new light on the nature of secured debt, which is a classic issue in economics research (Berger and Udell, 1990; Donaldson, Gromb, and Piacentino, 2020; Benmelech, Kumar, and Rajan, 2020a; Rampini and Viswanathan, 2020). 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, creditors can obtain priority by taking security (Baird and Jackson, 1984). They can do so with respect to different aspects of the firm: creditors can take priority over the standalone value of discrete assets (secured asset-based debt), or over the going-concern value of the firm (secured cash flow-based debt).[21]

Asset-based debt is typically explicitly secured by discrete assets, to make it clear that it has priority over the value of such assets. In bankruptcy, asset-based debt would have a high priority claim (i.e., secured claim) up to the standalone 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 value of the assets pledged to it). Meanwhile, cash flow-based debt can take security in the form of "substantially all assets" (other than assets pledged to asset-based debt), sometimes referred to as "blanket liens" ("all assets" in this context include business synergies and organizational capital, not just tangible assets, and effectively refer to the company as a whole). Such a claim has priority over the going-concern value of the firm. In Chapter 11, its collateral value is given by the going-concern value of the firm as a whole (minus the liquidation value of discrete assets pledged to asset-based debt).[22] Secured cash flow-based debt is often

[21] Unsecured or subordinated debt, on the other hand, represent low priority debt claims which are marginal claimants to the pool of value. In Chapter 11 restructuring, the marginal value is given by the firm's going-concern value; in Chapter 7 liquidation, the marginal value is given by the liquidation value.

[22] This priority rule is also recognized by ratings agencies. For example, Fitch writes in its report: "Fitch recognizes that an ABL is entitled to priority over other first lien cash flow-based debt to the extent of the

used to implement strong creditor control over the firm, given that much of firm value is pledged to these creditors and it is difficult to raise new debt without their consent.

Figure IA1 and Table 5 show that secured cash flow-based debt displays very different properties than those observed for asset-based debt in Figure 4 and Table 2. 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 cash flow-based loans and bonds. In contrast, asset-based debt 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%, 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 a given firm's choices about asset composition. While choices with respect to the combination of 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 Appendix Table IA3 we present additional results using industry-level liquidation values (i.e., the average firm-level liquidation value from PPE and working capital over total assets in an industry), which are not affected by the asset choices of a given firm. The findings are similar to the main results in Tables 2 to 4. Asset-based debt is more prevalent when liquidation values are higher, and the sensitivity of asset-based debt to liquidation values is higher when

value of specific collateral securing the ABL. Therefore, in allocating the adjusted EV to the two classes of senior secured claims, Fitch first allocates the portion attributable to the liquidation value of the specific assets securing the ABL (referred to as the "collateral component"); and the enterprise value for the other first lien debt is net of the amount allocated to the ABL collateral component" (Dabas, Simonton, and Oline, 2013). "ABL" and "EV" stand for "asset-based lending" and "enterprise value."

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 Chapter 11 going-concern value, while asset-based debt is not.

F. Within-Firm Variations

In the above analyses, we exploit cross-sectional variations in firms' liquidation values and Chapter 11 values, since these variations in firms' asset attributes are largely shaped by exogenous forces and industry features. In comparison, within-firm variations in the liquidation value are more likely to be contaminated by firm-specific decisions to acquire or finance certain assets. Nonetheless, it is reasonable to ask whether the "pecking order" of debt composition we show also holds within a firm (i.e., debt composition depends on the level of borrowing). We present this result in Appendix Table IA4, where we add firm fixed effects to focus on within-firm variations. We examine how debt composition changes with leverage. We also examine how this relationship depends on liquidation values, by interacting leverage with industry-level liquidation values (we use industry-level liquidation values here so that the interaction coefficient is driven only by within-firm changes in leverage, not by within-firm changes in liquidation values). We confirm that the pecking order results are very similar in this within-firm analysis. The share of asset-based debt declines as book leverage increases, especially for firms with low liquidation values. Meanwhile, the share of cash flow-based debt rises, and the shift to cash flow-based loans is especially pronounced for firms with low liquidation values.

G. Liquidation Values by Type of Asset

In the above, for parsimony we combine all asset-based debt in one group and study the relationship between the total amount of asset-based debt and the overall liquidation value. Below 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 IA5 examine how the fraction of asset-based debt backed by working capital (i.e., inventory and receivable) and by PPE in total debt relates to the liquidation value of working capital vs. 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, which is predictive of the share of asset-based debt backed by PPE (not working capital). Columns (3) and (4) repeat the same analysis, but normalize the amount of each type of debt by book assets, which produce similar results. This analysis shows that each type of asset-based debt depends primarily on the liquidation

value of a particular type of asset, consistent with the design of asset-based debt.

3.2 Covenant Strictness

To further investigate the role of creditor monitoring, we also examine the tightness of financial covenants, as a function of liquidation values, Chapter 11 values, and indebtedness.

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 and K is the number of covenants the firm has. The corresponding actual financial ratios of the firm are denoted by $\mathbf{r}$ and evolve 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 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 (earnings before interest, taxes, depreciation and amortization, or 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 allows lenders to intervene in managerial actions if firms have poor operating performance (Christensen and Nikolaev, 2012).[23] The second group consists of other financial covenants, includ-

[23]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

ing covenants on book leverage (e.g., maximum debt-to-asset or debt-to-equity ratios) and liquidity metrics (e.g., minimum current assets to current liabilities). They aim to ensure that firms have sufficient capital or liquidity, but their prevalence has declined substantially in recent decades (Demerjian, 2011).

Figure 7 and Table 6 show the variation of covenant tightness. Covenants are 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 covenants is higher, and increases more with leverage, for firms with lower liquidation values. This is in line with the results on cash flow-based debt with strong control in Table 4 and Table 5, which also point to more intensive creditor monitoring in these settings. Furthermore, covenant tightness increases with the industry-level Chapter 11 value. As we discuss further in Section 4, enforcing covenants requires effective threat (i.e., if borrowers do not comply with creditors' requests, creditors can accelerate the loan, which likely results in bankruptcy filings). The credibility of the threat can depend on the Chapter 11 value (i.e., how well firms in a given industry can function in Chapter 11 restructuring), which drives what creditors can get if they were to accelerate the loan and send the firm to restructuring in Chapter 11. More generally, as we also see in Tables 4 and 5, the strength of creditor control rights tends to increase with Chapter 11 values.

3.3 Additional Results

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

A. Interest Rates

Figure 8, 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 8, 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. This relationship, however, does not exist for cash flow-based debt. Second, interest rates on cash flow-based debt are relatively more sensitive to firm leverage than interest rates 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

illustrate in Section 4.

firm. While these patterns provide useful information, one might be worried that they can be affected by endogenous sorting of firms into different types of debt. For example, perhaps firms with low liquidation values yet choose to borrow asset-based debt could be riskier than firms with high liquidation values and borrow through asset-based debt, leading to higher observed interest rates.

In Table 8, we address such concerns by exploiting variations in the interest rates 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 columns (1) to (4), we use interest rate information on outstanding debt from CapitalIQ, and control for firm-year fixed effects to absorb any time-varying firm characteristics. We use interest rates 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. 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 rates of asset-based loans is slightly larger for firms with higher leverage. Finally, in column (5), we use interest rate data from DealScan and compare interest rates on different types of loans issued in the same loan package. 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 suggest that higher liquidation values from discrete assets can make asset-based debt relatively cheaper. Correspondingly, higher liquidation values are associated with a higher prevalence of asset-based debt. Meanwhile, interest rates on cash flow-based debt do not seem to depend on liquidation values.

B. Debt Recovery Rates in Default

Besides the interest rate results which show the *ex ante* pricing of different types of debt, we also examine debt recovery rates in bankruptcy which provides direct evidence on the *ex post* importance of liquidation values and going-concern values for different debt claims in default resolution.

In Table 9, 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 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 restructuring.

Overall, the results of Table 9 suggest that the recovery rate of asset-based debt is mainly affected by the liquidation value of discrete assets, and it does not depend much on the going-concern value of the firm. In contrast, the recovery rate of cash flow-based debt is driven by the going-concern value of the firm, not the liquidation value. These results are consistent with the interest rate results shown earlier. They are also consistent with US bankruptcy laws. They verify that asset-based lenders would mainly focus on the liquidation value of discrete assets pledged to them, whereas cash flow-based lenders would be more focused on the going-concern value of the firm.

C. Comparison with Book Values of "Tangible Assets"

In Internet Appendix Table IA6, we also compare our liquidation value measure with the book value of "tangible assets" often used in prior work (Rajan and Zingales, 1995; Almeida and Campello, 2007; Rampini and Viswanathan, 2013). Conceptually, measuring the liquidation value of discrete assets is important for several reasons. First, in ex ante lending decisions of asset-based debt, creditors specify borrowing limits according to the estimated liquidation value of discrete assets pledged. Second, in ex post default resolutions, payoffs of asset-based debt are also primarily determined by the liquidation value of the discrete assets pledged.

In the data, we examine how different measures explain both the quantity and the interest rates of asset-based debt. We show comparisons with two common 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 rates when the firm has higher liquidation values. 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 discrete assets).

D. Asset-Based Debt and Monitoring

So far we have assumed that asset-based debt is not much involved in monitoring firm performance. As shown above, their recovery rates in default depend primarily on

the liquidation value of discrete assets, rather than the value of the firm as an operating business. 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 monitoring firms' operating performance and managerial competence. Asset-based revolvers are revolving lines of credit mainly backed by working capital (i.e., inventory and receivable), which allow firms to borrow up to the liquidation value of working capital (the borrowing base). There are two reasons why lenders of these revolvers might be involved in monitoring. First, the revolvers can be part of a loan package that also includes cash flow-based term loans. The lead lender of the asset-based revolver may overlap 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 term loan lender in enforcing monitoring. Second, if the firm borrows from the revolver more than what is allowed by the borrowing base, the firm has to either reduce its borrowing from the revolver or post more collateral. Otherwise, the firm violates the borrowing base requirement and incurs a 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 IA2 and IA3.

In Figure IA2, we use DealScan data and plot 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 our main observation that firms with low liquidation values rely more on lending relations with more intensive monitoring.

To evaluate the relevance 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 at loan issuance (not subsequent borrowing amounts), while CapitalIQ does not have data on the borrowing base requirement associated with revolvers. Accordingly, we approximate the maximum borrowing base using the liquidation value of working capital (inventory plus receivable). We construct a dummy variable that is equal to one if the firm's borrowing through revolvers backed by working capital is more than the estimated liquidation value of its working capital. We plot the frequency of such occurrence in Figure IA3. For most levels of leverage, the probability of borrowing from asset-based revolvers more than the liquidation value of working capital (i.e., our proxy for borrowing more than the borrowing base) is low. It is slightly higher for firms with lower liquidation values. The results indicate that the incidence of asset-based lenders being able to exercise control rights appears relatively infrequent. Correspondingly, the

incidence of asset-based lenders 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 firms' financial performance, this seems more likely to happen for firms with lower liquidation values.

3.4 Total Leverage

The analyses in Section 3.1 investigate firms' debt composition. Another important question is the extent to which liquidation values affect total borrowing. In Figure 9, we find that firms' liquidation values have a positive relationship with total leverage for small firms and firms with negative earnings, 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 7 presents the results in regressions, which shows similar findings.

Overall, the evidence is consistent with observations in Lian and Ma (2020). Small public firms, which have negative earnings more than half of the time and are more likely to be liquidated, rely primarily on asset-based debt. Their total debt capacity depends significantly on liquidation values. On the other hand, large firms, which generally have positive earnings (for more than 90% firm-years in terms of EBITDA) and a low probability of liquidation, rely substantially on cash flow-based debt. Their total debt capacity is not necessarily dependent on liquidation values, but is instead typically tied to the level of earnings which serves as a verifiable proxy for firms' going-concern values. Outside Compustat, Jang (2020) documents that small firms backed by private equity (PE) have high earnings and behave like large Compustat firms: they primarily borrow cash flow-based debt and their total leverage is not dependent on liquidation values. Our model in Section 4 also illustrates that when it is feasible to enforce control rights based on verifiable signals and firm going-concern values, liquidation values can affect debt composition but may not drive total debt capacity.

4 Model

We now present a model that analyzes the connections between firm attributes and debt characteristics. It shows that monitoring would be more intensive when liquidation values are low and leverage is high. The model also delivers multi-dimensional priority rules under the optimal arrangement. It demonstrates 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 liquidation value. In addition, the

model shows that debt with strict monitoring provides broader benefits and helps firms borrow beyond the liquidation value. Finally and importantly, the model aims to follow, as closely as possible, the features of US bankruptcy laws and debt contracts in practice.

4.1 Setup

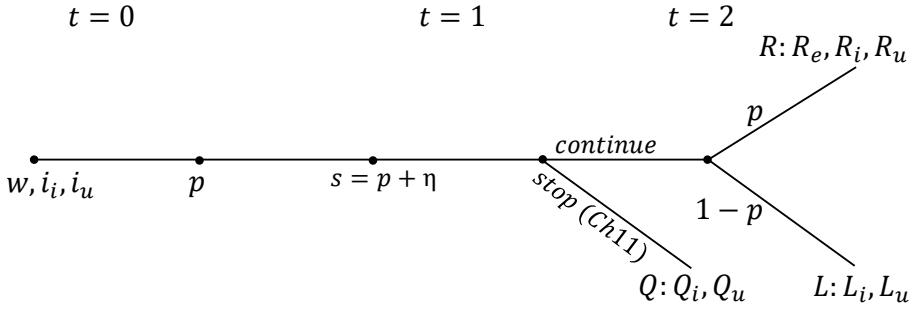
We consider a model with three agents: an entrepreneur, an informed investor, and an uninformed investor. The entrepreneur has access to an investment that requires one unit of funding. The entrepreneur's total wealth is $w < 1$, and therefore the rest of the project needs to be financed using external funds from uninformed and informed investors. The investment 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 $\frac{1}{2}\gamma p^2$ to the entrepreneur. All agents also have access to a storage technology with return 1. The entrepreneur's effort p is privately known and not contractible, but the firm's performance is a noisy signal of p and it is contractible. The informed investor has access to a technology that enables her to investigate and find out about p, but this technology costs c per incidence of monitoring. Accordingly, we separate investors into informed and uninformed to examine the mechanisms and functions of creditor monitoring.

The model has three periods. The sequence of events is also illustrated in the diagram below. At $t = 0$, the entrepreneur offers take-it or leave-it contracts to investors. If accepted, the investment decisions are made. It is also assumed that the informed investor pays the expected cost of monitoring in advance (i.e., at $t = 0$) and the entrepreneur chooses effort (or the probability of success p) after observing whether the informed investor has paid the expected monitoring cost or not.[24]

At $t = 1$, a publicly available noisy signal of effort $s = p + \eta$ is observed by investors, where $\eta \sim N(0, \sigma)$. The signal can be thought of as the firm's financial performance (such as earnings). The signal is verifiable and contractible. The contract specifies a threshold s^*, below which the informed investor has the control right to decide whether the project should continue or stop. This contractual provision can be thought of as a financial covenant, which is based on observable financial performance of the firm. Upon a low realization of the signal (i.e., $s < s^*$), the informed investor can observe the true value of p through the costly monitoring technology, and she then decides whether to continue or stop the project. If the project is stopped, the return will be Q

[24]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 also need to be performed in advance.

($L < Q < 1$). We interpret this intervention as a restructuring, e.g., through Chapter 11, and Q can represent the going-concern value in Chapter 11 restructuring. On the other hand, if the project continues, at $t = 2$ the final outcome is realized, which is R (success) with probability p and L (failure) with probability $1 - p$. If the signal is high (i.e., $s \geq s^*$), then the project continues automatically.



Timing of the Model

The contract $\mathbb{C}$ specifies the investment of the informed investor and the uninformed investor (i_i, i_u), as well as the allocation of payments among the informed and uninformed investors, when the project continues and the outcome is high (R_i, R_u), when the outcome is low (L_i, L_u), and when the project is stopped (Q_i, Q_u). Finally, the contract also specifies the threshold s^* below which the informed investor has the control right. Given the resource constraint, payments to the entrepreneur in different states of the world are $R_e = R - R_i - R_u$, $L_e = L - L_i - L_u$, and $Q_e = Q - Q_i - Q_u$.

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.

4.2 First Best

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

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

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 the low outcome $(R - L)$, and decreasing in the cost of effort γ.

4.3 Optimal Financial Contract

We now consider the optimal financial contract when the firm is financed without the informed investor, as well as the case when the informed investor is required.

Assumption 2. *Contracts are restricted to those with* $L_i \leq Q_i \leq p^{FB}R_i + (1-p^{FB})L_i$ *and* $L_u \leq Q_u \leq p^{FB}R_u + (1-p^{FB})L_u$.

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). In addition, investors cannot use bankruptcy as a way for rent extraction.

4.3.1 Without Informed Investor

We first consider the case with no informed investor. Here the entrepreneur's problem is to maximize profits given the uninformed investor's participation constraint:

$$\max_{p,R_u,L_u} \; p(R-R_u) + (1-p)(L-L_u) - \frac{1}{2}\gamma p^2,$$
$$\text{s.t. } pR_u + (1-p)L_u \geq i_u.$$

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

This is simply because as long as $R_u = L_u$, 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 an informed investor. This is because if $i_u > L$, the participation constraint of the uninformed investor requires $R_u > L$ and therefore the entrepreneur's effort $\hat{p} = (R-R_u)/\gamma$ will be less than p^{FB}.

4.3.2 With Informed Investor

We now consider the case when $w < 1-L$ and therefore the first best level of effort cannot be achieved without the informed investor. In this case, we investigate how the presence of the informed investor with costly monitoring technology can alleviate the moral hazard problem of the entrepreneur.

Define p^* as the threshold effort level of the entrepreneur, below which the informed investor will stop the project if she has the right to do so. Then the optimal contract with the informed investor consists of the optimal choice of $s^*$and p^*, as well as the contribution of investors (i_i, i_u) and payments to them in different states of the world

$\{(R_i, R_u), (Q_i, Q_u), (L_i, L_u)\}$, such that the total output net of the entrepreneur's effort cost and the monitoring cost is maximized subject to incentive compatibility and participation constraints of all agents. Since we are only considering the cases where the entrepreneur's total borrowing is more than L (i.e., $w < 1 - L$), it is straightforward to see that in the optimal contract $L_e = 0$.

Therefore the optimal contract can be characterized as:

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

$$\forall p < p^* : \; pR_i + (1-p)L_i < Q_i, \tag{4}$$

$$\forall p \geq p^* : \; pR_i + (1-p)L_i \geq Q_i, \tag{5}$$

$$\forall p < p^* : \; \mathbb{P}[s < s^*|p]Q_e + \mathbb{P}[s \geq s^*|p]pR_e - \frac{1}{2}\gamma p^2 \leq p^*R_e - \frac{1}{2}\gamma p^{*2}, \tag{6}$$

$$\mathbb{P}[s < s^*|\tilde{p}]Q_i + \mathbb{P}[s \geq s^*|\tilde{p}]\,[\tilde{p}R_i + (1-\tilde{p})L_i] \leq i_i, \tag{7}$$

$$p^*R_i + (1-p^*)L_i - \mathbb{P}[s < s^*|p^*]c \geq i_i, \tag{8}$$

$$p^*R_u + (1-p^*)L_u \geq i_u. \tag{9}$$

Equations (4) and (5) ensure that the informed investor stops the project whenever she observes a level of effort below p^*, and allows the project to continue otherwise. The only choice of (R_i, L_i, Q_i) that satisfies both conditions is:

$$p^*R_i + (1-p^*)L_i = Q_i. \tag{10}$$

This condition ensures that the informed investor does not experience any loss in the event of restructuring. One can think of this condition as the informed lender having priority with respect to the enterprise value in the event of restructuring. Indeed, it is exactly this seniority that ensures monitoring is enforceable and stopping the project at $t = 1$ when the effort is below p^* is incentive compatible for the informed investor.

Equation (6) ensures that conditional on monitoring and the enforcement of the threat point p^* by the informed investor, the entrepreneur does not benefit from shirking and therefore chooses effort level p^*. In particular, given Equation (10), the informed investor stops the project when she has the control right (i.e., $s < s^*$) and the effort level is found to be below p^*. In that case, the entrepreneur receives Q_e. Otherwise, the project continues and is successful with probability p.

Equation (7) guarantees that the informed investor has the skin in the game to pay the expected monitoring cost at $t = 0$. In particular, if the informed investor does not pay the monitoring cost, the entrepreneur will choose a level of effort that is below p^*. Given Equation (10) this means that the informed investor's best response is to stop

the project whenever she has the control right (i.e., $s < s^*$). Therefore, in that case the entrepreneur's level of effort $\tilde{p}$ is given by:

$$\tilde{p} = \arg\max_{p} \ \mathbb{P}[s < s^*|p]Q_e + \mathbb{P}[s \geq s^*|p]pR_e - \frac{1}{2}\gamma p^2.$$

Therefore, Equation (7) ensures that not paying the expected monitoring cost at $t = 0$ is associated with a negative net return for the informed investor. Equations (8) and (9) satisfy the participation constraint of the informed and uninformed investors.

Note that given the definition of $\tilde{p}$, the optimality of s^* requires that:

$$\mathbb{P}[s < s^*|\tilde{p}]Q_e + \mathbb{P}[s \geq s^*|\tilde{p}]pR_e - \frac{1}{2}\gamma\tilde{p}^2 = p^*R_e - \frac{1}{2}\gamma p^{*2}.$$

Otherwise, the total cost of monitoring $\mathbb{P}[s < s^*|p^*]c$ can be reduced without violating any of our constraints.

Finally, among all the possible financial contracts, we choose the contract that requires the minimum amount of investment by informed investors (i_i). This can be rationalized by assuming the cost of capital for the informed investor is slightly more than the cost of capital for the uninformed investor. See Internet Appendix Section IA5 for the full characterization of the optimal contract with informed investor.

Proposition 2. *For any level of entrepreneur's wealth $w \in [\underline{w}, 1 - L]$, the optimal contract with minimum investment by the informed investor requires priority of the informed investor with respect to the project value in restructuring (i.e., $Q_i = i_i + \mathbb{P}[s < s^*|p^*]c$), and priority of the uninformed investor with respect to the liquidation value (i.e., $L_u = L$).*[25]

The priority of the informed investor in the event of restructuring is a direct consequence of the incentive compatibility of the informed investor at $t = 1$ (i.e., Equation (10)) and her participation constraint (i.e., Equation (8)). This ensures that the decision to stop the project for low levels of effort (i.e., $p < p^*$) is time-consistent. Otherwise, the informed lender may have incentives to let the project continue to avoid ex post losses. The optimal financial contract with the minimum level of investment by the informed investor also requires $L_i = 0$ and $L_u = L$. This is because the ex ante incentive of the informed investor to pay the expected monitoring cost at $t = 0$ is a function of $R_i - L_i$. Intuitively, this is because the informed investor shirking on monitoring is associated with the entrepreneur choosing effort $\tilde{p}$ which is less than p^* (the optimal level of effort). Therefore, it is the difference between R_i and L_i that incentivizes the

[25] $\underline{w}$ is the minimum level of wealth for which the project net of effort cost and monitoring cost has positive NPV. That is, $\underline{w} \equiv \arg\min_{w} |p^*(w)R + [1 - p^*(w)]\,L - \frac{1}{2}\gamma p^*(w)^2 - \mathbb{P}[s < s^*(w)|p^*(w)]c - 1 \geq 0$.

informed lender to pay the monitoring cost. This means that any increase in L_i should be associated with a similar increase in R_i and therefore the same increase in i_i.

Figure 10 shows the variation of covenant tightness ($\mathbb{P}[s < s^*|p^*]$) in Panel A and investment of informed investor (i_i) in Panel B, as a function of the entrepreneur's wealth. The solid blue line represents a case with low liquidation values and the dashed red line represents a case with high liquidation values.[26] In the limit of $w \to 1 - L$, the solution to the above equations converges to $\mathbb{P}[s < s^*|p^*] = 0$ and $i_i = 0$. This confirms the smooth transition from the case without the informed investor to the case with the informed investor for values of w around $1 - L$.

In the optimal solution, as leverage increases above the liquidation value, the amount of investment by the informed investor, 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 the informed investor's investment i_i also ensures that she has the incentive to pay the monitoring cost. Moreover, for the same level of firm leverage, lower liquidation values are associated with a higher reliance on the informed investor and tighter covenants.

So far we have considered the optimal contract with minimum level of investment by the informed investor. We now ask whether there is any level of leverage for which the optimal contract cannot be achieved without an uninformed investor.

Proposition 3. *For any level of entrepreneur's wealth $w \in [\underline{w}, 1 - Q + \mathbb{P}[s < s^*|p^*]c)$, the optimal contract requires the existence of both the informed investor and the uninformed investor.*

Proof: Enforcement of the threat requires Equation (10) to be satisfied. Also, combining Equation (10) with Equation (8), we have $i_i = Q_i - \mathbb{P}[s < s^*|p^*]c$. Therefore, the maximum level of investment that can satisfy the incentive compatibility of the informed investor is $Q - \mathbb{P}[s < s^*|p^*]c$. This means that any additional amount of borrowing has to come from low priority debt from the uninformed investor (i.e., $L_u = 0$).

This proposition shows the complementarity between the informed investor and the uninformed investor for high levels of leverage. Basically, the incentive compatibility condition for the informed investor requires full recovery of the informed investor in the event of restructuring. However, the total value of the project in the event of restructuring limits the total amount of borrowing from the informed investor.

[26] 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 $\sigma = 2$ and $Q = 0.8$.

4.4 Discussion

The above model, despite its relative simplicity, sheds light on several key features in the data. First, consistent with Figure 6, firms rely significantly more on loans with monitoring for levels of leverage above their liquidation values. Relatedly, consistent with results in Table 6 and Figure 7, the tightness of covenants increases with leverage and decreases with liquidation values. Second, the model highlights that monitoring debt is backed by the firm's business value in success and in Chapter 11 restructuring, not by the liquidation value of discrete assets. Third, in the model 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 the finding in Section 3.4 that total leverage does not depend on liquidation values among large firms.

The model is also useful for thinking about the design of firms' capital structure and debt structure. To begin, the entrepreneur has the least senior claim to the project which we can think of it as equity. As in Gale and Hellwig (1985), an equity contract minimizes entrepreneur moral hazard. More importantly, loans with strong control, despite being a small fraction of the capital structure, can provide a monitoring service that other investors benefit from. However, the enforcement of monitoring requires both high priority (full recovery) of the informed investor in the case of restructuring and the sensitivity of the informed investor to the effort of the entrepreneur. The model shows that for high levels of leverage, these two conditions cannot be satisfied without the existence of the uninformed investor. Therefore, the model shows that the interaction between different types of lenders is key for addressing the time consistency problem of the informed investor. It ensures that the informed investor does not have incentives to continue projects with low net present values.[27] Moreover, consistent with empirical evidence in Schwert (2020), the model predicts that the interest rate on debt from informed investors is higher than the interest rate on debt form uninformed investors. The higher interest rate on debt from 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 institutions in determining firms' borrowing capacity. Better property right institutions

[27] The prediction that seniority of the informed lender makes the monitoring threat credible is similar to the theoretical results in Park (2000) and Repullo and Suarez (1998). However, these models abstract from the multifaceted priority rules observed in the data. Our model shows that it is the seniority with respect to the going-concern value of the firm (not the liquidation value) that helps the informed lender enforce monitoring. Bolton and Scharfstein (1996) study the holdup problem as another mechanism that can connect liquidation values with debt structures, which predicts that the number of creditors may increase with liquidation values.

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 facilitate creditor monitoring of firm performance can be important for firms' ultimate debt capacity. Covenants help allocate control rights and enforce monitoring, consistent with empirical results in previous studies (Chava and Roberts, 2008; Roberts and Sufi, 2009; Nini, Smith, and Sufi, 2012).

Finally, we note several caveats in interpreting this model. First, the above model focuses in particular on monitoring debt to illustrate the role of creditor control, and for simplicity it does not distinguish between asset-based debt and cash flow-based debt with weak 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 additional partition, asset-based debt (i_{ABL}) and cash flow-based bonds (i_B) would have the empirical properties documented in Section 3.1. 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, 2020; Benmelech, Kumar, and Rajan, 2020a), and would be more prevalent for firms with more liquid and generic assets. Indeed, tying payoffs (in default) to the 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, 2019; 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, but it does not occur in equilibrium. In practice, restructuring does happen, and the value of the firm in restructuring is an important determinant of the recovery rate of cash flow-based debt. This feature 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 and will happen with some probability.

Third, the current model does not allow for renegotiation of payments to investors (e.g., promised payments to the informed investor might change following covenant violation). Accordingly, while we are concerned with the incentive compatibility of the informed investor both ex ante and ex post, we do not require the contract to be renegotiation-proof.

5 Conclusion

In this paper, we collect new data to study the nature of debt enforcement among US non-financial firms. We first show that the liquidation value of fixed assets and working capital on average accounts for only 23% of total book assets. We then document that variations in firms' debt contracts are a function of their liquidation values, going-concern values, and indebtedness, which reflect that different debt contracts are backed by different aspects of the firm. Companies with lower liquidation values have more cash flow-based debt and more intensive creditor monitoring of firm performance. They also pay higher interest rates only when they borrow through asset-based debt. Overall, total leverage does not depend on the liquidation value of discrete assets, except among small public firms and firms with negative earnings. We provide a simple model that rationalizes the empirical results and demonstrates the role of creditor control rights in debt enforcement.

Our findings have several additional implications. First, our data sheds further light on the long-standing question of firms' borrowing constraints. Our liquidation value data provides estimates of the maximum borrowing capacity if borrowing constraints are determined by the liquidation value of discrete assets. Given that non-financial firms' assets tend to be highly specific, such borrowing constraints would be rather restrictive. Indeed, many firms in the data borrow beyond the liquidation value of discrete assets, and total leverage does not depend on the liquidation value when covenants on firms' financial performance are not very costly to enforce and the corporate restructuring system is well-developed. Second, our evidence suggests that only having institutions to enforce property rights (e.g., ability to seize and liquidate hard assets) may be insufficient. In light of the limited liquidation values of many firms, financial development also benefits from institutional structures that enable creditors to monitor firm performance and enforce control rights to maximize the value of a business as a going concern. Relatedly, the development of different industries in a country can depend on the institutional environment: industries with lower liquidation values may be more difficult to thrive in countries without well-developed control right institutions.

References

Acemoglu, Daron, and Simon Johnson, 2005, Unbundling institutions, *Journal of Political Economy* 113, 949–995.

Acharya, Viral V, Yakov Amihud, and Lubomir Litov, 2011, Creditor rights and corporate risk-taking, *Journal of Financial Economics* 102, 150–166.

Aghion, Philippe, and Patrick Bolton, 1992, An incomplete contracts approach to financial contracting, *Review of Economic Studies* 59, 473–494.

Alderson, Michael J, and Brian L Betker, 1995, Liquidation costs and capital structure, *Journal of Financial Economics* 39, 45–69.

Alfaro, Ivan, Nicholas Bloom, and Xiaoji Lin, 2019, The finance uncertainty multiplier, Working paper.

Almeida, Heitor, and Murillo Campello, 2007, Financial constraints, asset tangibility, and corporate investment, *Review of Financial Studies* 20, 1429–1460.

Baird, Douglas G, and Thomas H Jackson, 1984, Corporate reorganizations and the treatment of diverse ownership interests: A comment on adequate protection of secured creditors in bankruptcy, *U. Chi. L. Rev.* 51, 97.

Beck, Thorsten, and Ross Levine, 2005, Legal institutions and financial development, in *Handbook of New Institutional Economics*, 251–278 (Springer).

Becker, Bo, and Victoria Ivashina, 2016, Covenant-light contracts and creditor coordination, Working paper.

Becker, Bo, and Jens Josephson, 2016, Insolvency resolution and the missing high-yield bond markets, *Review of Financial Studies* 29, 2814–2849.

Benmelech, Efraim, 2009, Asset salability and debt maturity: Evidence from nineteenth-century American railroads, *Review of Financial Studies* 22, 1545–1584.

Benmelech, Efraim, and Nittai K Bergman, 2008, Liquidation values and the credibility of financial contract renegotiation: Evidence from US airlines, *Quarterly Journal of Economics* 123, 1635–1677.

Benmelech, Efraim, and Nittai K Bergman, 2009, Collateral pricing, *Journal of Financial Economics* 91, 339–360.

Benmelech, Efraim, Mark J Garmaise, and Tobias J Moskowitz, 2005, Do liquidation values affect financial contracts? Evidence from commercial loan contracts and zoning regulation, *Quarterly Journal of Economics* 120, 1121–1154.

Benmelech, Efraim, Nitish Kumar, and Raghuram Rajan, 2020a, The decline of secured debt, Working paper.

Benmelech, Efraim, Nitish Kumar, and Raghuram Rajan, 2020b, Secured credit spreads, Working paper.

Berger, Allen N, and Gregory F Udell, 1990, Collateral, loan quality and bank risk, *Journal of Monetary Economics* 25, 21–42.

Berger, Philip G, Michael Minnis, and Andrew Sutherland, 2017, Commercial lending concentration and bank expertise: Evidence from borrower financial statements, *Journal of Accounting and Economics* 64, 253–277.

Berger, Philip G, Eli Ofek, and Itzhak Swary, 1996, Investor valuation of the abandonment option, *Journal of Financial Economics* 42, 259–287.

Berlin, Mitchell, and Jan Loeys, 1988, Bond covenants and delegated monitoring, *Journal of Finance* 43, 397–412.

Berlin, Mitchell, Greg Nini, and G Yu Edison, 2020, Concentration of control rights in leveraged loan syndicates, *Journal of Financial Economics* .

Bernstein, Shai, Emanuele Colonnelli, and Benjamin Iverson, 2019, Asset allocation in bankruptcy, *Journal of Finance* 74, 5–53.

Bolton, Patrick, and David S Scharfstein, 1996, Optimal debt structure and the number of creditors, *Journal of Political Economy* 104, 1–25.

Bradley, Michael, and Michael R Roberts, 2015, The structure and pricing of corporate debt covenants, *Quarterly Journal of Finance* 5, 1550001.

Bris, Arturo, Ivo Welch, and Ning Zhu, 2006, The costs of bankruptcy: Chapter 7 liquidation versus Chapter 11 reorganization, *Journal of Finance* 61, 1253–1303.

Chaney, Thomas, David Sraer, and David Thesmar, 2012, The collateral channel: How real estate shocks affect corporate investment, *American Economic Review* 102, 2381–2409.

Chava, Sudheer, and Michael R Roberts, 2008, How does financing impact investment? The role of debt covenants, *Journal of Finance* 63, 2085–2121.

Christensen, Hans B, and Valeri V Nikolaev, 2012, Capital versus performance covenants in debt contracts, *Journal of Accounting Research* 50, 75–116.

Corbae, Dean, and Pablo D'Erasmo, 2020, Reorganization or liquidation: Bankruptcy choice and firm dynamics, *Review of Economic Studies* Forthcoming.

Crouzet, Nicolas, 2018, Aggregate implications of corporate debt choices, *Review of Economic Studies* 85, 1635–1682.

Dabas, Ruchira, Mike Simonton, and Mark Oline, 2013, Rating asset-based lending (ABL) facilities, Fitch report.

De Fiore, Fiorella, and Harald Uhlig, 2011, Bank finance versus bond finance, *Journal of Money, Credit and Banking* 43, 1399–1421.

De Fiore, Fiorella, and Harald Uhlig, 2015, Corporate debt structure and the financial crisis, *Journal of Money, Credit and Banking* 47, 1571–1598.

Demarzo, Peter M, 2019, Presidential address: Collateral and commitment, *Journal of Finance* 74, 1587–1619.

Demerjian, Peter R, 2011, Accounting standards and debt covenants: Has the "balance sheet approach" led to a decline in the use of balance sheet covenants?, *Journal of Accounting and Economics* 52, 178–202.

Denis, David J, and Vassil T Mihov, 2003, The choice among bank debt, non-bank private debt, and public debt: Evidence from new corporate borrowings, *Journal of Financial Economics* 70, 3–28.

Dewatripont, Mathias, and Jean Tirole, 1994, A theory of debt and equity: Diversity of securities and manager-shareholder congruence, *Quarterly Journal of Economics* 109, 1027–1054.

Diamond, Douglas, Yunzhi Hu, and Raghuram Rajan, 2019, Liquidity and the structure of intermediation, Working paper.

Diamond, Douglas W, 1984, Financial intermediation and delegated monitoring, *Review of Economic Studies* 51, 393–414.

Diamond, Douglas W, 1991, Monitoring and reputation: The choice between bank loans and directly placed debt, *Journal of Political Economy* 99, 689–721.

Diamond, Douglas W, Yunzhi Hu, and Raghuram G Rajan, 2020, Pledgeability, industry liquidity, and financing cycles, *Journal of Finance* 75, 419–461.

Djankov, Simeon, Oliver Hart, Caralee McLiesh, and Andrei Shleifer, 2008, Debt enforcement around the world, *Journal of Political Economy* 116, 1105–1149.

Djankov, Simeon, Caralee McLiesh, and Andrei Shleifer, 2007, Private credit in 129 countries, *Journal of Financial Economics* 84, 299–329.

Donaldson, Jason Roderick, Denis Gromb, and Giorgia Piacentino, 2019, The paradox of pledgeability, *Journal of Financial Economics* .

Donaldson, Jason Roderick, Denis Gromb, and Giorgia Piacentino, 2020, Conflicting priorities: A theory of covenants and collateral, Working paper.

Eisfeldt, Andrea L, and Adriano A Rampini, 2009, Leasing, ability to repossess, and debt capacity, *Review of Financial Studies* 22, 1621–1657.

Gale, Douglas, and Martin Hellwig, 1985, Incentive-compatible debt contracts: The one-period problem, *Review of Economic Studies* 52, 647–663.

Gan, Jie, 2007, Collateral, debt capacity, and corporate investment: Evidence from a natural experiment, *Journal of Financial Economics* 85, 709–734.

Gertner, Robert, and David Scharfstein, 1991, A theory of workouts and the effects of reorganization law, *Journal of Finance* 46, 1189–1222.

Gilson, Stuart C, Edith S Hotchkiss, and Richard S Ruback, 2000, Valuation of bankrupt firms, *Review of Financial Studies* 13, 43–74.

Gopal, Manasa, 2019, How collateral affects small business lending: The role of lender specialization, Working paper.

Green, Daniel, 2018, Corporate refinancing, covenants, and the agency cost of debt, Working paper.

Hart, Oliver, and John Moore, 1994, A theory of debt based on the inalienability of human capital, *Quarterly Journal of Economics* 109, 841–879.

Hart, Oliver, and John Moore, 1998, Default and renegotiation: A dynamic model of debt, *Quarterly Journal of Economics* 113, 1–41.

Haselmann, Rainer, Katharina Pistor, and Vikrant Vig, 2010, How law affects lending, *Review of Financial Studies* 23, 549–580.

Holmstrom, Bengt, and Jean Tirole, 1997, Financial intermediation, loanable funds, and the real sector, *Quarterly Journal of Economics* 112, 663–691.

Ivashina, Victoria, Luc Laeven, and Enrique Moral-Benito, 2020, Loan types and the bank lending channel, Working paper.

Iverson, Benjamin, 2018, Get in line: Chapter 11 restructuring in crowded bankruptcy courts, *Management Science* 64, 5370–5394.

Iverson, Benjamin Charles, Joshua Madsen, Wei Wang, and Qiping Xu, 2020, Financial costs of judicial inexperience, Working paper.

Jang, Young Soo, 2020, Five facts about direct lending to middle-market buyouts, Working paper.

Kaplan, Steven N, and Per Strömberg, 2003, Financial contracting theory meets the real world: An empirical analysis of venture capital contracts, *Review of Economic Studies* 70, 281–315.

Kermani, Amir, and Yueran Ma, 2020, Asset specificity of non-financial firms, Working paper.

Kim, Hyunseob, and Howard Kung, 2017, The asset redeployability channel: How uncertainty affects corporate investment, *Review of Financial Studies* 30, 245–280.

Kiyotaki, Nobuhiro, and John Moore, 1997, Credit cycles, *Journal of Political Economy* 105, 211–248.

Lian, Chen, and Yueran Ma, 2020, Anatomy of corporate borrowing constraints, *Quarterly Journal of Economics* Forthcoming.

Luck, Stephan, and João AC Santos, 2020, The valuation of collateral in bank lending, Working paper.

Ma, Yueran, and Jose Scheinkman, 2020, Going-concern debt of financial intermediaries, Working paper.

Maksimovic, Vojislav, and Gordon Phillips, 2001, The market for corporate assets: Who engages in mergers and asset sales and are there efficiency gains?, *Journal of Finance* 56, 2019–2065.

Matvos, Gregor, 2013, Estimating the benefits of contractual completeness, *Review of Financial Studies* 26, 2798–2844.

Mian, Atif, and Amir Sufi, 2011, House prices, home equity-based borrowing, and the us household leverage crisis, *American Economic Review* 101, 2132–56.

Murfin, Justin, 2012, The supply-side determinants of loan contract strictness, *Journal of Finance* 67, 1565–1601.

Murfin, Justin, and Ryan Pratt, 2019, Who finances durable goods and why it matters: Captive finance and the Coase conjecture, *Journal of Finance* 74, 755–793.

Nini, Greg, David C Smith, and Amir Sufi, 2012, Creditor control rights, corporate governance, and firm value, *Review of Financial Studies* 25, 1713–1761.

Park, Cheol, 2000, Monitoring and structure of debt contracts, *Journal of Finance* 55, 2157–2195.

Ponticelli, Jacopo, and Leonardo S Alencar, 2016, Court enforcement, bank loans, and firm investment: Evidence from a bankruptcy reform in Brazil, *Quarterly Journal of Economics* 131, 1365–1413.

Porta, Rafael La, Florencio Lopez-de Silanes, Andrei Shleifer, and Robert W Vishny, 1998, Law and finance, *Journal of Political Economy* 106, 1113–1155.

Rajan, Raghuram G, and Luigi Zingales, 1995, What do we know about capital structure? Some evidence from international data, *Journal of Finance* 50, 1421–1460.

Ramey, Valerie A, and Matthew D Shapiro, 2001, Displaced capital: A study of aerospace plant closings, *Journal of Political Economy* 109, 958–992.

Rampini, Adriano A, and S Viswanathan, 2010, Collateral, risk management, and the distribution of debt capacity, *Journal of Finance* 65, 2293–2322.

Rampini, Adriano A, and S Viswanathan, 2013, Collateral and capital structure, *Journal of Financial Economics* 109, 466–492.

Rampini, Adriano A, and S Viswanathan, 2020, Collateral and secured debt, Working paper.

Rauch, James E, 1999, Networks versus markets in international trade, *Journal of International Economics* 48, 7–35.

Rauh, Joshua D, and Amir Sufi, 2010, Capital structure and debt structure, *Review of Financial Studies* 23, 4242–4280.

Repullo, Rafael, and Javier Suarez, 1998, Monitoring, liquidation, and security design, *Review of Financial Studies* 11, 163–187.

Roberts, Michael R, and Amir Sufi, 2009, Control rights and capital structure: An empirical investigation, *Journal of Finance* 64, 1657–1695.

Schwert, Michael, 2020, Does borrowing from banks cost more than borrowing from the market?, *Journal of Finance* 75, 905–947.

Shleifer, Andrei, and Robert W Vishny, 1992, Liquidation values and debt capacity: A market equilibrium approach, *Journal of Finance* 47, 1343–1366.

Smith, Clifford W, and Jerold B Warner, 1979, On financial contracting: An analysis of bond covenants, *Journal of Financial Economics* 7, 117–161.

Strömberg, Per, 2000, Conflicts of interest and market illiquidity in bankruptcy auctions: Theory and tests, *Journal of Finance* 55, 2641–2692.

Townsend, Robert M, 1979, Optimal contracts and competitive markets with costly state verification, *Journal of Economic Theory* 21, 265–293.

Vig, Vikrant, 2013, Access to collateral and corporate debt structure: Evidence from a natural experiment, *Journal of Finance* 68, 881–928.

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 Lyondell (case number 09-10023). Panel B shows the example of a communications product company Sorenson Communications (case number 14-10454).

Panel A. Lyondell

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

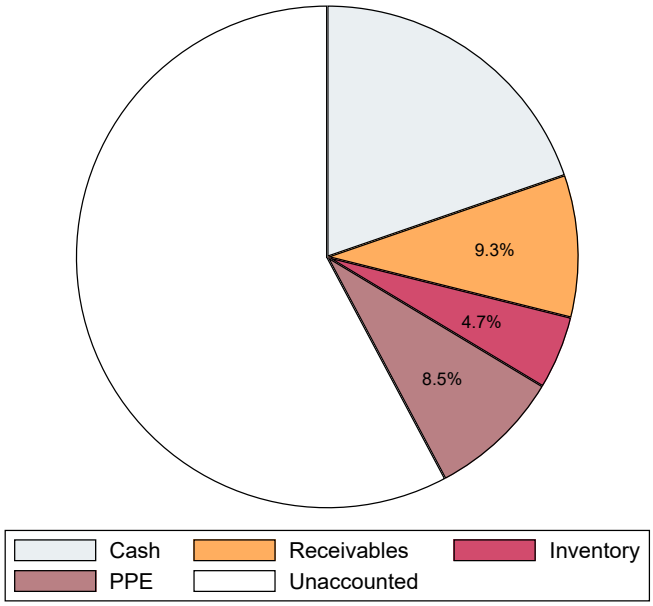
Panel B. Sorenson Communications

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 property, plant, and equipment (PPE). The figure in Panel B shows the distributions of non-financial firms' liquidation values, both excluding and including 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

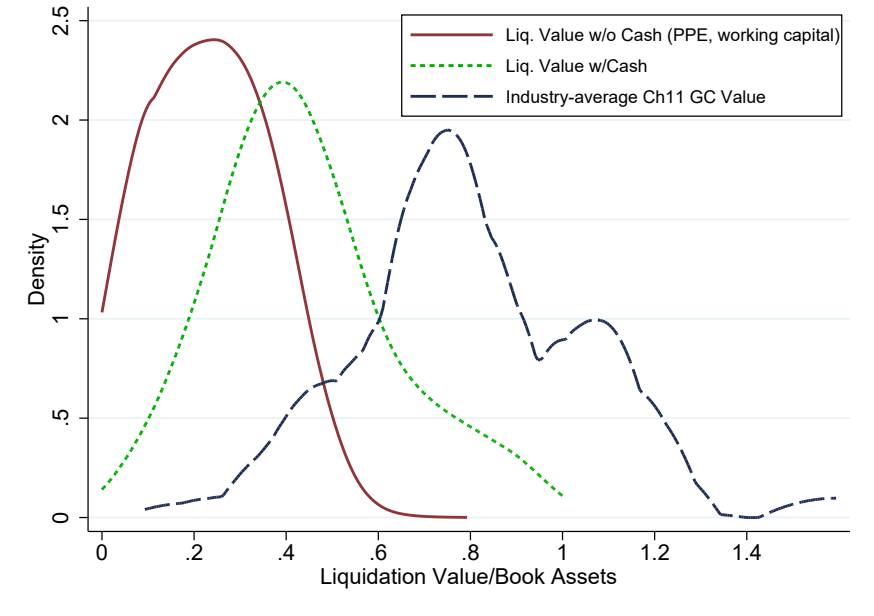
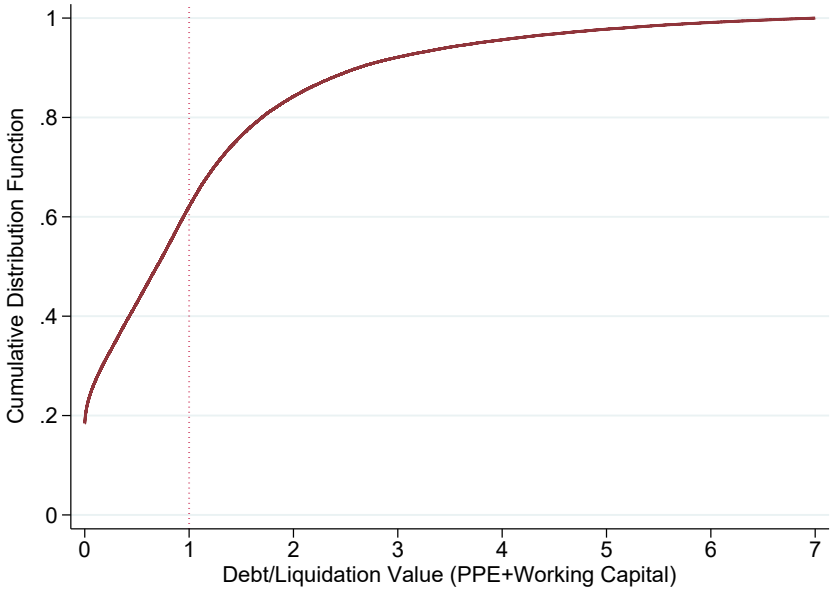


Figure 3: Borrowing Relative to Liquidation Values

Panel A shows the cumulative density function (CDF) of the ratio of total debt relative to the liquidation value of fixed assets and working capital, for non-financial firms in Compustat. Panel B shows the CDF of the ratio of total liabilities relative to the cash plus the liquidation value of fixed assets and working capital (solid red curve), and the ratio of total liabilities relative to the industry-average Chapter 11 going-concern value (dashed blue curve).

Panel A. Total Debt/Liquidation Value



Panel B. Total Liabilities/Liquidation Value (with Cash)

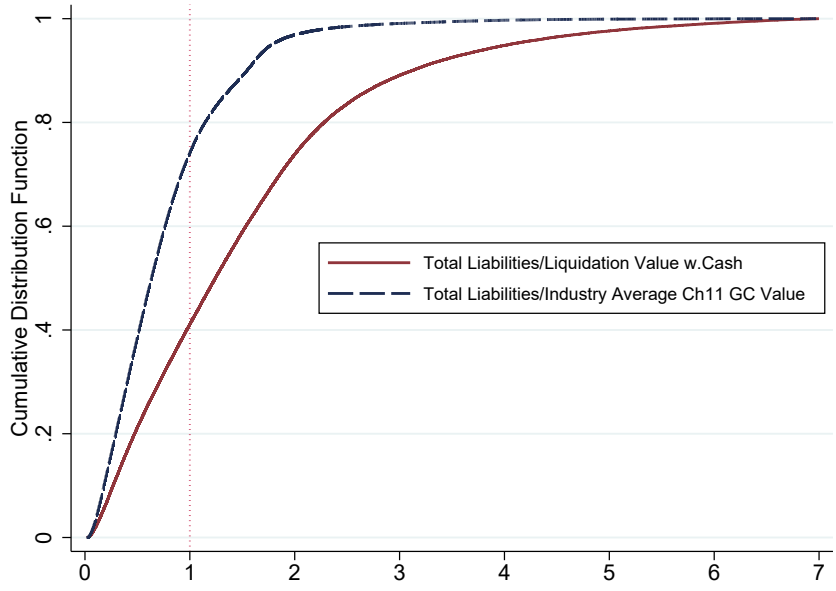
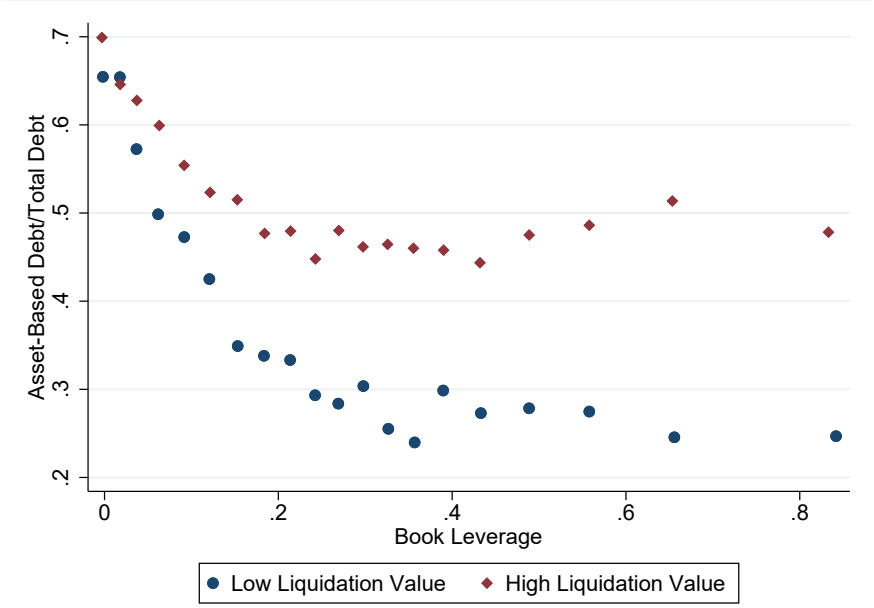


Figure 4: Asset-Based Debt

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. The high (low) liquidation value group includes firms in the top (bottom) tercile of liquidation value each year. Year fixed effects are included. We restrict to firms with book leverage between zero and one. Sample is based on Compustat and CapitalIQ and sample period is 2003 (beginning of CapitalIQ data for constructing debt composition) to 2016.

Panel A. Share in Total Debt



Panel B. Divide by Total Assets

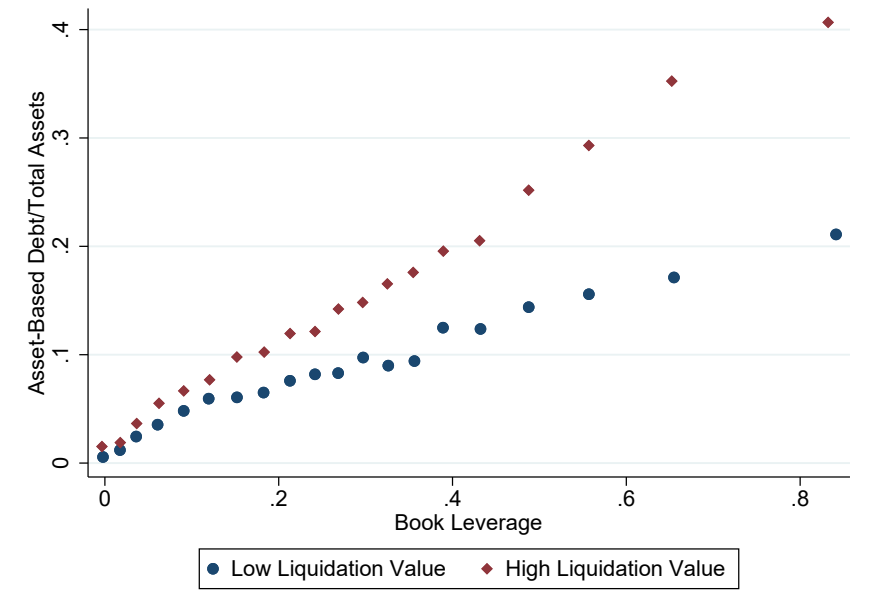
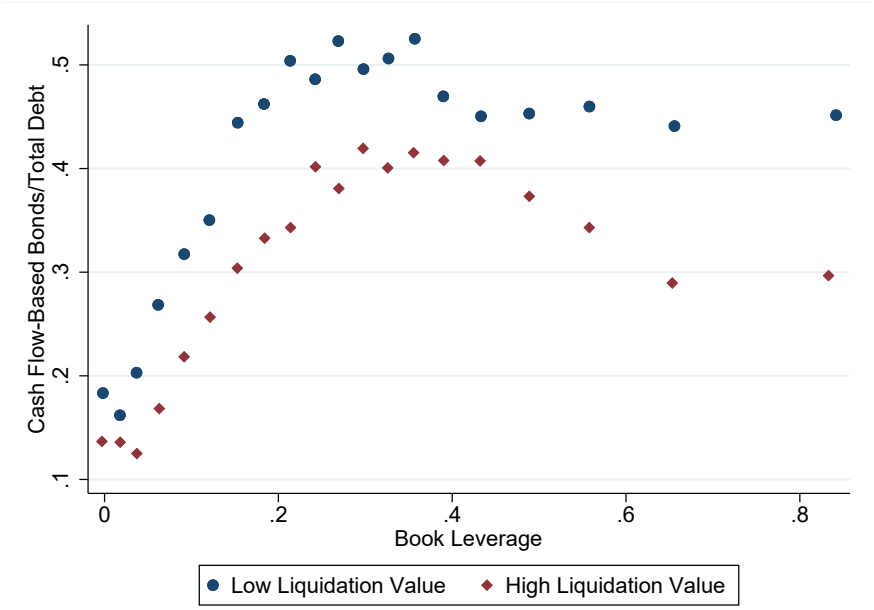


Figure 5: Cash Flow-Based Debt with Weak Control (Bonds)

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. The high (low) liquidation value group includes firms in the top (bottom) tercile of liquidation value each year. Year fixed effects are included. We restrict to firms with book leverage between zero and one. Sample is based on Compustat and CapitalIQ and sample period is 2003 (beginning of CapitalIQ data for constructing debt composition) to 2016.

Panel A. Share in Total Debt



Panel B. Divide by Total Assets

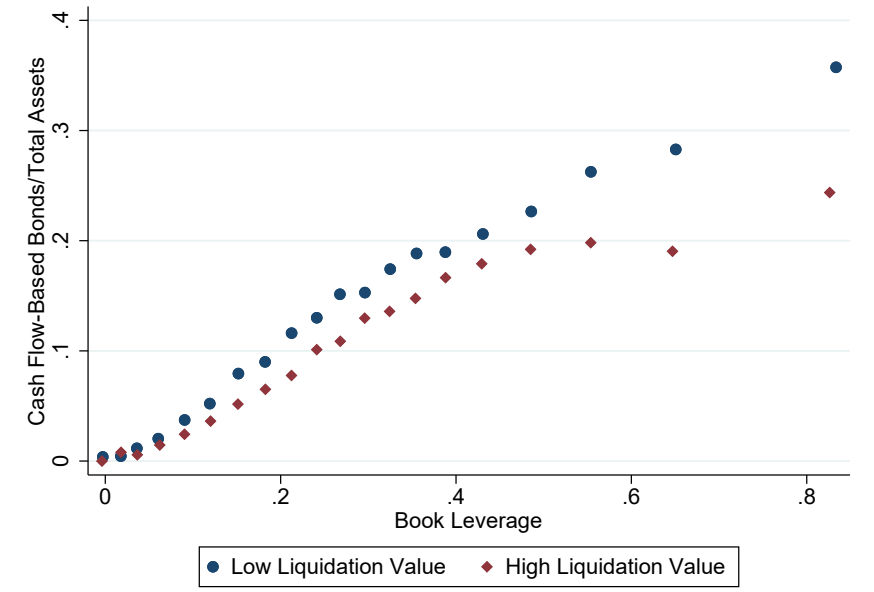
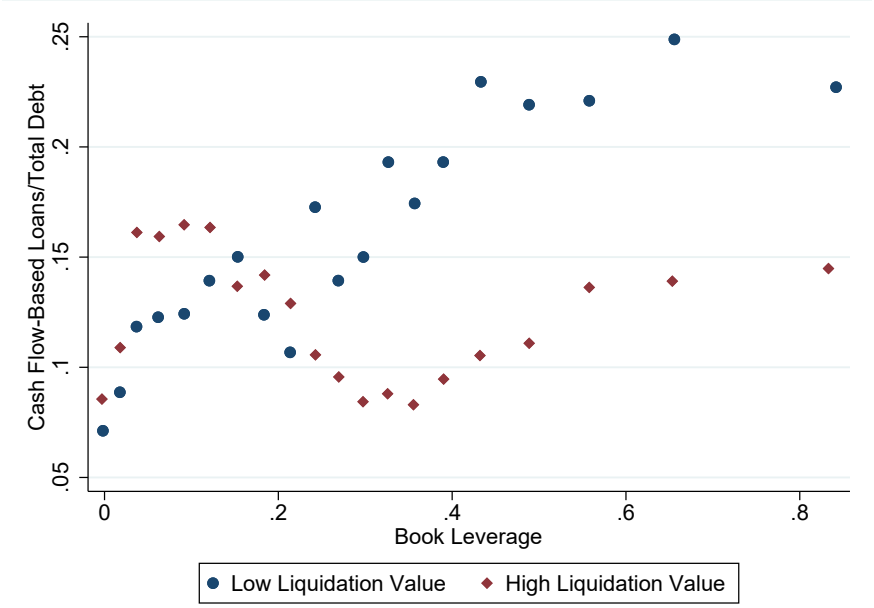


Figure 6: Cash Flow-Based Debt with Strong Control (Loans)

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. The high (low) liquidation value group includes firms in the top (bottom) tercile of liquidation value each year. Year fixed effects are included. We restrict to firms with book leverage between zero and one. Sample is based on Compustat and CapitalIQ and sample period is 2003 (beginning of CapitalIQ data for constructing debt composition) to 2016.

Panel A. Share in Total Debt



Panel B. Divide by Total Assets

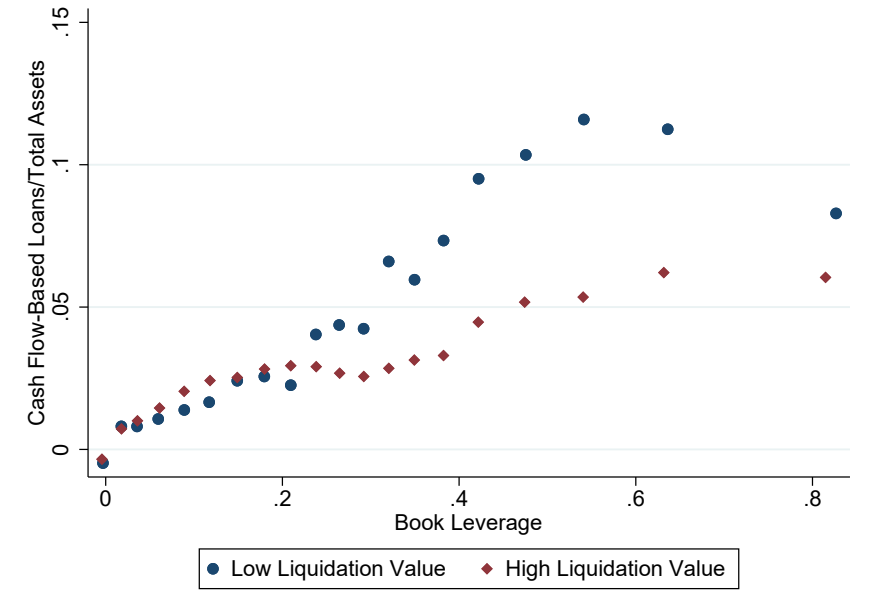


Figure 7: Strictness of Performance Covenants

The figure provides a binned scatterplot of the tightness of performance covenants (probability of violating at least one covenant, in %) 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). Performance covenants include financial covenants on EBITDA, debt to EBITDA, senior debt to EBITDA, interest coverage, fixed charge coverage, cash interest coverage, and debt service coverage. 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 are categorized within the low liquidation value group. Year fixed effects and loan size controls are included. We restrict to firms with book leverage between zero and one. Sample period is 1996 to 2016.

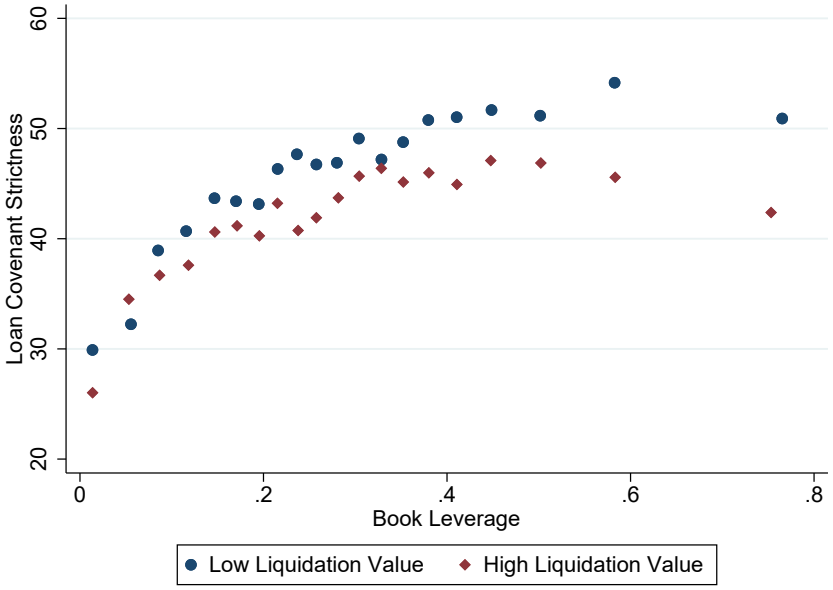
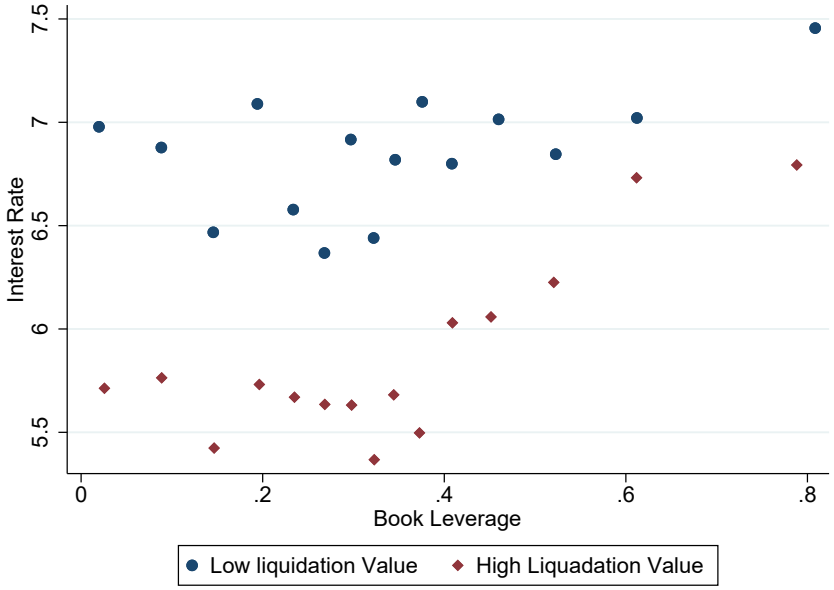


Figure 8: Interest Rates

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 values in Compustat each year are categorized within the high liquidation value group, and firms in the bottom tercile are categorized within the low liquidation value group. Year-quarter fixed effects are included. We restrict to firms with book leverage between zero and one. Sample period is 2003 (beginning of CapitalIQ data) to 2016.

Panel A. Asset-Based Debt



Panel B. Cash Flow-Based Debt

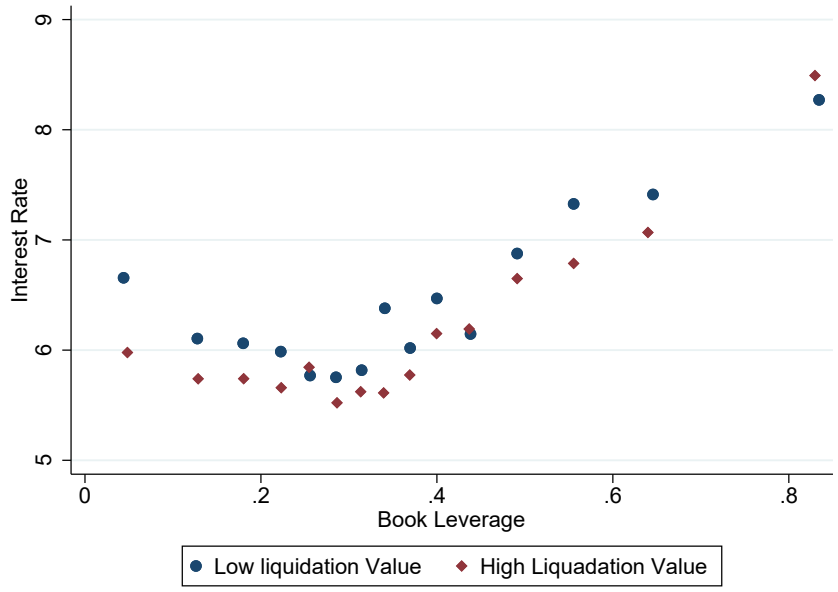
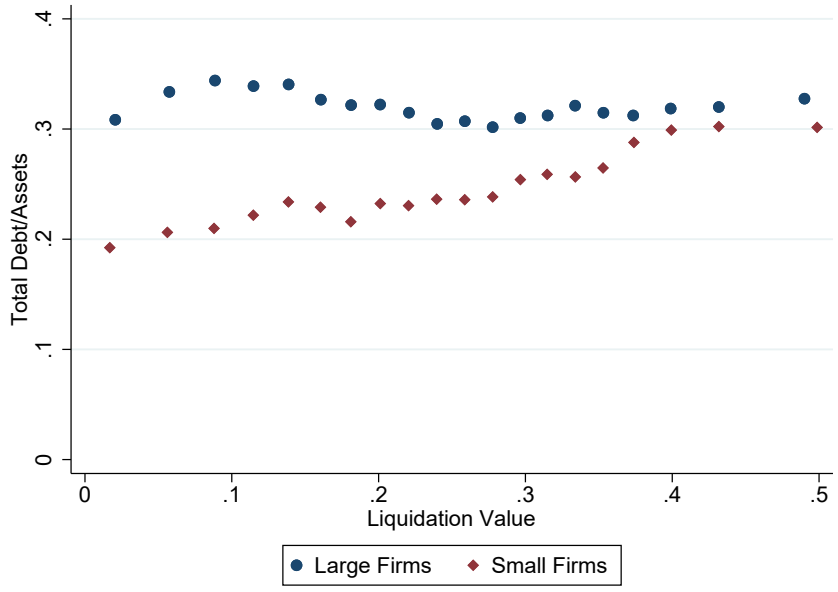


Figure 9: Liquidation Values and Total Leverage

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 (earnings before interest, taxes, depreciation and amortization), 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. We restrict to firms with book leverage between zero and one. Sample is based on Compustat and sample period is 1996 to 2016.

Panel A. Large vs. Small Firms



Panel B. Firms with Positive vs. Negative Earnings

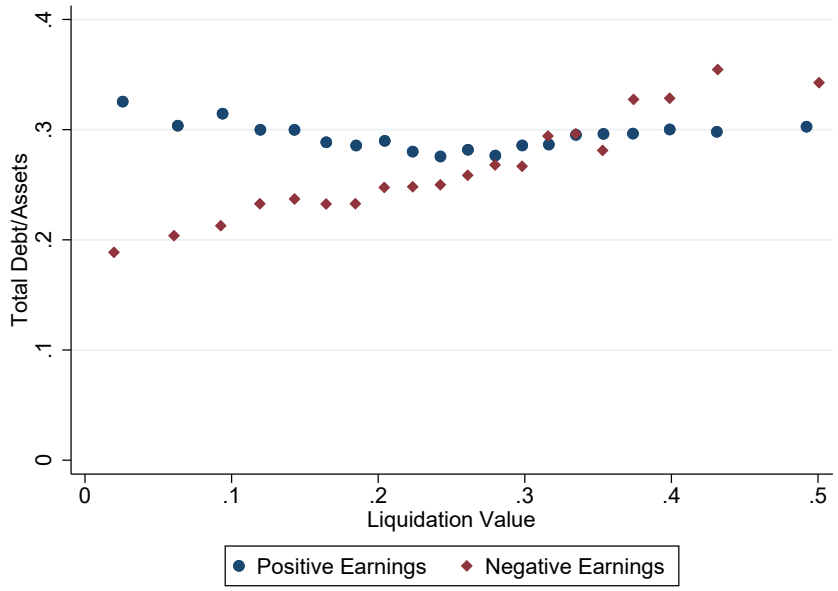
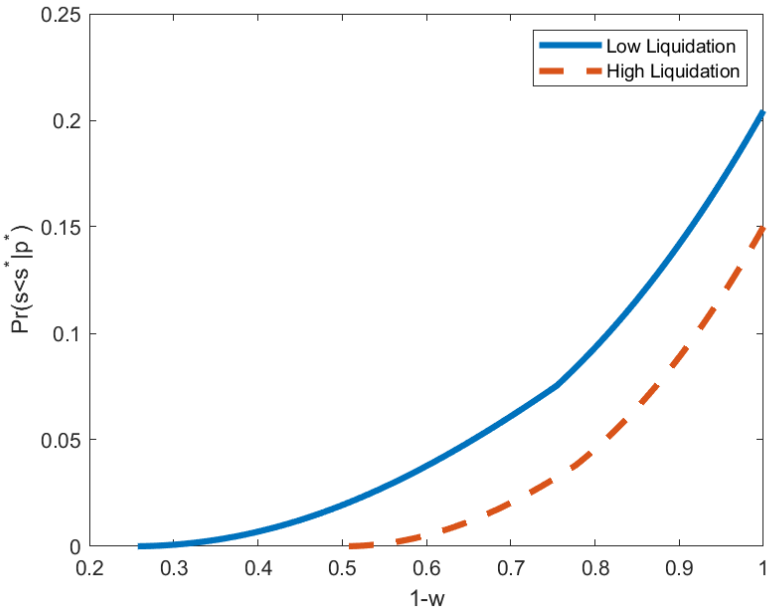


Figure 10: Model Solutions

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 the informed investor 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 Investor i_i

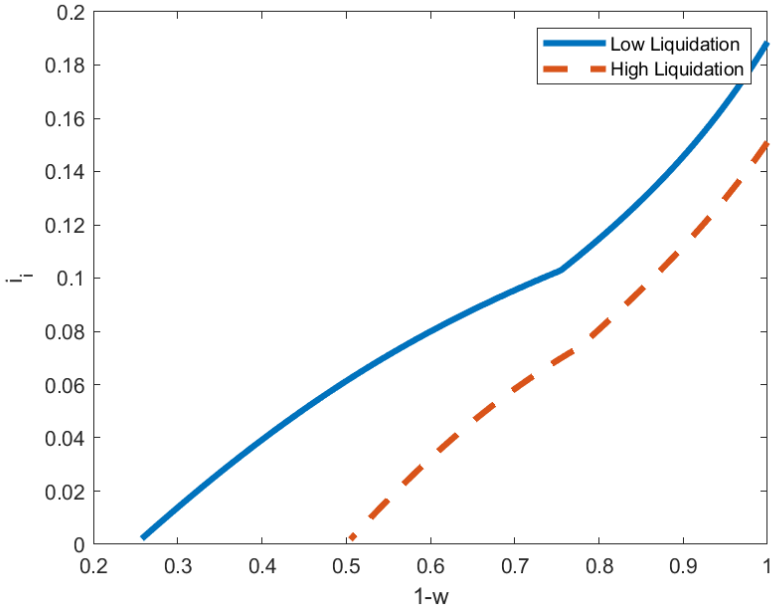


Table 1: Summary Statistics

Panel A shows industry-average (two-digit SICs) liquidation recovery rates of PPE, inventory, and receivable, as well as firm-level liquidation value estimates. The baseline firm-level liquidation value estimate includes the liquidation value of PPE, inventory, and receivable, and is normalized by book assets. It is calculated by combining the industry-average liquidation recovery rate and the book value of each type of asset. The value including cash adds all cash holdings. Chapter 11 going-concern value is the industry-average Chapter 11 value (normalized by total assets at filing) matched to the firm. Panel B shows statistics of total debt and debt composition. The baseline sample period for firm-level Compustat 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. Asset Attributes

Industry-level liquidation recovery rate	mean	sd	p25	p50	p75
PPE	35.34	16.69	24	33	44
Inventory	44.26	15.66	34	44	56
Receivable	61.60	13.64	55	63	71
Firm-level	**mean**	**sd**	**p25**	**p50**	**p75**
Baseline liquidation value	22.93	13.36	12	23	33
Liquidation value including cash	43.59	19.91	30	41	54
Ch 11 going-concern value	80.52	25.48	68	78	100

Panel B. 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: 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 includes PPE and working capital, and is normalized by the firm's total book assets. In columns (2) and (4), both liquidation value and book leverage are demeaned using sample means. Ch 11 recovery rate is industry-average Chapter 11 values normalized by book assets at Chapter 11 filings. Market value of assets is book value of assets minus book value of equity plus market value of equity. EBITDA is normalized by lagged total assets, and cash holdings are normalized by total assets. 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 is based on Compustat and CapitalIQ and 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)
Market/book value of assets	-0.025***	-0.024***	-0.007***	-0.006***
	(0.004)	(0.004)	(0.001)	(0.001)
EBITDA	0.051***	0.061***	0.001	0.007
	(0.016)	(0.016)	(0.005)	(0.005)
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 3: Cash Flow-Based 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 includes PPE and working capital, and is normalized by the firm's total book assets. In columns (2) and (4), both liquidation value and book leverage are demeaned using sample means. Ch 11 recovery rate is industry-average Chapter 11 values normalized by book assets at Chapter 11 filings. Market value of assets is book value of assets minus book value of equity plus market value of equity. EBITDA is normalized by lagged total assets, and cash holdings are normalized by total assets. 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 is based on Compustat and CapitalIQ and 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)
Market/book value of assets	0.011***	0.010**	0.005***	0.004***
	(0.003)	(0.004)	(0.001)	(0.001)
EBITDA	-0.106***	-0.111***	-0.021***	-0.025***
	(0.017)	(0.017)	(0.005)	(0.005)
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 4: Cash Flow-Based 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 includes PPE and working capital, and is normalized by the firm's total book assets. In columns (2) and (4), both liquidation value and book leverage are demeaned using sample means. Ch 11 recovery rate is industry-average Chapter 11 values normalized by book assets at Chapter 11 filings. Market value of assets is book value of assets minus book value of equity plus market value of equity. EBITDA is normalized by lagged total assets, and cash holdings are normalized by total assets. 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 is based on Compustat and CapitalIQ and 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)
Market/book value of assets	0.009**	0.009**	0.001	0.001
	(0.003)	(0.003)	(0.001)	(0.001)
EBITDA	0.067***	0.062***	0.016***	0.014***
	(0.009)	(0.009)	(0.003)	(0.003)
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 5: 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 includes PPE and working capital, and is normalized by the firm's total book assets. In columns (2) and (4), both liquidation value and book leverage are demeaned using sample means. Ch 11 recovery rate is industry-average Chapter 11 values normalized by book assets at Chapter 11 filings. Market value of assets is book value of assets minus book value of equity plus market value of equity. EBITDA is normalized by lagged total assets, and cash holdings are normalized by total assets. 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 is based on Compustat and CapitalIQ and 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)
Market/book value of assets	-0.004	-0.005*	-0.002*	-0.002*
	(0.003)	(0.003)	(0.001)	(0.001)
EBITDA	0.006	0.001	0.007**	0.005**
	(0.008)	(0.007)	(0.003)	(0.002)
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 6: 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). It captures the probability (in %) of violating at least one covenant. Performance 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. 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.

	Performance Covenant		Other Covenant	
	(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)
Market/book value of assets	-1.053**	-1.058**	-1.175**	-1.175**
	(0.374)	(0.379)	(0.421)	(0.427)
EBITDA	-14.283***	-14.370***	-1.893	-1.893
	(3.360)	(3.402)	(2.773)	(2.773)
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 7: 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 (including PPE and working capital) 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 is based on Compustat and 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
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Table 8: Interest Rates

This table shows the relationship between liquidation values 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. Liquidation value is the liquidation value of PPE and working capital of the issuer firm. Control variables are the same as those in Tables 2 to 4. We include firm-year fixed effects and interest rate type-year fixed effects (interest rate types include fixed rate and floating rate with different benchmarks). Standard errors are double-clustered by firm and time and reported in parentheses, and asterisks denote significance levels (***=1%, **=5%, *=10%). 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)
Asset-based debt=1 × Liquidation value	-1.507**	-1.429**	-1.140**	-1.949*	-0.966***
	(0.522)	(0.581)	(0.507)	(1.071)	(0.303)
Asset-based debt=1	0.050	0.480***	0.590***	0.376**	-0.404***
	(0.072)	(0.089)	(0.083)	(0.132)	(0.039)
Bond=1	0.790***				
	(0.099)				
Note=1	0.288**				
	(0.131)				
Observations	46573	23035	12527	10508	12429
Within R^2	.02	.018	.024	.013	.042
Controls	Yes	Yes	Yes	Yes	Yes
Interest rate type-year fixed effects	Yes	Yes	Yes	Yes	Yes
Firm-year fixed effects	Yes	Yes	Yes	Yes	Yes

Table 9: Creditor Recovery Rates in Default

This table shows the relationship between firm characteristics and default recovery rates for different types of debt. Each observation is a debt instrument in default. 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 default recovery rate data that we can match with Compustat firms. Firm-level liquidation value is the liquidation value of the firm (from PPE and working capital) prior to default. Industry-level liquidation value is the industry average of firm-level liquidation value using all Compustat firms in each industry. 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 assets is calculated as the book value of assets minus the book value of equity plus the market value of equity. 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%). Sample period is 1996 to 2016.

	Asset-Based Debt				Cash Flow-Based Debt			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Industry-level liquidation value	39.468**		49.929**		-0.251		17.696	
	(16.522)		(17.957)		(20.881)		(22.332)	
Liquidation value		34.360**		33.495**		5.115		0.301
		(12.705)		(12.735)		(23.780)		(24.815)
Industry-level Ch 11 recovery rate	-12.814*				-7.531			
	(7.119)				(7.638)			
Ch 11 recovery rate		3.560				25.132***		
		(8.653)				(8.364)		
25% market/book value of assets in industry			5.853	7.265			36.357**	33.025**
			(10.195)	(18.273)			(16.283)	(13.731)
% of debt claims more senior	-65.587***	-49.524***	-68.135***	-49.322***	-41.739***	-42.064***	-43.107***	-38.299***
	(10.508)	(15.415)	(10.376)	(16.119)	(5.722)	(3.302)	(5.611)	(5.179)
Bond=1	-26.962***	-24.356***	-26.291***	-24.595***	-16.237***	-16.354***	-15.361***	-19.273***
	(8.279)	(6.998)	(8.396)	(7.371)	(5.415)	(4.831)	(5.341)	(4.925)
Log(debt amount)	2.042	3.247*	2.086	3.342*	-2.706	-5.600***	-2.471	-5.375***
	(1.710)	(1.857)	(1.736)	(1.851)	(2.037)	(0.854)	(2.009)	(1.109)
Pre-filing log(assets)		-1.398		-1.480		6.723***		5.944**
		(1.528)		(1.485)		(1.734)		(2.124)
Pre-filing EBITDA		8.785		8.281		6.904		2.307
		(13.371)		(12.150)		(6.529)		(7.422)
Pre-filing market/book value of assets		-2.751		-2.547		-5.664*		-4.967
		(2.644)		(2.733)		(3.026)		(3.236)
Pre-filing past 12m equity return vol		2.617		2.542		1.665		2.515
		(6.040)		(5.852)		(6.866)		(7.236)
Pre-filing cash		8.469		9.551		-5.565		-10.332
		(23.718)		(23.152)		(19.622)		(25.338)
Observations	955	387	952	392	2237	1023	2224	1033
Within R^2	.321	.407	.314	.405	.209	.277	.222	.242
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

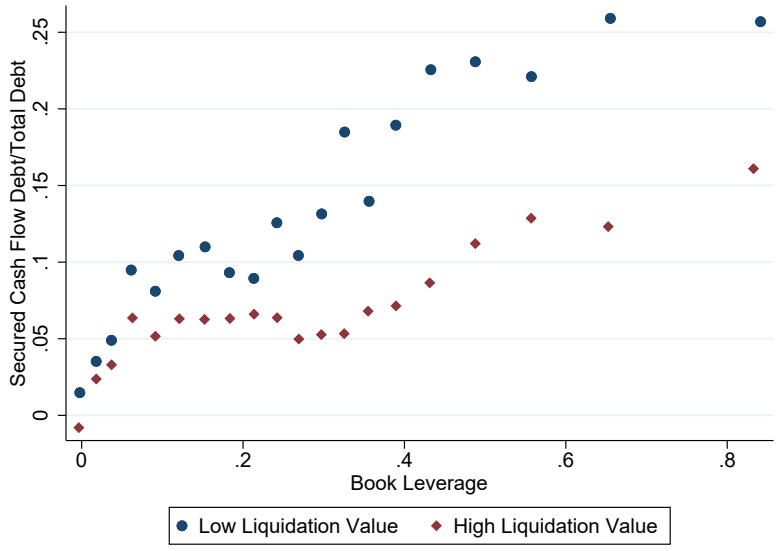
Internet Appendix

IA1 Additional Figures and Tables

Figure IA1: Secured Cash Flow-Based Debt

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. The high (low) liquidation value group includes firms in the top (bottom) tercile of liquidation value each year. Year fixed effects are included. We restrict to firms with book leverage between zero and one. Sample is based on Compustat and CapitalIQ and sample period is 2003 (beginning of CapitalIQ data for constructing debt composition) to 2016.

Panel A. Share in Total Debt



Panel B. Divide by Total Assets

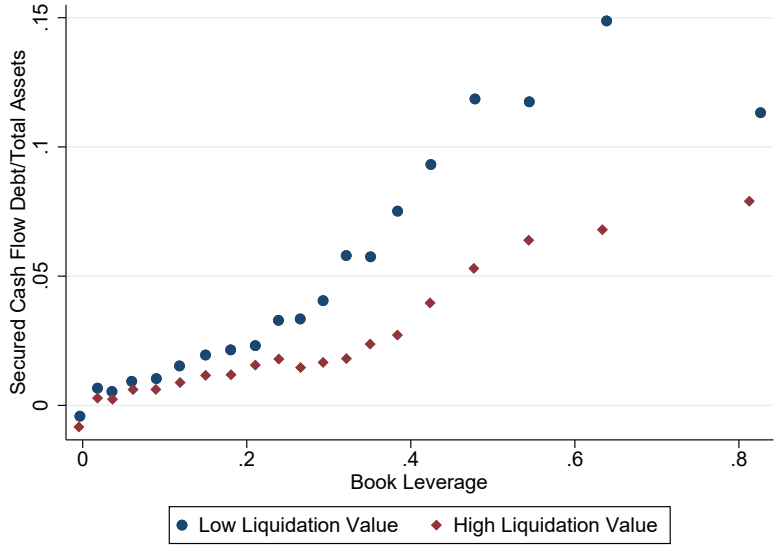
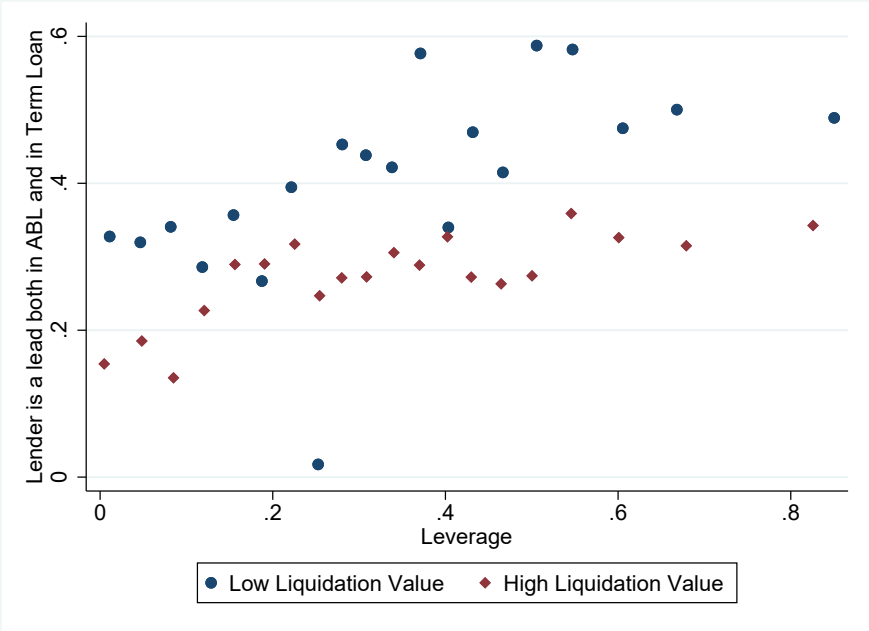


Figure IA2: Frequency of Having Same Lead Lenders in Asset-Based Loans and Cash Flow-Based Loans

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 are categorized within the low liquidation value group. Year fixed effects are included. We restrict to firms with book leverage between zero and one. Sample period is 1996 to 2016.

Panel A. By Book Leverage



Panel B. By Firm Size

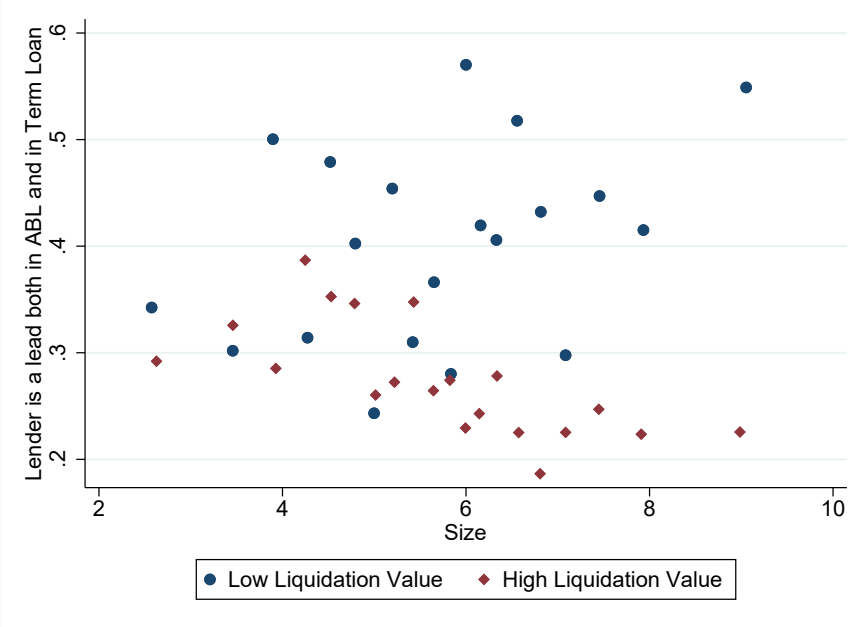


Figure IA3: Probability of Borrowing Base Violations

The figure provides a binned scatterplot of the share of firms where asset-based debt against working capital is 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 are categorized within the low liquidation value group. Year fixed effects are included. We restrict to firms with book leverage between zero and one. Sample period is 2003 (beginning of CapitalIQ data) to 2016.

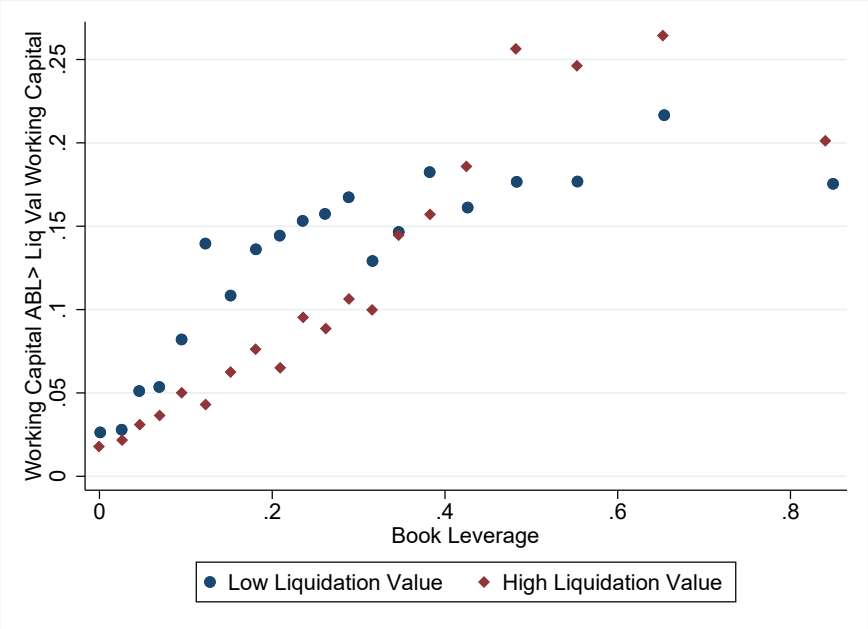


Table IA1: Industry List

The table shows the number of cases in 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 Chapter 11 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: 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. Panel B reports 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 average	0.12	0.33	0.32	0.48	0.49
Chapter 11 estimated average	0.31				

Panel B. Regression Comparisons

	Total Liquidation Value/Total Assets				
	Basic	Medium v1	Medium v2	High v1	High v2
	(1)	(2)	(3)	(4)	(5)
Chapter 7 case=1	-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 IA3: Industry-Level Variations in Liquidation Values

This table reports firm-level annual regressions where the outcome is asset-based debt in columns (1) and (4), cash flow-based bonds in columns (2) and (5), and cash flow-based loans in columns (3) to (6). Columns (1) and (3) use shares in total debt and columns (4) to (6) use shares in total asset. The dependent variable uses industry-level liquidation value (PPE and working capital, normalized by book assets), and its interaction with firm leverage. Book leverage and industry-average liquidation value are demeaned. The firm-level control variables are the same as those in Tables 2 to 4. 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 is based on Compustat and CapitalIQ and sample period is 2003 to 2016.

	Share of Total Debt			Share of Total Asset		
	Asset-Based	CF Bonds	CF Loans	Asset-Based	CF Bonds	CF Loans
	(1)	(2)	(3)	(4)	(5)	(6)
Ind-avg liq val	0.178**	0.154	-0.358***	0.146***	0.054	-0.125***
	(0.078)	(0.092)	(0.057)	(0.039)	(0.044)	(0.027)
Ind-avg liq val × Book leverage	1.784***	-0.694*	-1.097***	0.763***	-0.189	-0.277**
	(0.289)	(0.327)	(0.231)	(0.141)	(0.177)	(0.098)
Book leverage	-0.272***	0.256***	0.078***	0.366***	0.417***	0.129***
	(0.023)	(0.033)	(0.022)	(0.014)	(0.021)	(0.016)
Ch 11 recovery rate	-0.113***	0.080***	0.036**	-0.036***	0.023***	0.012**
	(0.020)	(0.021)	(0.016)	(0.007)	(0.006)	(0.005)
Observations	31348	31331	31348	32467	32457	32110
Within R^2	.228	.280	.026	.277	.434	.103
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Table IA4: Within-Firm Variations in Debt Composition

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), cash flow-based bonds in columns (3) and (4), and cash flow-based loans in columns (5) and (6). Book leverage and industry-average liquidation value are demeaned. Firm and 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 is based on Compustat and CapitalIQ and sample period is 2003 to 2016.

	Asset-Based Debt		CF-Based Bonds		CF-Based Loans	
	(1)	(2)	(3)	(4)	(5)	(6)
Book leverage	-0.366***	-0.359***	0.334***	0.333***	0.086***	0.084***
	(0.032)	(0.034)	(0.032)	(0.032)	(0.021)	(0.021)
Industry-avg liq value × Book leverage		1.063***		-0.370		-0.540**
		(0.339)		(0.320)		(0.243)
Market/book value of assets	-0.005	-0.006	-0.005	-0.005	0.006**	0.006**
	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)
EBITDA	0.019	0.025	-0.032*	-0.036**	0.015*	0.014
	(0.018)	(0.019)	(0.016)	(0.017)	(0.008)	(0.008)
Past 12m equity return vol	-0.000	-0.000	-0.008	-0.008	-0.000	0.001
	(0.008)	(0.008)	(0.007)	(0.007)	(0.005)	(0.005)
Cash	-0.108***	-0.118***	0.232***	0.236***	-0.122***	-0.115***
	(0.033)	(0.034)	(0.033)	(0.034)	(0.026)	(0.027)
Log(assets)	-0.078***	-0.081***	0.063***	0.066***	0.022***	0.023***
	(0.007)	(0.007)	(0.008)	(0.008)	(0.006)	(0.006)
Observations	32398	30693	32380	30676	32398	30693
Within R^2	.036	.039	.039	.041	.007	.008
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Table IA5: Liquidation Values by Type of Asset

This table reports firm-level annual regressions where the outcome variable is debt against working capital (inventory and receivable) 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. All the firm-level control variables are the same as those in Tables 2 to 4. 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 is based on Compustat and CapitalIQ and 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)
Ch 11 recovery rate	0.059**	-0.048**	-0.010*	-0.010***
	(0.023)	(0.018)	(0.005)	(0.002)
Market/book value of assets	-0.008	-0.010***	-0.004***	-0.001***
	(0.005)	(0.003)	(0.001)	(0.000)
EBITDA	0.031	-0.030**	0.006*	-0.006***
	(0.019)	(0.013)	(0.003)	(0.001)
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
Time fixed effects	Yes	Yes	Yes	Yes

Table IA6: Comparison with Book Value 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. The regressions compare our liquidation value measure with the book value of tangible assets using PPE (normalized by total book assets) in Panel A and PPE plus inventory in Panel B. Column (3) uses interest rates (from CapitalIQ) on asset-based debt, and column (4) uses interest rates on all debt. Regressions in both panels control for Chapter 11 going-concern values, market value of assets, EBITDA, past 12 months equity volatility, cash holdings, 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, and asterisks denote significance levels (***=1%, **=5%, *=10%). Sample is based on Compustat and CapitalIQ and sample period is 2003 to 2016.

Panel A. PPE as Tangible Assets

	Asset-Based Debt as Share of		Interest Rates on	
	Assets	Debt	Asset-Based	All
	(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=1 × Liquidation value				-1.782***
				(0.524)
Asset-based debt=1 × PPE				0.306
				(0.271)
Asset-based debt=1				0.375*
				(0.179)
Book leverage	0.352***	-0.299***		
	(0.014)	(0.024)		
Observations	31015	29923	21943	46573
Within R^2	.274	.23	.085	.02
Controls	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Firm-year fixed effects	No	No	No	Yes

Panel B. PPE and Inventory as Tangible Assets

	Asset-Based Debt as Share of		Interest Rates on	
	Assets	Debt	Asset-Based	All
	(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=1 × Liquidation value				-1.541**
				(0.670)
Asset-based debt=1 × PPE plus inventory				0.026
				(0.444)
Asset-based debt=1				0.422**
				(0.191)
Book leverage	0.354***	-0.293***		
	(0.014)	(0.024)		
Observations	31015	29923	21943	46573
Within R^2	.274	.23	.084	.02
Controls	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Firm-year fixed effects	No	No	No	Yes

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 IA4: Lyondell Chemical Example: Plant-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 plant-level estimate in the accompanying appendix (Panel B).

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 Plant-Level Estimate in Liquidation Analysis Appendix

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 IA4: Lyondell Chemical Example: Plant-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 IA5: 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 Values: Market-Based vs. Plan-Based

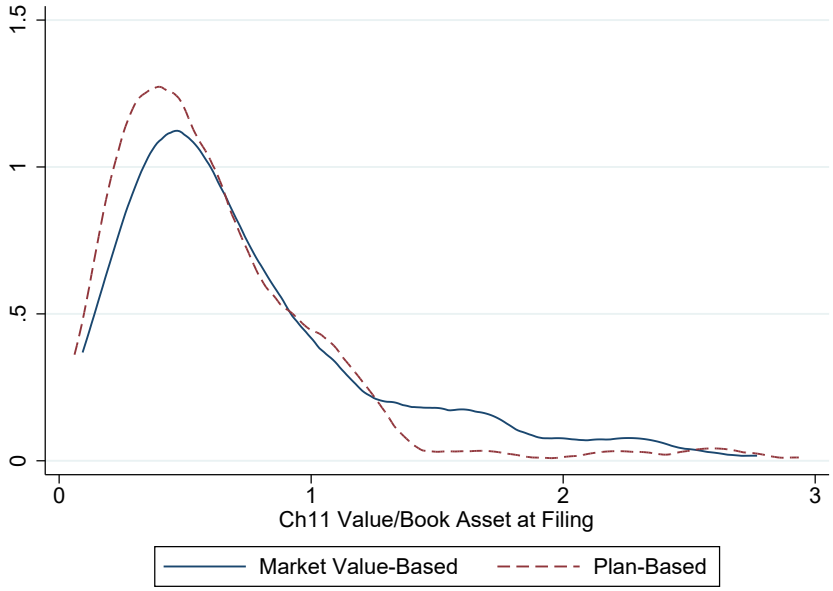
As explained in Section 2.1, for Chapter 11 going-concern values, we use firm value estimates from post-emergence market trading information as well as the valuation analysis in Chapter 11 plans. In particular, we use market value-based estimates when they are available (market value of equity plus book value of debt if the firm emerged as a public company, 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 IA6, Panel A, shows the distribution of the market-value based estimates and the distribution of the plan-based estimates, 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, Hotchkiss, and Ruback (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 IA6, 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 values are reasonably reliable.

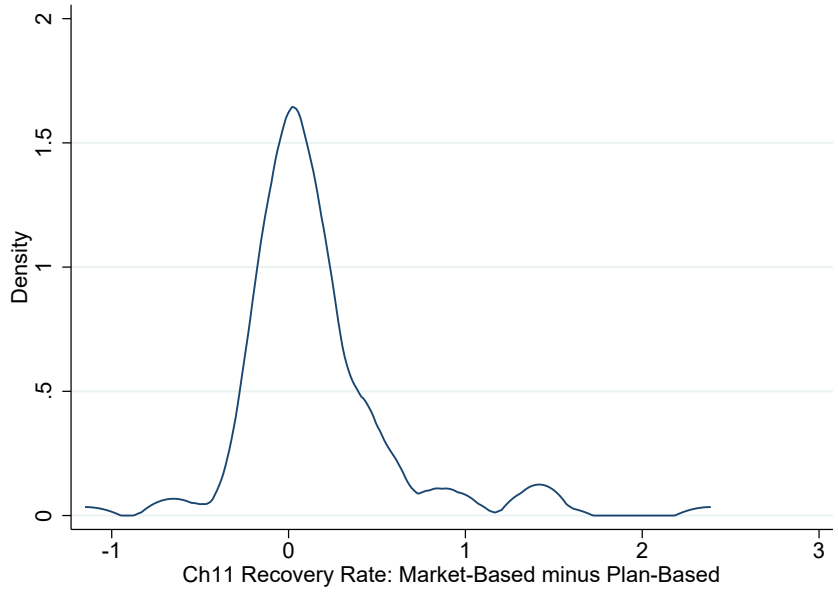
Figure IA6: Distributions of Chapter 11 Going-Concern Recovery Rates

Panel A shows the distribution of Chapter 11 going-concern values using post-emergence market values (market value of equity plus book value of debt, or acquisition value) in the solid blue line, and the distribution of Chapter 11 going-concern values using plan estimates in the dashed red line. Both values are normalized by total book assets at filing. Panel B shows the distribution of market value estimates minus plan estimates. Each observation is a Chapter 11 case.

Panel A. Market and Plan Values



Panel B. Differences between Market and Plan Values



IA3 Additional Results Incorporating Operating Leases

One may also view operating leases as akin to asset-based debt, in the sense that the lessor can repossess the asset under an operating lease when the lease terminates (Eisfeldt and Rampini, 2009). In this section, we perform robustness checks which include estimates of the 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. We assume liquidation recovery rate of 100% if the lessor were to repossess the asset.[28]

We estimate the value of operating leases using two methods. The first method follows Rampini and Viswanathan (2013) and multiplies firms' annual rental expenses by ten. The second method utilizes the value of operating leases provided by firms, which became available in 2019 after changes in accounting rules, as discussed in Section 2.1.1. We obtain firms' estimates of operating leases in 2019 from Compustat Snapshot and CapitalIQ. For each firm, we calculate the ratio of operating leases relative to owned assets. We take the average ratio in each two-digit SIC industry, and use this ratio to estimate the value of operating leases for pre-2019 firm-years in our sample (i.e., we multiply owned assets by this ratio to estimate operating leases in prior years).

We add 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). We also add operating leases to liquidation values (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 can contribute to a mechanical positive association between asset-based debt (including operating leases) and liquidation values (including operating leases).

The results are presented in Table IA7 below. The regression specifications follow those in columns (3) and (4) of Tables 2 to 4, 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 2 to 4, 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.

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

Table IA7: Results including Operating Leases

In this table, we include the capitalized value of operating leases in liquidation values, asset-based debt, total leverage, and total assets. We use two methods to estimate the value of operating leases as described above. The dependent variables are asset-based debt in columns (1) and (2), cash flow-based bonds in columns (3) and (4), and cash flow-based loans in columns (5) and (6), all normalized by total assets (including operating leases). The firm-level control variables are the same as those in Tables 2 to 4. 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 is based on Compustat and CapitalIQ and sample period is 2003 to 2016.

Panel A. Method 1

	Asset-Based Debt		CF-Based Bonds		CF-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
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Panel B. Method 2

	Asset-Based Debt		CF-Based Bonds		CF-Based Loans	
	(1)	(2)	(3)	(4)	(5)	(6)
Liquidation value	0.269***	0.374***	-0.112***	-0.188***	-0.113***	-0.132***
	(0.019)	(0.027)	(0.022)	(0.032)	(0.015)	(0.018)
Book leverage	0.402***	0.390***	0.384***	0.393***	0.124***	0.127***
	(0.014)	(0.013)	(0.022)	(0.023)	(0.015)	(0.016)
Liquidation value × Leverage w/ lease		1.133***		-0.817***		-0.188***
		(0.097)		(0.122)		(0.058)
Ch 11 recovery rate	-0.037***	-0.026***	0.017**	0.009	0.015***	0.013***
	(0.007)	(0.007)	(0.006)	(0.006)	(0.004)	(0.004)
Observations	31018	31018	31008	31008	30682	30682
Within R^2	.328	.354	.405	.421	.11	.112
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

IA4 Estimating Financial Covenant Tightness

We construct covenant tightness measures following Murfin (2012).[29] The main idea is to compare covenant threshold values from Dealscan with firms' financial ratios 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 ratios, we can calculate the probability of covenant violations, 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.[30] For the tightness of performance covenants, 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 changes in firms' log financial ratios. We then create a positive-definite covariance matrix of changes in the log of financial ratios. Following Murfin (2012), we calculate the covariance matrices for each one-digit SIC industry and backwards-rolling ten-year period combination. In addition, prior to creating each covariance matrix, observations with missing values for the changes in log financial ratios are dropped. Finally, the changes in log of financial ratios are winsorized at the 1% level.

We merge loan covenant thresholds from Dealscan with firms' financial ratios 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.

The final step is to calculate the multivariate normal probability of covenant violations. First, we remove loan observations that do not have covenants relevant for the measure of covenant tightness, or those that violate covenants prior to the start date (i.e., have a negative slack value). Using the covariance matrices of changes in financial ratios, we calculate each loan's multivariate normal probability of the relevant slack variable being greater than or equal to zero, for each one-digit SIC industry-year combination. The covenant tightness measure, which captures the probability of violating at least one covenant, is one minus the calculated multivariate normal probability.

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

[30] 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.

IA5 Solution to the Model

The optimal contract can be characterized as the solution to:

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

$$pR_i + (1-p)L_i = Q_i, \tag{IA1}$$

$$\mathbb{P}[s < s^*|\tilde{p}]Q_e + \mathbb{P}[s \geq s^*|\tilde{p}]\tilde{p}R_e - \frac{1}{2}\gamma\tilde{p}^2 = p^*R_e - \frac{1}{2}\gamma p^{*2}, \tag{IA2}$$

$$\mathbb{P}[s < s^*|\tilde{p}]Q_i + \mathbb{P}[s \geq s^*|\tilde{p}]\left[\tilde{p}R_i + (1-\tilde{p})L_i\right] = i_i, \tag{IA3}$$

$$p^*R_i + (1-p^*)L_i - \mathbb{P}[s < s^*|p^*]c = i_i, \tag{IA4}$$

$$p^*R_u + (1-p^*)L_u = i_u, \tag{IA5}$$

and

$$\tilde{p} = \arg\max_{p} \; \mathbb{P}[s < s^*|p]Q_e + \mathbb{P}[s \geq s^*|p]pR_e - \frac{1}{2}\gamma p^2.$$

Combining Equations (IA1), (IA3), and (IA4), we have:

$$R_i - L_i = \frac{\mathbb{P}[s < s^*|p^*]}{\mathbb{P}[s \geq s^*|\tilde{p}]}\frac{c}{p^* - \tilde{p}}.$$

Also, taking the first order condition of the above system of equations, $(p^*, \tilde{p}, s^*, R_e, Q_e)$ is the solution to this system of equations:

$$p^* = \frac{R-L}{\gamma} - \frac{c}{\gamma}\frac{\partial}{\partial p^*}\mathbb{P}[s < s^*|p^*],$$

$$\mathbb{P}[s \geq s^*|\tilde{p}]\tilde{p}R_e + \mathbb{P}[s < s^*|\tilde{p}]Q_e - \frac{1}{2}\gamma\tilde{p}^2 = p^*R_e - \frac{1}{2}\gamma p^{*2},$$

$$p^*(R - R_e) + (1-p^*)L = (1-w) + \mathbb{P}[s < s^*|p^*]c,$$

$$\gamma\tilde{p} = \frac{\partial}{\partial\tilde{p}}\left[\mathbb{P}[s \geq s^*|\tilde{p}]\tilde{p}R_e + \mathbb{P}[s < s^*|\tilde{p}]Q_e\right],$$

$$Q_e = \max\left(0, Q - (1-w) - \mathbb{P}[s < s^*|p^*]c\right).$$

And the rest of the parameters of the contract can be written as a function of $(p^*, \tilde{p}, s^*, R_e, Q_e)$.

For the contract with minimum investment from the informed investor, we have: $L_i = 0$, $R_i = \frac{\mathbb{P}[s<s^*|p^*]}{\mathbb{P}[s\geq s^*|\tilde{p}]}\frac{c}{p^*-\tilde{p}}$, $Q_i = p^*R_i$, and $i_i = p^*R_i - \mathbb{P}[s < s^*|p^*]c$. Finally, for the uninformed investor we have: $i_u = 1 - w - i_i$, $L_u = L$, $R_u = (i_u - L)/p^* + L$, and $Q_u = Q - Q_e - Q_i$.