Redefining Financial Constraints: A Text-Based Analysis

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We score 10-K text to obtain annual measures of financial constraints, with separate measures for firms reporting equity and debt financing issues. Equity market constraints are associated with firms funding growth opportunities, have more severe consequences for the firm following large unexpected negative shocks, and are likely driven by informational asymmetries. A significant population of firms reporting equity market constraints also declare that they possess material undisclosed proprietary information. Constraints in the debt markets are distinct and are linked to covenant violations. Our measures outperform others used in the literature in predicting investment cuts following negative shocks. (*JEL* G30, G32, M41)

Researchers have identified several theories explaining why financial constraints might exist (asymmetric information, moral hazard, cost of contract enforcement, transaction costs, and debt overhang). A limitation of existing measures of financial constraints is that they are unidimensional, even as theory recognizes that the binding constraints might separately relate to the ability to raise equity or to raise debt. Moreover, existing constraint measures rely on potentially unstable reduced-form predictive models estimated on small samples using accounting ratios, which are then applied out of sample to materially different populations of firms. We develop a novel methodology that overcomes these limitations.

Our results suggest that the most constrained firms are high-growth firms that desire external equity financing. These firms have high Tobin's q relative

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to industry peers, likely due to high adjustment costs and inability to quickly exercise investment options. These firms also significantly curtail R&D, CAPX, and equity issuance policies following negative shocks. We find that these equity market-constrained firms are more likely to mention concerns about the risk of losing proprietary information in their 10-Ks (proprietary information risks). These findings provide some of the first direct evidence regarding potential informational asymmetries in equity market financial constraints. Our findings strongly support Krasker's (1986) extension of Myers and Majluf (1984). Krasker (1986) shows that asymmetric information can lead to "equity rationing," where firms with the best investment opportunities face a bounded issuance proceeds function (financial constraints) and are forced to under invest.

Our results also show that firms funding investment using debt financing also can be constrained. However, the impact of negative shocks for these firms is less severe in our sample. We find that these constraints are likely not driven by informational asymmetries and differ substantially from equity market constraints. In particular, these firms are not more likely to report proprietary information risks, but they are more likely to discuss issues relating to covenant violations in their 10-Ks. In all, these firms likely have investment opportunities they would like to fund, but are likely challenged by a high existing debt burden.

Our measures of the firm's financial constraints are based on analysis of the Management's Discussion and Analysis (MD&A) section in 48,512 10-Ks for the period 1997–2009. We focus on mandated disclosures regarding each firm's liquidity, as well as the discussion of the sources of capital each firm intends to use in addressing its financing needs. We calculate four direct measures of financial constraints for each firm in each year: those due to broad liquidity challenges leading to potential under investment and those due to specific liquidity challenges pertaining to equity, debt, and private placement financing. We examine how the constraints for different forms of external finance are related to firm characteristics, and show how the constraints are differentially related to investment and issuance decisions following unexpected negative shocks.

Following Kaplan and Zingales (1997) (KZ), we focus on the discussion of liquidity in the MD&A section of the 10-K. This section is context sensitive, and when managers indicate the potential need to curtail or delay investment, the intended conclusion for the reader is that the firm is investing less than what might be optimal due to the existence of challenges to its liquidity. Our constraint indices differ substantially from those used by KZ and Whited and Wu (2006) (WW). For example, our new constraint measures are 15% or less correlated with the KZ and WW indices.

Our findings also extend those of Hadlock and Pierce (2010) (HP), who suggest that firm size and age are measures of financial constraints. Consistent with HP, the top chart in Figure 1 shows that, according to our measures, smaller and younger firms are more likely to discuss issues relating to constraints than

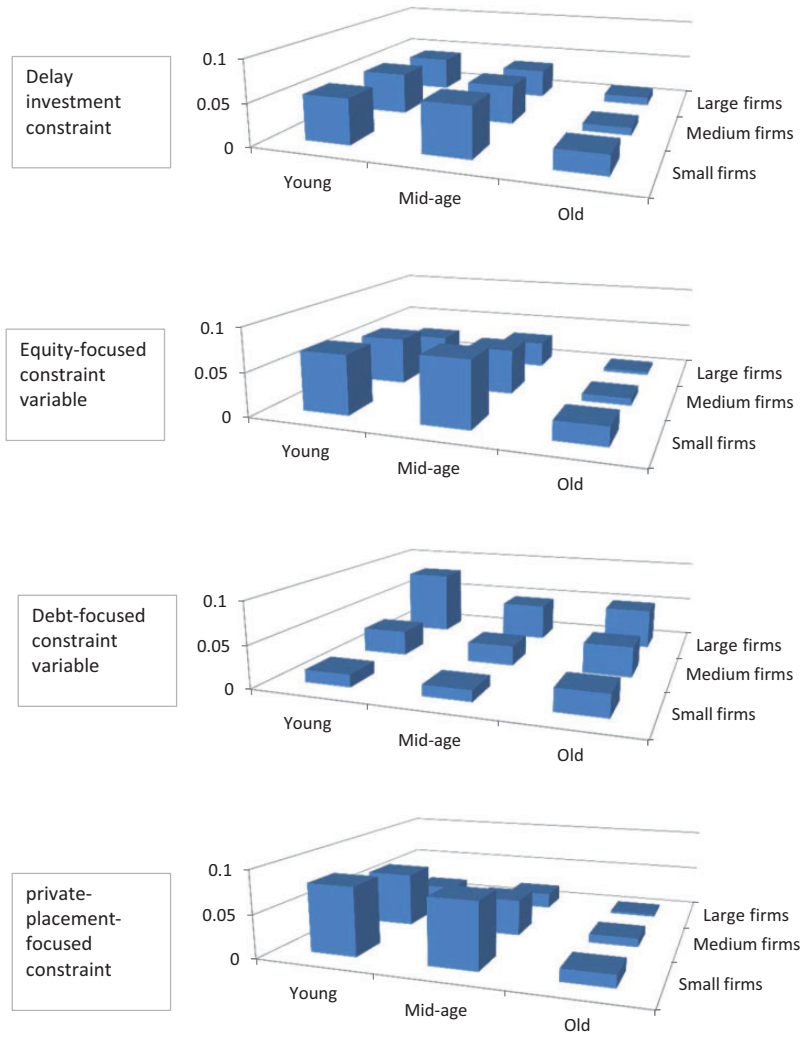

Figure 1
Three-dimensional plots of the likelihood of being highly constrained versus size and age. A figure is displayed for each constraint variable as noted on the left-hand side of each figure. The variable being plotted is the fraction of firms with a level of the constraint variable that is more than two standard deviations above the mean based on annual standard deviations.

are larger and older firms. Going beyond HP, we also identify a large fraction of small and young firms that are unlikely to be constrained, and a large number of medium-sized and middle-aged firms that are likely constrained. We are also the first to show, as depicted in the lower three charts, that constrained firms focusing on equity, debt, and private placements are also distinct and

likely cannot be systematically identified by size and/or age. Equity-focused constrained firms are likely to be smaller; debt-focused constrained firms are likely to be larger young firms; and private-placement-focused constrained firms are likely to be middle sized or middle aged.

Our findings also extend those of Brown, Fazzari, and Petersen (2009) (BFP), who suggest that R&D plays a major role in financial constraints. Consistent with BFP, Figure 2 shows that constraints are broadly higher for younger firms with high R&D. Going beyond BFP, we identify a significant population of firms that declare proprietary information risks in their 10-Ks and that this category of firms have higher constraints even holding R&D fixed (as shown in the figure). Financing frictions related to proprietary information concerns even exist in Fama-French-48 industries in which R&D is less pervasive: Personal Services, Retail, Transportation, and Meals. Our results regarding proprietary information are novel and highly robust.

We take our constraint measures to the data and examine the responsiveness of firms' investment and issuance policies to unexpected negative shocks. In Opler and Titman-style (1994) tests, we examine whether constrained firms curtail these polices more than unconstrained firms during the 2008 financial crisis and also following the technology bust of 2001. In a more targeted test aimed at identifying a causal channel for liquidity, we consider the Edmans, Goldstein, and Jiang (2012) forced mutual fund selling shock. As their measure of forced mutual fund selling is not sector specific, and only affects equities, this shock is particularly direct and unexpected regarding equity market liquidity. Our findings are strong and are consistent with a relation between increasingly binding financial constraints and both investment and SEO issuance curtailment. We do not find similar results for existing constraint measures in the literature, and our findings cannot be explained by size and age following Hadlock and Pierce (2010).

We find that firms having an equity, debt, or private placement focus curtail investment and issuance policies differently. Equity-focused constrained firms (and more so, private-placement-focused constrained firms) most severely curtail their R&D, capital expenditures, and equity issues following negative shocks. In contrast, debt focus constrained firms reduce their debt issuances following negative shocks but do not materially curtail their investments.

The differential responses to shocks by constrained and unconstrained firms are also economically large. For example, the highest tercile of constrained firms (using our baseline constraint variable) reduced their R&D by 13.6% of sales in the financial crisis of 2008, whereas the lowest tercile reduced R&D by only 0.7% of sales. Following the technology bust of 2001, the highest tercile constrained technology firms curtailed their R&D by 16.4% of sales, compared with 3.2% for the least constrained tercile of technology firms. Following shocks to mutual fund selling in the highest decile among firms in each year, the highest tercile constrained firms curtailed their R&D by 9.5% of sales, compared with 1.0% for the least constrained tercile firms.

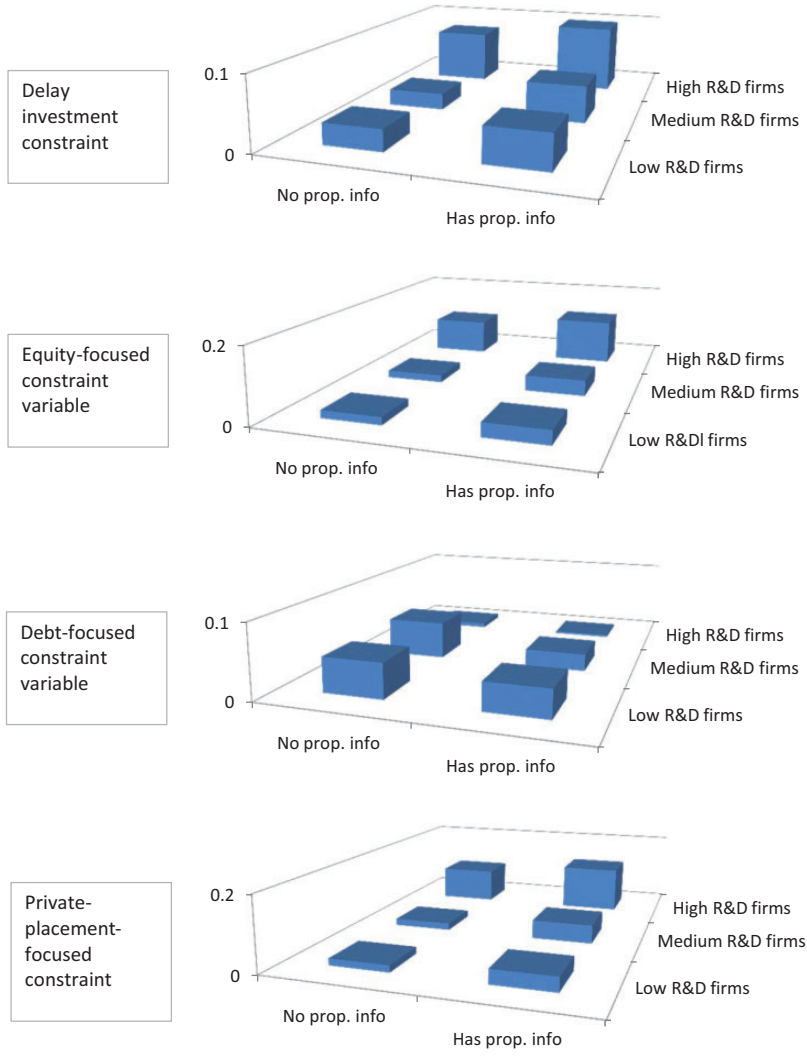

Figure 2
Three-dimensional plots of the likelihood of being highly constrained versus R&D and whether or not the firm mentions proprietary information risks in its 10-K. The calculations are based only on firms with below median age (we expect and observe in unreported tests that results are similar but weaker for the overall sample). A figure is displayed for each constraint variable as noted on the left-hand side of each figure. The variable being plotted is the fraction of firms with a level of the constraint variable that is more than two standard deviations above the mean based on annual standard deviations.

Our paper is most strongly related to existing articles that imply measures of constraintedness, including that of Fazzari, Hubbard, and Petersen (FHP) (1988), and the aforementioned articles by Kaplan and Zingales (1997), Whited and Wu (2006), and Hadlock and Pierce (2010). Also related, is a second strand

of research that uses surveys to measure financial constraints. Graham and Harvey (2001) and Campello, Graham, and Harvey (2010) analyze the role of constraints for large firms, and Beck, Demirguc-Kunt, and Maksimovic (2005) for small firms. Our paper also draws upon a growing literature that considers text-based analysis to test theoretical hypotheses in finance.[1]

There is also a large literature on the roots of financial constraints. Myers and Majluf (1984), Krasker (1986), Greenwald, Stiglitz, and Weiss (1984), Jensen and Meckling (1976), and Hart and Moore (1998) have all identified reasons for a wedge between internal and external financing. Regarding equity market constraints, we find strong support for a role for information (Myers and Majluf 1984; Krasker 1986). Regarding debt market constraints, our results are less conclusive, but suggest that information is likely not a key factor, and that a high existing debt burden might be a material factor. Hennessy and Whited (2005, 2007) also consider financial constraints in a setting in which debt and equity are potential choices using structural estimation.

Our study is unique, and our empirical framework has several advantages. First, we obtain information on constraints for a large fraction of the COMPUSTAT universe directly from firm disclosures. Our variables thus have the advantage of direct textual context. Second, we avoid the difficulty of having to predict constraints out of sample using potentially unstable reduced-form relations based on accounting variables. Third, we can query the text further regarding related more nuanced issues predicted by theory. This flexibility has the potential to identify the specific channels through which constraints matter, and we use this approach to assess the degree to which constraints are related to proprietary information and covenant violations. Fourth, the methodology we are using is transparent, consistent, and can be applied out of sample with the same interpretation.

1. Literature Review

In early work, FHP argue that if financial constraints are a first-order issue, investment will become positively correlated with cash-flow realizations once the researcher controls for the value of investment opportunities. KZ criticize FHP on the grounds that the relation between cash-flow sensitivity and constraints is not necessarily monotonic and depends on the firm's production function and its cost of external funds. KZ use expert evaluations of 10-K MD&A statements for forty-nine firms to measure financial constraints. Many later studies use the "KZ Index," which is a linear function of the accounting variables (firm cash-flow, long-term debt, dividend-to-asset ratio, and Tobin's q)

[1] Early financial studies using text include Antweiler and Frank (2004) and Tetlock (2007). In corporate finance, earlier work includes Hanley and Hoberg (2010), Hoberg and Phillips (2010a), Loughran and McDonald (2011), and Ball, Hoberg, and Maksimovic (2014). See Sebastiani (2002) for an excellent review of text analytic methods.

shown by KZ to predict constraints within that 49-firm sample in the period 1970–1984 (see, for example, Lamont, Polk, and Saa-Requejo 2001).

HP use a similar approach and consider a larger random sample of 356 firms for 1995–2004. They read the management's letter to shareholders and MD&A and group firms into categories of constraintedness based on the number and quality of statements indicating financial constraints. HP find that the KZ index is unstable and that only size and age robustly predict financial constraints. These results cast serious doubt on any attempt to measure constraints using potentially unstable reduced-form accounting relations. However, while characteristics such as size and age can identify firms that likely face high costs of external finance, this approach is limited in that many small and young firms might not be constrained. For example, some of these firms might take measures to circumvent constraints, such as increasing cash holdings. Moreover, whether a specific firm is constrained is also affected by its informational environment, and by factors such as technological shocks. Our approach identifies binding constraints using the firm's own verbal disclosures, without requiring a second-stage projection onto accounting variables.[2]

A second approach, exemplified by Whited (1992) and WW, is to explicitly model the relation between investment and the cost of external funds. A key advantage is the possibility of directly estimating the shadow price of external capital. A key limitation is that the theoretical assumptions can be restrictive, especially regarding the functional form of the shadow price of external finance. WW relate the shadow price to leverage, dividends, sales growth, firm size, liquid assets to total assets, and cash-flow to total assets. Later studies use the estimated coefficients out of sample to measure financial constraints (the WW index).[3]

Our approach is similar to KZ and HP as we rely on disclosures in the MD&A section of the 10-K to construct direct indices of financial constraints. However, our approach departs from both studies in three critical ways. First, we use automated textual analysis, and thus we can score the entire COMPUSTAT universe. We are not limited to a small random sample, and we do not have to rely on difficult-to-replicate human judgments. Second, we use the text directly, and we do not have to project our estimates of constraints onto any set of potentially unstable accounting variables or firm characteristics. This avoids potential loss of signal when the relation between constraints and the characteristics might change over time and especially in response to various shocks. Third, our use of direct verbal statements eliminates concerns regarding

[2] The approaches are also complementary, as demonstrated in the tables below. Our approach is consistent with the approach originally outlined by Kaplan and Zingales (1997) as applied to their hand-classified sample of forty-nine firms.

[3] It should be noted that WW do not use estimates out of sample in this way.

unstable model projections out of sample (our approach thus addresses a central HP critique).

The premise that our measures of financial constraints can be computed using firm disclosures in the 10-K are motivated by SEC regulations, specifically regulation S-K. We briefly discuss the regulation here and refer readers to Appendix A for a fuller treatment. SEC Regulation S-K obligates firms to discuss (1) challenges to their liquidity, (2) their demand for liquidity (investment plans), and (3) the sources of available liquidity. The term liquidity "refers to the ability of an enterprise to generate adequate amounts of cash to meet the enterprise's needs for cash...Liquidity generally shall be discussed on both a long-term and short-term basis.[4]" We find that firms widely comply and also discuss their issuance plans.

The framework offered by Kaplan and Zingales (1997) suggests that constrained firms face a wedge between the cost of internal capital and external capital. Our extension is based on the additional assumption that this wedge might be different in the equity market than in the debt market. Based on this assumption, therefore, we construct separate measures of financial constraints for each. We also note that regulation S-K requires firms to disclose the sources of liquidity they intend to tap. This allows us to compute market-specific constraint variables by identifying firms that both (1) indicate that they might have to delay their investment plans due to liquidity issues and (2) specifically intend to attempt to issue one of the two types of capital (equity or debt).

2. Data and Methods

The variables we create derive purely from 10-K text extracted from the "Management's Discussion and Analysis" (MD&A) section. We web-crawl and parse the MD&A section from each 10-K for all electronically filed 10-Ks from 1997 to 2009. From each MD&A, we then extract the Liquidity and Capital Resources subsection. This subsection's title is not fully uniform, and we explain in Appendix 1 of our Online Appendix how we unify subsections of similar content. This key subsection, which is also used by KZ, contains the firm's remarks concerning its financial liquidity and its intentions regarding future capital market interactions.

All of the text-extraction steps outlined in this paper can be programmed using familiar languages and web-crawling techniques. For convenience, we utilize text processing software provided by meta Heuristica LLC. The advantage of doing so from a research perspective is that the technology contains prebuilt modules for fast and highly flexible querying, while producing

[4] See http://www.ecfr.gov/cgi-bin/text-idx?SID=7772b55252984b0217bd2f5aa6e8fa97&node=se17.3.229_1303&rgn=div8 for the full text of Item 303 of Regulation S-K.

output that is easy to interpret.[5] For example, many of the variables used in this study are constructed by simply identifying which firm-year filings (within a set of 40,000+ filings) specifically contain a statement indicating that the firm may have to delay its investments due to financial liquidity issues.

2.1 Data

Our sample begins with the universe of Compustat firm-years with adequate data available between 1997 and 2009. We restrict the sample years based on availability of SEC Edgar data. After excluding financial firms and regulated utilities (SIC 6000–6999 and 4900–4949, respectively), and limiting the sample to firm-years with sales of at least $1 million and positive assets, we are left with 56,496 firm-years.

Our sample of 10-K MD&A's is extracted by web-crawling the Edgar database for all filings that appear as "10-K," "10-K405," "10-KSB," or "10-KSB40." MD&A generally appears as item 7 in most 10-Ks. The document is processed for text information, fiscal year, and the central index key (CIK).

We link each document to the CRSP/COMPUSTAT database using the central index key (CIK), and the mapping table provided in the WRDS SEC Analytics package. Of the 56,496 observations available in CRSP and COMPUSTAT database noted above, we are left with 52,438 after requiring that same-year machine-readable text data are available. The loss of these observations is due to two reasons: (1) a mapping from CIK to gvkey is not available or (2) some MD&As are not filed in the 10-K itself but are incorporated by reference. Of the 52,438 machine-readable MD&A sections, 44,441 of these also have a machine-readable Liquidity and Capitalization Resources subsection (henceforth CAP+LIQ). We later show that the firms that have a machine-readable MD&A, but do not have a separable CAP+LIQ, are generally healthy firms that have few if any liquidity issues to disclose.

2.2 Identifying constraints in different markets

Our first query identifies firms that discuss the possibility of delaying investment in CAP+LIQ. Because firms focus on liquidity issues in CAP+LIQ, it follows by context that these firms are curtailing investment due to challenges to the firm's liquidity. Indeed, some firms often state explicitly that poor financing options are to blame. Importantly, we do not identify investment curtailment anywhere else in the 10-K to ensure we focus solely on issues relating to financial liquidity.

Because there are many ways to verbally indicate the notion of investment curtailment, and many forms of investment, identifying a reliable set of firms

[5] For interested readers, the software implementation employs "Chained Context Discovery" (see Cimiano 2010 for details). The database supports advanced querying, including contextual searches, proximity searching, multivariant phrase queries, and clustering. These tools allow us to avoid writing our own routines to identify firms that directly indicate liquidity constraints even though firms might indicate this using different but related phrases.

that are curtailing investment using text searches offers several challenges. Using the two-sided sentence view features in the metaHeuristica software, we identify key synonyms to the word curtail, and a long list of words identifying types of investment. To identify firms that are directly reporting potential delays in investment, we query CAP+LIQ for instances in which one word from each of the following two lists exists side by side (separated by no more than one stop word, such as "the," "of," "and"). Note that "∗" denotes a wildcard.

Delay list 1: delay* OR abandon OR eliminate OR curtail OR (scale back) OR postpone*

Delay list 2: construction OR expansion OR acquisition* OR restructuring OR project* OR research OR development OR exploration OR product* OR expenditure* OR manufactur* OR entry OR renovat* OR growth OR activities OR (capital improvement*) OR (capital spend*) OR (capital proj*) OR (commercial release) OR (business plan) OR (transmitter deployment) OR (opening restaurants)

We refer to firms that trigger this query as the "precise training set." We find that 1.7% of all firm-year observations load on this query. However, in reading many other CAP+LIQ samples, we note that a large number of firms use words from both lists, but they are not necessarily side by side. This is a natural consequence of the interaction between liquidity and investment being a rather intricate issue to express verbally. We thus consider a generalized query that requires instead that both words appear within a twelve-word window of one another. We find that 5.5% of sample firms load on this enhanced query, and we refer to these firms as the "twelve-word-enhanced training set." By virtue of its larger size, the enhanced query training set allows us to identify the vocabulary used by constrained firms with greater accuracy because averages based on more data should help to minimize the influence of noise.

We also identify which firms are focused on issuing equity or debt. By using the two-sided sentence views available in metaHeuristica software, we identify a number of commonly used phrases that identify the intent to issue equity as follows:

Equity-focused list: issuing equity securities OR expects equity securities OR through equity financing OR sources equity financing OR seek equity investments OR seek equity financings OR access equity markets OR raised equity arrangements OR undertake equity offerings OR sell common stock OR issuing common stock OR selling common stock OR use equity offerings OR offering equity securities OR planned equity offering OR seek equity offering OR raise equity offering OR equity offering would add OR additional equity offering OR considering equity offering OR seek equity financing OR pursue equity offering OR consummates equity offering OR raises equity capital OR raise equity offering OR sources equity offering.

Regarding debt-focused firms, we consider the following commonly used phrases.

Debt-focused list: increased borrowings OR use line of credit OR expanded borrowings OR funded by borrowings OR additional credit lines OR incur additional indebtedness OR pursue lines of credit OR anticipates lines of credit OR through loan financing OR borrowings bond issue OR increase line of credit OR provided by credit facilities OR seek borrowing transaction OR raise borrowings OR additional bank financing OR raises debt capital OR secure line of credit OR borrowing of capital.

For both equity and debt focus, we also consider precise queries using these phrases directly, and expanded queries allowing these phrases to be expressed in a twelve-word window. For the precise query, we find that 1.0% and 3.4% of sample firms are equity and debt focused, respectively. When we use the twelve-word window, we find that 12.8% and 14.6% of sample firms are equity and debt focused, respectively.

Finally, we also identify which firms are focused on issuing private placements of equity. We require that one word from each of the following three lists be present within a twelve-word window in CAP+LIQ:

Private placement list 1: private

Private placement list 2: placement OR placements OR sale OR sales OR offering OR offerings OR infusion OR infusions OR issued OR issuance OR financing OR financings OR funding

Private placement list 3: equity OR stock

We find that 9.4% of the firms in our sample load on this query.

2.3 Degrees of financial constraints and scores

The approach outlined in previous section is binary, and firms that explicitly state that they face constraints are deemed to be in the constrained-firm training set. Those that do not make these direct statements are deemed to be fully unconstrained. This approach thus fails to recognize that the state of being constrained likely comes in shades and that some firms are highly constrained, some firms are somewhat constrained, and some firms might be sharply unconstrained.

To construct continuous measures of financial constraints, we use the cosine similarity method to score each firm's 10-K regarding how proximate its overall CAP+LIQ vocabulary is to that of the firms in each directly identified training set. Cosine similarities are computed as the inner product of two vectors: one characterizing the word usage in the firm's CAP+LIQ section and the other the word usage of firms in the specific training set (see Appendix B for more details). Thus, the method uses substantially all text from the whole CAP+LIQ subsection to more fully measure the magnitude of financial constraints. Cosine similarities are widely used in computational linguistics and also in applications

in finance and accounting. They have the benefits of being simple, easily replicated, and having built-in controls for document length.[6]

By computing the cosine similarity between the text in each firm's CAP+LIQ, and the average vocabulary used by firms hitting each of the constrained firm training sets discussed in the previous section, we thus compute four continuous constraint variables for each firm. These more informative constraint scores are then used in the remainder of this study: "Delay Investment Score," "Equity Focus Delay Investment Score," "Debt Focus Delay Investment Score," and the "Private Placement Focus Delay Investment Score." The former measures each firm's degree of overall financial constraints, and the latter three measure financial constraints uniquely faced by firms intending to issue equity, debt, and private placement securities, respectively. We also compute an analogously derived variable, "Covenant Violation Score," which measures the degree to which each firm is likely to report covenant violations in its 10-K.

In a final step, we purge each constraint variable of two types of boilerplate content: (1) content that is in all CAP+LIQ sections in a given year (likely due to SEC filing requirements) and (2) content that is used by all firms in each industry in each year (likely due to common but uninformative industry statements). Our final constraint variables are defined to be orthogonal to these measures of boilerplate, which sharpens their focus on informative content. Technical details regarding the implementation of the cosine similarity calculations and boilerplate adjustments are described in Appendix B.

2.4 Policy variables

We examine two investment policies R&D/sales, CAPX/sales, and three financing policies public SEO issuance/assets, private SEO issuance/assets, and long-term debt issuance/assets. The focus on long-term debt is consistent with the definition of the financial deficit in the literature, for example, Frank and Goyal (2003). The R&D, CAPX, and debt issuance variables are constructed directly from COMPUSTAT data. Regarding debt issuance, we consider newly issued long-term debt (COMPUSTAT DLTIS), scaled by assets. For both public and private SEOs, we use data from SDC Platinum as our intent is to identify equity issues made through public markets, where equity constraints are most likely to be binding. All five policy variables are winsorized at the 1%/99% level to control for outliers. We also winsorize financial variables that are defined as ratios at the 1%/99% level. We also include controls for log firm age and size (log assets) in all of our specifications. Thus, the results we report go beyond those identified by Hadlock and Pierce (2010).

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[6] See Sebastiani (2002), Hoberg and Phillips (2010b), and Brown and Tucker (2011) for examples of studies that use the cosine similarity method in computational linguistics, finance, and accounting, respectively.

3. Financial Constraints

In this section, we first examine the properties of our constraint variables in the time series and cross-section. We then compare them to measures used in the literature.

The Online Appendix to this paper contains three detailed appendices outlining (1) the heterogeneity in subsection names regarding subsections that are analogous to Liquidity and Capital Resources, (2) ten sample firms from each of our sample years that scored highly on our financial constraint measures along with their Fama-French-48 industries, and (3) sample paragraphs from the CAP+LIQ section of the firms with high constraint scores. Based on the Online Appendix, we note that many constrained firms are in the drug and technology industries. An interesting exception is that home builder Toll Brothers was financially constrained in 2005 and 2006 exactly when valuations were high, but not in later years when, arguably, this industry was more in distress than it was financially constrained. Regarding the sample paragraphs, the examples show that the text queries are highly reliable in terms of identifying firms that acknowledge the possibility of delaying their investments in CAP+LIQ. However, the results also show that the queries are not fully perfect, as occasional "difficult to parse" 10-Ks such as Gliatech's 1997 10-K can add some noise to our calculations. However, because we focus on average word distributions across hundreds of firms to form the vocabulary of the training sets, we do not believe this low level of noise is problematic.

3.1 Summary statistics and correlations

Table 1 displays summary statistics for our 1997 to 2009 panel of 52,438 firm-year observations having machine-readable MD&A sections in their 10-K. Panel A shows that 85.1% of these firms also have a machine-readable CAP+LIQ subsection. Because we require a CAP+LIQ section to compute our key variables, we conduct our empirical analysis in two stages: (1) we examine which firms have a distinct CAP+LIQ section, and (2) among those that do, we explore the nature of financial constraints. In later sections, our results will suggest that the firms that do not include a CAP+LIQ section are primarily unconstrained firms. As a result, the fact that we focus on firms that do have CAP+LIQ is unlikely to be problematic because the primary challenge in the literature is to identify constrained firms rather than unconstrained firms.

Panel B reports summary statistics regarding the membership of our precise training sets, and panel C reports summary statistics regarding the members of our twelve-word-expanded training sets. Not surprisingly, expanding the text queries to twelve words greatly improves coverage. For example, coverage increases from 1.7% to 5.7% for delay investment constraints. The larger training sets offer improved power.

Panel D reports summary statistics for our score-based constraint variables, and panel E reports summary statistics related to covenant violation score and

Table 1
Summary statistics

Variable	Mean	SD	Min.	Median	Max.	# Obs.
Panel A: MD&A content (firms with MD&A section)						
Has Cap+Liq subsection dummy	0.851	0.356	0.000	1.000	1.000	52,438
Panel B: Precise text constraint declarations (firms with Cap+Liq section)						
Delay investment text	0.017	0.129	0.000	0.000	1.000	44,441
Equity-focused text	0.010	0.100	0.000	0.000	1.000	44,441
Debt-focused Text	0.036	0.185	0.000	0.000	1.000	44,441
Panel C: twelve-word text constraint declarations (firms with Cap+Liq section)						
Delay investment text	0.057	0.232	0.000	0.000	1.000	44,441
Equity-focused text	0.132	0.339	0.000	0.000	1.000	44,441
Debt-focused text	0.146	0.353	0.000	0.000	1.000	44,441
Private-placement foc. text	0.161	0.368	0.000	0.000	1.000	44,441
Panel D: Text constraint scores (firms with Cap+Liq section)						
Delay investment score	−0.010	0.093	−0.200	−0.020	0.279	44,441
Equity-focused score	−0.013	0.091	−0.197	−0.023	0.293	44,441
Debt-focused score	0.001	0.058	−0.150	−0.004	0.193	44,441
Private-placement foc. score	−0.005	0.081	−0.177	−0.013	0.264	44,441
Panel E: Other text variables (firms with Cap+Liq section)						
Covenant violation score	0.003	0.094	−0.230	−0.007	0.405	44,441
Log # words in Cap+Liq section	8.280	0.865	3.951	8.394	11.315	44,441
Panel F: Corporate policy variables						
R&D/sales	0.191	0.779	0.000	0.000	11.218	52,438
CAPX/sales	0.117	0.328	−0.000	0.035	5.243	52,438
Public SEO issuance/assets	0.014	0.072	0.000	0.000	0.767	52,438
Private SEO issuance/assets	0.004	0.030	0.000	0.000	0.351	52,438
Debt issuance/assets	0.109	0.229	0.000	0.000	1.669	52,438

Summary statistics for firms with machine-readable 10-Ks, and having machine-readable Management's Discussion and Analysis. Observations are from 1997 to 2009. We discard all financials, and require COMPUSTAT data coverage in the current and past year. We also discard firms with zero assets or zero sales, and require valid text data to be available. Please see Section 2 for a description of variables. All nonbinary variables are winsorized at the 1%/99% level.

the size of the CAP+LIQ section. Because the construction of these variables controls for boilerplate content, intuitively, these scores are relative rankings and have means near zero. These variables measure the degree to which the given firm's CAP+LIQ section is similar to that of firms in each respective training set. This approach provides a measure of the degree to which a firm is constrained.

Panel F reports summary statistics for the five corporate finance policies we examine. These results suggest that firms in our sample spend an average of 19.1% of their sales on R&D and 11.7% of their sales on CAPX. Public and private SEO equity issuance average 1.4% and 0.4% of assets, respectively. Long-term debt issuance averages 10.9% of assets.

Table 2 reports Pearson correlation coefficients between our financial constraint variables and other constraint variables, including the KZ index and the WW index. We first note that our delay investment score is 91.8% correlated with the equity focus delay score. This strong correlation foreshadows a major

Table 2
Pearson correlation coefficients (investment and constraint measures)

Variable	Delay invest. score	Equity-focused score	Debt-focused score	Private-placement focused score	Covenant viol. score	KZ index	WW index	Size (log assets)
Correlation coefficients								
Equity-focused delay score	0.918							
Debt-focused delay score	−0.062	−0.144						
Private-placement foc. delay score	0.422	0.627	−0.518					
Covenant violation score	−0.070	−0.114	0.782	−0.520				
KZ index	−0.054	−0.097	0.190	−0.204	0.199			
WW index	0.085	0.139	−0.156	0.197	−0.099	−0.012		
Log assets	−0.030	−0.091	0.174	−0.162	0.110	0.079	−0.903	
Log firm age	−0.156	−0.180	0.063	−0.180	0.058	0.072	−0.285	0.364

This table displays Pearson correlation coefficients between various measures of financial constraints. We include our four constraint variables based on investment delay, equity-focused delay, debt-focused delay, and private-placement-focused delay. We also include the covenant violation score. In addition to the text variables, we include correlations with firm size, firm age, the KZ index, and the WW index. Please see Section 2 for a description of variables.

conclusion of our study: constraints are most severe for firms that are focused on the equity markets relative to those focused on the debt markets.

We also find that our delay investment score is positive but only modestly correlated with the WW index (8.5%) and is weakly negatively correlated with the KZ index (−5.4%). We also note that the WW index is more correlated with our equity focus constraint variable, and the KZ index is more correlated with our debt focus constraint variables. These findings suggest that the two measures might be measuring different types of constraints, which might explain why other studies report differential performance for the two measures. We also note that delay investment score is negatively correlated with both size and age. However, these correlations are somewhat modest at −3.0% and −15.6%. This foreshadows a second major finding of our study: our constraint variables (1) are consistent with the conclusion of Hadlock and Pierce (2010) that constrained firms tend to be smaller and younger, but (2) our variables also contain a significant amount of information that goes beyond the conclusions of HP as many smaller and younger firms appear to be unconstrained and some medium sized firms appear to be constrained.

Also relevant, our debt market constraint variable correlates positively with the Covenant Violation Score (78.2%). This suggests that firms that are constrained in that debt market are also struggling to meet contractual obligations. However, our other constraint variables are somewhat negatively correlated with covenant violations, further indicating that constraints in the equity and debt markets are likely different.

Although not reported to conserve space, we note that our financial constraint variables are somewhat persistent, but not overwhelmingly so. Our three key textual constraint variables have autocorrelation coefficients that range from 0.4 to 0.6. Hence, a firm that is constrained in a given year is quite likely to be constrained the next year, but it is unlikely to be still constrained two to three

years later. Our measures thus appear to capture the dynamics of constraints in a reasonable way.

Figure 3 displays the time-series average for our delay investment constraint. We display results for all firms (upper figure), and for firms with December fiscal year endings (lower figure). The figures show a jump in reported constraints in 2008, the year of the financial crisis. Despite the small number of annual observations, the jump is large, and it is statistically significant at the 5% level. Also noteworthy, we observe a decline in reported constraints in 2003. This decline is likely due to either (1) the SEC's release of the new MD&A guidance in late 2003 or (2) the fact that economic conditions were improving rapidly from 2002 to 2003 as financial markets rebounded following the technology collapse of 2000 and the terrorist attacks in September 2001. In all, the persistence levels and the aggregate time series results illustrate that our constraint measures are dynamically managed by firms as their liquidity changes, and they are not a form of boilerplate content that is held fixed in filings from year to year.

3.2 Firm characteristics and constraints

We begin our analysis by assessing which firms have a machine-readable CAP+LIQ subsection in their MD&A in a given year. Our summary statistics indicate that 85.1% of firms have this subsection, and we conjecture that only unconstrained firms would omit this content. This conjecture is based on the fact that disclosure of liquidity is required by law, and only unconstrained firms might have sufficiently little to disclose to warrant not doing so in a separate subsection. In our Online Appendix 4, we formally test this conjecture using a logistic regression in which the dependent variable is a dummy equal to one when the firm has a CAP+LIQ subsection. We include firm and year fixed effects, and all standard errors are adjusted for clustering by firm. The results confirm that firms disclosing a CAP+LIQ subsection indeed are more likely to be constrained (these firms are smaller, younger, and are less likely to pay dividends). Because we are primarily interested in examining constrained firms, the remainder of this paper focuses only on the sample of firms that have a machine-readable CAP+LIQ subsection.

In Table 3, we consider panel data regressions in which we explore the association between various firm and industry level characteristics, and our four constraint variables (delay investment constrained, equity-market constrained, debt-market constrained, and private-placement-constrained) plus controls for the size of the CAP+LIQ section, firm size, and firm age. Although we report results for all four constraint variables in columnar form on the same table, in order to characterize each variable independently, we run regressions separately for each constraint variable. In all regressions, we include the same controls, and we report the control variable coefficients for the first regression that includes the delay investment constraint as these coefficients do not change materially

Figure 3
Firms mentioning delay investment constraints over time based on the twelve-word window. The upper figure displays the fraction of firms mentioning delay investment constraints for the entire sample, and the lower figure displays this fraction only for firms with December fiscal year endings. The increase in constraints in the year 2008 is statistically significant at the 1% level in both figures.

Table 3
Firm characteristics and constraint variables

Row	Dependent variable	Delay invest score	Equity-focused score	Debt-focused score	Private-placement score	Log # words in CAP+LIQ	Log Firm age	Log assets	# Obs. / RSQ
(1)	Tobin's q (industry specific)	1.757	2.527	−3.461	3.701	0.034	−0.120	−0.025	35,262
		(18.71)	(24.85)	(−25.25)	(32.86)	(3.83)	(−13.35)	(−4.54)	0.389
(2)	Tobin's q (firm specific)	0.739	1.414	−1.973	2.640	−0.000	−0.100	−0.053	35,262
		(4.05)	(7.14)	(−8.24)	(12.13)	(−0.00)	(−6.35)	(−4.74)	0.014
(3)	Dividend payer (industry specific)	−0.204	−0.270	0.427	−0.421	−0.013	0.025	0.015	35,262
		(−10.94)	(−13.35)	(15.15)	(−18.99)	(−6.14)	(11.31)	(11.79)	0.390
(4)	Dividend payer (firm specific)	−0.109	−0.031	−0.618	0.212	−0.019	0.046	0.042	35,262
		(−3.14)	(−0.86)	(−10.92)	(5.37)	(−4.65)	(10.94)	(16.50)	0.086
(5)	oi/sales (industry specific)	−0.451	−0.586	0.561	−0.746	−0.019	0.018	0.012	35,262
		(−21.93)	(−26.65)	(21.62)	(−31.80)	(−10.31)	(9.79)	(10.58)	0.491
(6)	oi/sales (firm specific)	−2.060	−2.794	1.762	−3.199	−0.087	0.081	0.094	35,262
		(−14.76)	(−18.30)	(12.05)	(−20.17)	(−8.42)	(8.43)	(16.38)	0.114
(7)	oi/assets (industry specific)	−0.264	−0.354	0.368	−0.469	−0.012	0.013	0.009	35,262
		(−21.26)	(−26.43)	(22.85)	(−33.03)	(−9.95)	(11.40)	(12.11)	0.472
(8)	oi/assets (firm specific)	−0.318	−0.445	0.110	−0.461	−0.021	0.004	0.045	35,262
		(−14.13)	(−18.04)	(3.94)	(−16.65)	(−10.61)	(2.26)	(28.07)	0.143
(9)	cash/assets (industry specific)	0.152	0.208	−0.323	0.322	0.005	−0.010	−0.005	35,262
		(18.35)	(23.63)	(−28.21)	(34.18)	(6.65)	(−11.64)	(−9.80)	0.490
(10)	cash/assets (firm specific)	0.020	0.048	−0.349	0.222	−0.007	−0.007	−0.012	35,262
		(1.39)	(3.20)	(−17.80)	(14.16)	(−5.58)	(−5.60)	(−15.40)	0.038
(11)	Book leverage (industry specific)	−0.067	−0.097	0.273	−0.208	−0.000	0.004	0.006	35,262
		(−7.66)	(−10.51)	(19.43)	(−20.47)	(−0.02)	(4.21)	(10.40)	0.466
(12)	Book leverage (firm specific)	0.102	0.085	0.657	−0.198	0.028	−0.004	0.015	35,262
		(4.78)	(3.83)	(21.37)	(−8.25)	(12.29)	(−1.67)	(11.72)	0.045
(13)	Market leverage (industry specific)	−0.085	−0.121	0.270	−0.231	−0.001	0.005	0.005	35,262
		(−10.78)	(−14.50)	(21.78)	(−24.83)	(−1.12)	(6.11)	(9.09)	0.476
(14)	Market leverage (firm specific)	0.044	0.006	0.560	−0.244	0.021	−0.003	0.011	35,262
		(2.94)	(0.38)	(24.19)	(−14.27)	(12.65)	(−1.94)	(11.91)	0.046
(15)	CAPX/sales (industry specific)	0.427	0.529	−0.329	0.538	0.019	−0.021	−0.003	35,262
		(19.97)	(23.07)	(−10.28)	(20.99)	(9.70)	(−10.03)	(−2.17)	0.457
(16)	CAPX/sales (firm specific)	−0.052	−0.061	0.079	−0.043	−0.002	−0.011	0.011	35,262
		(−1.80)	(−1.93)	(1.99)	(−1.31)	(−0.73)	(−3.89)	(7.61)	0.075
(17)	R+D/sales (industry specific)	2.330	3.081	−2.371	3.677	0.091	−0.064	−0.052	35,262
		(15.60)	(18.47)	(−13.75)	(20.46)	(6.82)	(−5.07)	(−6.59)	0.484
(18)	R+D/sales (firm specific)	−0.811	−1.079	1.020	−1.341	−0.028	0.018	0.022	35,262
		(−6.23)	(−7.46)	(7.17)	(−9.34)	(−2.40)	(1.86)	(3.21)	0.288

This table displays the results of OLS regressions in which the dependent variable is specified by row. This panel only includes firms (85.1% of all firms) that have a machine-readable CAP+LIQ section. Industry-specific variables are computed using TNIC industries as in Hoberg and Phillips (2010b). Firm-specific components are computed as a firm's raw value for the specific characteristic minus the industry value. All regressions include time and three-digit SIC fixed effects. Although we report results for all four constraint variables in columnar form on the same table, we run regressions separately for each constraint variable due to their nontrivial correlations. In all regressions, we include the same control variables, and we report the control variable coefficients for the first regression that includes the delay investment constraint variable as these coefficients do not change materially when different constraint variables are included. We report results using this compact format to conserve space. All standard errors are adjusted for clustering by firm.

when different constraint variables are included. We use this compact format to conserve space.

The results of Table 3 are consistent with our delay investment constraint variable indeed being a valid measure of financial constraints. We highlight three major pieces of evidence, but also note other nuances. First, the table shows that firms with high delay investment scores operate in industries with high q. This is consistent with these firms having good investment opportunities, a necessary requirement for binding financial constraints (a firm must have a promising investment before it can delay it). This result also confirms that financial constraints and distress are distinct concepts, as distressed firms intuitively have low q. Second, we find that the delay investment score is negatively correlated with profitability, consistent with these firms having little in the way of free cash-flow.

The third major finding regarding the delay investment variable is that it is positively related to both capital expenditures and R&D at the industry level. This again supports the existence of good investment projects as a necessary condition for financial constraints to be binding. More striking, the delay investment variable is negatively related to own-firm R&D and own-firm CAPX. This supports another direct prediction of financial constraints: constrained firms likely have low investment relative to what would be optimal if they had perfect liquidity (so the constrained firm in an industry invests less than its industry peers). Finally, we note that these findings are statistically significant. In all cases, standard errors are adjusted for clustering by firm.

Table 3 also shows that equity market and debt market constraints are different. For example, many coefficients (including those for cash and leverage at the industry level) have opposite signs for these two variables. The overall coefficient patterns also show that equity market constrained firms are similar but more extreme variants of delay investment constrained firms. These firms have high q, little in the way of current profits, and hence they are more growth oriented. Regarding investment policy, they also reside in product markets with high levels of R&D, although their own-firm R&D is lower than the industry average. These firms also reside in product markets where firms tend to hold high levels of cash, consistent with precautionary savings relating to financial constraints. The link to R&D is also consistent with a role for asymmetric information in financial constraints, especially for equity market constrained firms, a link we find more evidence for later.

In contrast, firms that are debt market constrained are in product markets with below average q, and these firms have lower q relative to their industry peers. These firms also hold less cash and have higher leverage. In all, these firms, unlike equity market constrained firms, have some resemblance to distressed firms given their higher leverage and lower q's. These firms also reside in industries where investment tends to be below average, but at the same time, these firms are investing more than their industry peers. This provides some initial evidence suggesting that debt constrained firms are likely challenged

by high existing debt burdens, and find it difficult to fund their investment opportunities due to excess liabilities.

The results for the private-placement-focused score are similar overall to those for the equity-focused score. Intuitively, equity private-placement-focused constrained firms are essentially more extreme versions of equity-focused constrained firms. In all, our results support the conclusion that our delay investment variable measures the degree of constraints, and our equity and debt constraint variables affirm that both forms of capital play unique roles in financial constraints.

4. Investment Policy and Financial Constraints

In this section, we examine whether firms with higher levels of financial constraints react to negative shocks differently than do unconstrained firms. We consider two types of investment expenditures – CAPX and R&D expenditures – and two forms of external financing — equity and debt financing. While historically the literature on constraints has focused on examining financing of CAPX expenditures, the financing of R&D is more likely to be subject to the constraints, both because R&D is less tangible and less certain, and because R&D focused firms are often small and young and lack a well-established track record.[7]

We consider three shock variables as independent variables in our initial policy regressions: the 2008–2009 financial crisis, the 2001–2002 technology collapse, and exogenous mutual fund selling shocks following Edmans, Goldstein, and Jiang (2012). Our shock framework parallels that of Opler and Titman (1994), who examine the effect of a macroeconomic shock on distressed firms.

A central hypothesis in the literature is that constrained firms should more aggressively curtail issuance and investment activities following unexpected negative shocks, as their constraints likely become more binding in times of hardship. Table 4 displays the economic magnitudes regarding the degree of policy curtailment experienced by firms in various groups when they experience each of the three shocks discussed above. For the financial crisis, the value after the shock is the firm's value of the policy in 2009, and the pre-shock value is the firm's value of the given policy in 2007. For the technology collapse, we only consider technology firms as defined by Loughran and Ritter (2004), and the value after the shock is the firm's value of the policy in 2002, and the preshock value is the firm's value of the given policy in 2000.

For forced mutual fund selling, we define shocked firms in each year as firms in the top decile of forced mutual fund selling. The firm's value of a given policy before the shock is thus the value of the policy in the year prior to the mutual

[7] Brown, Fazzari, and Petersen (2009) discuss factors that make financing R&D expenditures more susceptible to constraints.

Table 4
Investment policies versus constraint cross terms (economic magnitudes)

Constraint variable and tercile (1 to 3)	Change in R&D/sales	Change in CAPX/sales	Change in pub SEO issuance /assets	Change in priv SEO issuance /assets	Change in debt issuance /assets
Panel A: Financial crisis change from 2007 to 2009					
Delay constraint 1	−0.002	−0.024	−0.000	−0.003	−0.030
Delay constraint 2	−0.050	−0.056	−0.008	−0.002	−0.033
Delay constraint 3	−0.160	−0.115	0.005	−0.008	−0.044
Equity-focus delay 1	−0.003	−0.029	0.001	−0.003	−0.037
Equity-focus delay 2	−0.024	−0.049	−0.009	−0.001	−0.026
Equity-focus delay 3	−0.185	−0.117	0.005	−0.010	−0.045
Debt-focus delay 1	−0.109	−0.047	0.005	−0.003	−0.012
Debt-focus delay 2	−0.073	−0.066	−0.003	−0.008	−0.041
Debt-focus delay 3	−0.031	−0.082	−0.005	−0.003	−0.054
Private-placement focus delay 1	0.001	−0.033	−0.002	−0.002	−0.037
Private-placement focus delay 2	−0.017	−0.070	−0.003	−0.002	−0.038
Private-placement focus delay 3	−0.196	−0.091	0.001	−0.009	−0.032
Panel B: Tech bust change from 2000 to 2002					
Delay constraint 1	−0.031	−0.056	−0.005	0.006	0.009
Delay constraint 2	−0.015	−0.114	−0.044	0.004	−0.007
Delay constraint 3	−0.159	−0.205	−0.042	0.006	−0.004
Equity-focus delay 1	−0.018	−0.054	−0.020	0.005	0.008
Equity-focus delay 2	−0.009	−0.110	−0.026	0.004	−0.010
Equity-focus delay 3	−0.177	−0.212	−0.045	0.006	0.001
Debt-focus delay 1	−0.142	−0.188	−0.057	0.006	0.016
Debt-focus delay 2	−0.032	−0.122	−0.020	0.004	−0.004
Debt-focus delay 3	−0.031	−0.065	−0.014	0.005	−0.013
Private-placement focus delay 1	−0.011	−0.064	−0.012	0.006	−0.017
Private-placement focus delay 2	−0.048	−0.106	−0.035	0.002	0.006
Private-placement focus delay 3	−0.146	−0.206	−0.044	0.008	0.010
Panel C: One-year response to mutual fund selling shock					
Delay constraint 1	0.003	−0.004	−0.028	0.000	−0.007
Delay constraint 2	−0.021	−0.029	−0.030	−0.001	−0.010
Delay constraint 3	−0.091	−0.071	−0.058	−0.000	−0.005
Equity-focus delay 1	−0.000	−0.008	−0.020	−0.001	−0.010
Equity-focus delay 2	−0.008	−0.017	−0.033	−0.000	−0.005
Equity-focus delay 3	−0.102	−0.079	−0.062	−0.000	−0.007
Debt-focus delay 1	−0.081	−0.053	−0.047	−0.001	−0.001
Debt-focus delay 2	−0.020	−0.007	−0.044	−0.001	0.003
Debt-focus delay 3	−0.008	−0.044	−0.025	0.001	−0.024
Private-placement focus delay 1	0.005	−0.012	−0.015	−0.000	0.002
Private-placement focus delay 2	−0.016	−0.034	−0.027	0.002	−0.025
Private-placement focus delay 3	−0.098	−0.058	−0.074	−0.003	0.001

Economic magnitudes of interactions between policy variables and constraint variables during each of the two shocks considered in this paper. We consider the three shocks as noted in panels A to C. For each shock, we consider the change in each policy following the shock, and we separately do so for firms sorted into quintiles in each year based on their ex ante constraint values. For the financial crisis, we consider the change in each variable from 2007 to 2009. For the technology bust, we only consider technology firms as defined by Loughran and Ritter (2004), and we consider the change in each variable from 2000 to 2002. For the mutual fund selling shock, we consider firms in the highest tercile of mutual fund selling in each year, and then we consider two-year changes in each policy in the subsequent two years, also for firms sorted into terciles based on their ex ante constraint variables. Note that because each of the policy variables is scaled by sales or assets, the reported mean changes are in fractional units of sales or assets, respectively.

fund selling, and the postshock value is the value of the given policy at the end of the year during which the shock arrived. Because each of the policy variables is scaled by sales or assets, the reported mean changes are in fractional units of sales or assets, respectively.

The table shows that constrained and unconstrained firms react differentially to shocks, and that these differences are economically large. For example, the highest tercile delay constrained firms curtailed R&D by 16.0% of sales in the financial crisis of 2008-2009, whereas the lowest tercile firms reduced R&D by only 0.2% of sales. This inter-tercile range of 15.8% is an economically large 20.3% of one standard deviation (the cross sectional standard deviation of R&D/sales is 78%).[8] On the CAPX side, constrained firms curtailed CAPX by 11.5% of sales, and low constraint firms by just 2.4%.

Panel B of Table 4 displays results for the technology bust of 2001–2002. The results are only based on technology firms, as defined by Loughran and Ritter (2004). The results for R&D and CAPX are similar to those in panel A, which suggests that our results are not unique to any one shock. However, we also note that public SEO issuance curtailment was more severe for constrained firms during the tech bust in panel B than in panel A. One likely explanation is timing, as public SEOs likely became more popular in late 2009 when equity markets rebounded.

Panel C of Table 4 displays results for the forced mutual fund selling shock. The results are again consistent with those of the financial crisis and the technology bust, although the economic magnitudes are smaller. In particular, the most constrained firms curtail their R&D and CAPX more than the less constrained firms. We also find evidence that constrained firms curtailed public SEO issuance more than do unconstrained firms. This finding regarding SEOs is particularly noteworthy because the forced mutual fund shock is designed to be an instrument specifically for equity market liquidity. In particular, non-sector-specific mutual fund selling creates downward price pressure only on a firm's stock (and thus poor equity market liquidity for issuance). Hence we expect both the curtailment of SEO issuance and investment spending, which is what we find.

Overall, the nonparametric tests in Table 4 illustrate that our constraint variables indeed conform to the predictions that, at the time of large negative shocks, financial constraints predict reductions in investment and financing activity. Our next tests, which consider shock-response regressions, confirm these univariate conclusions.

4.1 Shock-response regressions

We now examine the link between constraints and firm investment and issuance policies using a shock-response approach. As in Table 4, we consider firm

[8] This result is also not influenced by outliers as we winsorize R&D/sales at the 99% level.

responses to three shocks: the financial crisis of 2008–2009, the tech bust of 2001–2002, and firms in the highest decile of forced mutual fund selling shocks in each year. We consider firm responses through the lens of the following five policies: R&D/sales, CAPX/sales, public SEO issuance/assets, private SEO issuance/assets, and debt issuance/assets. The central prediction is that constrained firms should curtail both investment policies and issuance policies more than unconstrained firms following all three shocks. The goal of these tests is to further illustrate the information content of our constraint variables as indeed measuring financial constraints. We also use this framework to compare the performance of our measures to other constraint variables such as the Whited-Wu Index (WW Index) and the Kaplan-Zingales Index (KZ Index).

We also consider whether our constraint variables contain information beyond the findings of Hadlock and Pierce (2010) (henceforth HP), who also consider the verbal content in 10-Ks through a different channel. Our approach is to take the central conclusion of HP as our starting point. HP conclude that size and age are the best measure of financial constraints. Hence, in all of our shock-response regressions, we include controls for size and age. If our constraint variables are indeed informative beyond HP, we expect strong results for our constraint variables even when size and age are included as controls.

Our shock-response framework is based on the difference in each firm's policies before and after a given shock. We note that our difference-based approach implicitly accounts for firm fixed effects as they are differenced out.[9] For each of the policies we consider, such as R&D/sales, we take the change in the given policy as the dependent variable. Our primary independent variable is the given constraint variable being tested (we consider the four text-based constraint variables, the WW index and the KZ index). We also include controls for log assets, log firm age, Tobin's q, sales growth, and industry sales growth.[10] Inclusion of q and sales growth in the equation ensures that our constraint variables are not picking up a q effect rather than a constraint effect. Given that the dependent variable is a difference in the level of a policy subsequent to a shock, we do not make predictions on the sign of the Tobin's q variable.

4.1.1 Financial crisis shock response regressions. Table 5 displays the results of our shock-response regressions for the 2008-2009 financial crisis shock. Each row displays the results of a regression in which the dependent variable is one of the five policy variables as noted in the first column. The independent variable coefficients are then displayed in the latter four columns.

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[9] We also note that Erickson and Whited (2012) find some evidence that investment regressions are not sensitive to inclusion or noninclusion of firm fixed effects.

[10] We do not include controls for sales growth or industry sales growth in regressions in which we consider the WW Index in order to reduce the impact of multicollinearity as variance inflation approaches seven to eight in such specifications. We note that alternatively removing log assets from the regression produces similar inferences. This regression is prone to multicollinearity due to the fact that some of the control variables are inputs into the computation of the WW index itself.

Table 5
Investment and issuance policy reactions to the financial crisis (2008–2009)

	Dependent variable	Lagged constraint variable	Lagged log assets	Log firm age	Lagged Tobin's q	Lagged sales growth	Lagged industry sales growth
Panel A: Constraint index = delay investment score							
(1)	Δ R&D/sales	−0.029***	0.031***	0.009	−0.053***	0.026***	−0.081***
(2)	Δ CAPX/sales	−0.012**	−0.010**	0.022***	0.007	−0.024***	−0.034***
(3)	Δ Public SEOs	0.002	−0.005**	0.008***	−0.002	−0.002	0.008***
(4)	Δ Private SEOs	−0.002***	0.003***	0.002**	−0.001	−0.004***	−0.002***
(5)	Δ Debt issues	−0.004	−0.008*	0.010**	0.009*	−0.014***	−0.005
Panel B: Constraint index = equity focus delay							
(6)	Δ R&D/sales	−0.044***	0.030***	0.007	−0.050***	0.027***	−0.078***
(7)	Δ CAPX/sales	−0.012**	−0.011**	0.022***	0.007	−0.024***	−0.034***
(8)	Δ Public SEOs	0.002	−0.005**	0.009***	−0.002	−0.002	0.007***
(9)	Δ Private SEOs	−0.003***	0.003***	0.001*	−0.001	−0.004***	−0.002***
(10)	Δ Debt issues	0.000	−0.008*	0.011**	0.009*	−0.014***	−0.005
Panel C: Constraint index = debt focus delay							
(11)	Δ R&D/sales	0.004	0.027***	0.016*	−0.053***	0.025***	−0.084***
(12)	Δ CAPX/sales	−0.006	−0.011**	0.024***	0.005	−0.024***	−0.036***
(13)	Δ Public SEOs	−0.003	−0.004**	0.008***	−0.002	−0.001	0.008***
(14)	Δ Private SEOs	−0.001	0.003***	0.002***	−0.001*	−0.004***	−0.003***
(15)	Δ Debt issues	−0.013***	−0.007	0.010**	0.006	−0.014***	−0.006
Panel D: Constraint index = private placement focus delay							
(16)	Δ R&D/sales	−0.060***	0.028***	0.004	−0.042***	0.027***	−0.075***
(17)	Δ CAPX/sales	−0.003	−0.011**	0.024***	0.007	−0.024***	−0.035***
(18)	Δ Public SEOs	0.002	−0.005**	0.008***	−0.002	−0.002	0.007***
(19)	Δ Private SEOs	−0.003***	0.003***	0.001*	0.000	−0.004***	−0.002***
(20)	Δ Debt issues	0.006	−0.008*	0.012***	0.007	−0.014***	−0.006
Panel E: Constraint index = KZ index							
(21)	Δ R&D/sales	0.014	0.028***	0.014	−0.056***	0.025***	−0.084***
(22)	Δ CAPX/sales	−0.016***	−0.011**	0.025***	0.004	−0.024***	−0.037***
(23)	Δ Public SEOs	−0.002	−0.005**	0.009***	−0.002	−0.002	0.009***
(24)	Δ Private SEOs	−0.001	0.004***	0.002***	−0.001	−0.004***	−0.003***
(25)	Δ Debt issues	0.000	−0.010**	0.011**	0.009*	−0.014***	−0.003
Panel F: Constraint index = WW index							
(26)	Δ R&D/sales	−0.180***	−0.130***	0.007	−0.066***		
(27)	Δ CAPX/sales	0.003	−0.009	0.030***	−0.005		
(28)	Δ Public SEOs	0.011**	0.005	0.008***	0.000		
(29)	Δ Private SEOs	0.000	0.003**	0.003***	−0.002***		
(30)	Δ Debt issues	−0.013	−0.020**	0.012**	0.005		

OLS change regressions for investment and issuance policies. The sample includes all firms that exist in our sample from 2007 to 2009. The dependent variable is each firm's change in R&D/sales, CAPX/ sales, public SEO issuance/assets, private SEO issuance/assets, and debt issuance/assets as noted in the first column. The independent variables are ex ante measurable and are constructed using 2007 data. The change in the dependent variables is from 2007 to 2009, bracketing the financial crisis. We examine a different constraint index as noted in each panel header. Because the regressions are based on changes and contain a single change observation for each firm, our results are already clustered by firm and firm effects are differenced out. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Each panel considers a different lagged constraint variable and this is noted in the panel headers. For example, panel A considers the delay investment constraint variable.

Panel A of Table 5 shows that constrained firms, as measured using our delay investment text-based variable, significantly curtail R&D, CAPX, and private SEO issuance during the financial crisis more than less constrained firms. These results are significant at the 5%, and the 1% level. These results cannot be explained by size, age, Tobin's q, or sales growth. We find similar results for equity focus constrained firms and private placement constrained firms in panels B and D. Debt focus constrained firms in panel C, on the other hand, significantly curtail their debt issuance policies during the crisis, but do not significantly curtail investment policies. These results suggest that equity-focused firms face more binding constraints than do debt-focused firms, a main result of our paper. These results also support the conclusion that our constraint variables are indeed valid measures of financial constraints.

We next consider the KZ index and the WW index in panels E and F. We find weak results in both cases. Regarding the KZ index, constrained firms curtail CAPX during the crisis, but the other policies are not significant. Regarding the WW index, firms curtail their R&D spending but increase their public SEO issuances. We conclude that the text based measures perform in a way that is more consistent with measuring financial constraints.

Regarding the predictions of Hadlock and Pierce (2010), we consider the results for the size and age controls. We find strong support for HP through the firm age control, as younger firms significantly curtail all policies with the exception of R&D more than older firms do. However, the results for firm size are mixed. Small firms curtail R&D and private SEOs more than large firms, but they increase CAPX, public SEOs, and debt issuance relative to large firms. Overall, we view these findings as supportive of HP. However, we note that our text-based constraint variables contain unique information about constraints that is not captured by size and age.

One potential concern regarding the results in this section is that the policy curtailments we document might be due to firms experiencing reduced demand instead of the liquidity channel implied by a constraint-based explanation. In the Online Appendix 5 to this paper, we further test this hypothesis by adding controls for ex post changes in demand (sales) both at the firm level and at the industry level. In particular, we measure ex post demand changes using sales growth during the same ex post period we use to measure our ex post investment and issuance dependent variables (2007 to 2009). The inclusion of these rather stringent controls does not materially change our inferences.

4.1.2 Technology bust shock response regressions. Table 6 displays analogous tests to those in Table 5 for the technology bust of 2001 to 2002. The only other difference is that we restrict the sample in Table 6 to technology firms as defined in Loughran and Ritter (2004).

Table 6
Investment and issuance policy reactions to the technology bust (2001–2002)

	Dependent variable	Lagged constraint variable	Lagged log assets	Log firm age	Lagged Tobin's q	Lagged sales growth	Lagged industry sales growth
Panel A: Constraint index = delay investment score							
(1)	Δ R&D/sales	−0.018*	0.030***	0.034***	0.025**	−0.018*	0.003
(2)	Δ CAPX/sales	−0.029***	−0.026***	0.035***	0.021**	−0.048***	−0.037***
(3)	Δ Public SEOs	−0.010**	−0.013**	0.007	−0.002	−0.026***	0.001
(4)	Δ Private SEOs	−0.001	−0.004**	−0.002	0.002	0.001	−0.002
(5)	Δ Debt issues	−0.008	−0.017**	−0.005	−0.001	−0.005	−0.005
Panel B: Constraint index = equity focus delay							
(6)	Δ R&D/sales	−0.030***	0.029***	0.031***	0.026***	−0.016	0.003
(7)	Δ CAPX/sales	−0.026***	−0.027***	0.034***	0.021**	−0.050***	−0.038***
(8)	Δ Public SEOs	−0.004	−0.013**	0.008	−0.003	−0.028***	0.000
(9)	Δ Private SEOs	0.001	−0.004**	−0.001	0.002	0.000	−0.002
(10)	Δ Debt issues	−0.011	−0.017**	−0.005	0.000	−0.004	−0.005
Panel C: Constraint index = debt focus delay							
(11)	Δ R&D/sales	0.027***	0.032***	0.033***	0.026***	−0.015	0.001
(12)	Δ CAPX/sales	0.018*	−0.025**	0.037***	0.021**	−0.050***	−0.040***
(13)	Δ Public SEOs	0.011**	−0.012**	0.007	−0.002	−0.026***	0.000
(14)	Δ Private SEOs	−0.001	−0.004**	−0.001	0.002	0.000	−0.002
(15)	Δ Debt issues	−0.008	−0.017**	−0.002	−0.001	−0.009	−0.005
Panel D: Constraint index = private placement focus delay							
(16)	Δ R&D/sales	−0.036***	0.031***	0.029***	0.027***	−0.013	0.000
(17)	Δ CAPX/sales	−0.019**	−0.026***	0.035***	0.021**	−0.050***	−0.040***
(18)	Δ Public SEOs	−0.005	−0.013**	0.008	−0.002	−0.027***	0.000
(19)	Δ Private SEOs	0.003**	−0.004**	−0.001	0.002	0.000	−0.002
(20)	Δ Debt issues	0.002	−0.017**	−0.003	−0.001	−0.007	−0.006
Panel E: Constraint index = KZ index							
(21)	Δ R&D/sales	0.021**	0.034***	0.038***	0.027**	−0.020*	0.002
(22)	Δ CAPX/sales	0.014	−0.026**	0.040***	0.021**	−0.055***	−0.040***
(23)	Δ Public SEOs	0.026***	−0.012**	0.007	−0.001	−0.026***	0.000
(24)	Δ Private SEOs	0.000	−0.005***	−0.001	0.003*	0.001	−0.002
(25)	Δ Debt issues	−0.012	−0.020**	0.001	−0.001	−0.006	−0.005
Panel F: Constraint index = WW index							
(26)	Δ R&D/sales	−0.029	0.000	0.040***	0.018*		
(27)	Δ CAPX/sales	−0.008	−0.059***	0.057***	0.012		
(28)	Δ Public SEOs	0.042***	0.015*	0.017***	−0.005		
(29)	Δ Private SEOs	0.000	−0.004	−0.001	0.002		
(30)	Δ Debt issues	0.003	−0.018	−0.001	−0.002		

OLS change regressions for investment and issuance policies. The sample includes all firms in the technology industry (as defined by Loughran and Ritter 2004) that exist in our sample from 2000 to 2002. The dependent variable is each firm's change in R&D/sales, CAPX/ sales, public SEO issuance/assets, private SEO issuance/assets, and debt issuance/assets as noted in the first column. The independent variables are ex ante measurable and are constructed using 2000 data. The change in the dependent variables is from 2000 to 2002, bracketing the financial crisis. We examine a different constraint index as noted in each panel header. Because the regressions are based on changes and contain a single change observation for each firm, our results are already clustered by firm and firm effects are differenced out. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

The results in Table 6 are similar to those for the financial crisis. In particular, we observe statistically significant and consistent policy curtailments for the text based measures (with the exception of the debt-focused constraint variable). We also find weak or contrary results for the WW index and the KZ index. Panel A shows that delay investment constrained technology firms significantly curtailed R&D spending, CAPX spending, and public SEOs following the technology bust. Results are similar for equity focus constrained firms. private-placement-focused constrained firms are also similar, except we additionally see that these firms increased their issuance of private SEOs during the tech bust, likely to maintain their liquidity given that the tech bust may have impacted public markets more than private markets.

Regarding debt focus constrained firms, they increased investments and SEO issuances. We do not see evidence that these firms curtailed debt issuance following the technology bust, either in response to liquidity concerns or to drops in demand. This finding likely reflects the fact that, among technology firms, few firms issue debt and those that do might follow a different pattern of asset acquisition. We conclude that equity focus constraints are particularly binding for technology firms around the time of the bust, and we find little evidence of binding constraints for debt focus constrained firms, indicating that this shock was more severe in its implications for equity market liquidity (consistent with the observation that equity prices fell considerably during this period).

Panels E and F are not consistent with the KZ Index and the WW Index being reliable measures of financial constraints. High KZ index firms increased R&D and public SEOs following the technology bust, and high WW Index firms increased public SEOs. These firms did not curtail any policies.

We conclude that the text-based measures provide more consistent results, and that financial constraints were binding on the equity side during the tech bust, predicting reductions in investment and R&D. Regarding the HP variables, we again find that younger firms behave in a manner that is consistent with constraints, as they significantly curtail both investment policies. However, we observe mixed results for firm size, as small firms curtail R&D but increase CAPX and all forms of issuance following the tech bust. Importantly, our text-based constraint variables are robust to including these controls for size and age. We also note in Online Appendix 5 that controls for ex post changes in demand, as measured using ex post firm and industry sales growth, do not materially change our inferences.

4.1.3 Mutual fund selling shock response regressions. Table 7 displays analogous tests for the forced mutual fund selling shock. For this shock-response test, we define treated firms in each year as those firms in the highest decile of forced mutual fund selling as defined in Edmans, Goldstein, and Jiang (2012). We then assess policy changes measured from the end of the year prior to the forced mutual fund selling shock until the end of the year

Table 7
Investment and issuance policy reactions to top decile mutual fund selling shocks (one-year response)

	Dependent variable	Lagged constraint variable	Lagged log assets	Log firm age	Lagged Tobin's q	Lagged sales growth	Lagged industry sales growth
Panel A: Constraint index = delay investment score							
(1)	Δ R&D/sales	−0.011***	0.003	0.003	−0.011**	0.020***	−0.010**
(2)	Δ CAPX/sales	−0.008***	−0.001	0.003	0.010***	−0.023***	0.001
(3)	Δ Public SEOs	−0.007**	0.000	0.006*	−0.008***	−0.015***	−0.004
(4)	Δ Private SEOs	−0.001**	0.001**	0.000	0.000	0.000	0.001
(5)	Δ Debt issues	0.006	−0.010**	0.008*	0.016***	−0.017***	−0.005
Panel B: Constraint index = equity focus delay							
(6)	Δ R&D/sales	−0.021***	0.003	0.001	−0.009**	0.021***	−0.010**
(7)	Δ CAPX/sales	−0.012***	−0.001	0.002	0.011***	−0.023***	0.001
(8)	Δ Public SEOs	−0.010***	0.001	0.005*	−0.008**	−0.014***	−0.004
(9)	Δ Private SEOs	−0.001***	0.001**	0.000	0.000	0.000	0.001
(10)	Δ Debt issues	0.004	−0.010**	0.007*	0.016***	−0.017***	−0.005
Panel C: Constraint index = debt focus delay							
(11)	Δ R&D/sales	0.007	0.001	0.004	−0.010**	0.020***	−0.011**
(12)	Δ CAPX/sales	−0.004	−0.001	0.005	0.009***	−0.024***	0.001
(13)	Δ Public SEOs	0.005*	−0.001	0.006**	−0.008**	−0.015***	−0.004
(14)	Δ Private SEOs	0.000	0.001*	0.000	0.000	0.000	0.000
(15)	Δ Debt issues	−0.001	−0.009**	0.007	0.016***	−0.017***	−0.005
Panel D: Constraint index = private placement focus delay							
(16)	Δ R&D/sales	−0.023***	0.000	0.001	−0.007	0.022***	−0.012***
(17)	Δ CAPX/sales	−0.008***	−0.002	0.003	0.011***	−0.023***	0.001
(18)	Δ Public SEOs	−0.018***	−0.001	0.004	−0.005	−0.013***	−0.005*
(19)	Δ Private SEOs	−0.002***	0.001	0.000	0.000	0.000	0.000
(20)	Δ Debt issues	−0.002	−0.010**	0.006	0.017***	−0.016***	−0.005
Panel E: Constraint index = KZ index							
(21)	Δ R&D/sales	0.000	0.001	0.004	−0.013***	0.019***	−0.010**
(22)	Δ CAPX/sales	−0.006*	−0.001	0.005	0.008***	−0.025***	0.002
(23)	Δ Public SEOs	0.014***	−0.002	0.006**	−0.003	−0.014***	−0.005
(24)	Δ Private SEOs	0.000	0.001**	0.000	0.000	0.000	0.001
(25)	Δ Debt issues	0.001	−0.012***	0.009**	0.018***	−0.019***	−0.002
Panel F: Constraint index = WW index							
(26)	Δ R&D/sales	−0.048***	−0.037***	−0.003	−0.010**		
(27)	Δ CAPX/sales	0.007	0.002	0.009***	0.004		
(28)	Δ Public SEOs	0.006	0.004	0.010***	−0.013***		
(29)	Δ Private SEOs	−0.002**	−0.001	0.000	0.000		
(30)	Δ Debt issues	−0.006	−0.015*	0.009**	0.011***		

OLS change regressions for investment and issuance policies. The sample includes all firms in each year that experienced mutual fund selling pressure in the highest decile among firms in the given year (we exclude observations if they were also in the highest decile in the previous year). Firms must also exist in our sample one year later to be included. The dependent variable is each firm's ex post one-year change in R&D/sales, CAPX/ sales, public SEO issuance/assets, private SEO issuance/assets, and debt issuance/assets as noted in the first column. The independent variables are ex ante measurable. The change in the dependent variables is for the one-year ex post period (starting from the year the firm is in the high mutual fund selling decile through one year later). We examine a different constraint index as noted in each panel header. Because the regressions are based on changes and contain a single change observation for each firm, our results are already clustered by firm and firm effects are differenced out. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

during which the shock arrived. We again predict that constrained firms will curtail investment and issuance policies more severely than unconstrained firms.

This test is perhaps the most sharp among our three shock-response tests due to the fact that forced nonsectoral mutual fund selling (1) is more unexpected and exogenous and (2) this particular shock should only impact firm policies through the channel of equity market liquidity. Unlike the financial crisis and the technology bust, this shock should not directly affect the real side of the firm or issues relating to product demand.

The results in Table 6 are similar to those for the financial crisis and for the technology bust. We observe in panel A that constrained firms significantly curtail R&D, CAPX, public SEOs and private SEOs more than unconstrained firms when they are treated with a large forced mutual fund selling shock. The first two results are significant at the 1% level, and the latter two results are significant at the 5% level. We also find that constrained firms do not significantly curtail debt issuance. This latter finding is consistent with the fact that (1) we broadly find that firms focused on equity issuance face the most binding constraints and (2) the forced mutual fund selling shock is uniquely a shock to equity market liquidity and not debt market liquidity. This more nuanced finding conforms to interpreting the shock through the lens of the hypothesized equity market liquidity channel, and also to the conclusion that our constraint variables are valid measures of financial constraints.

Panels B and D show that the mutual fund selling shock is particularly binding for equity focus constrained firms and private-placement-focused constrained firms. The coefficients and significance levels, when compared to panel A, reveal that these equity-focused constrained firms curtail investment and equity issuance more severely than other constrained firms. In panels B and D, all four results are significant at the 1% level. Panel C shows that we find little evidence for debt-focused constrained firms, which further supports the hypothesized equity market liquidity channel.

Finally, in panels E and F we do not find consistent results for the KZ index, and we find only modest results for the WW index. In particular, high WW index firms curtail R&D spending following the mutual fund shock, and also curtail private placement SEO issuance. Regarding the predictions of Hadlock and Pierce (2010), we again find consistent results for younger firms, which weakly curtail two of the five policies following mutual fund shocks. However, we continue to find mixed results for firm size. We also note in Online Appendix 5 that controls for ex post changes in demand, as measured using ex post firm and industry sales growth, do not materially change our inferences. Overall, our results support the conclusion that the text-based variables offer the most consistent and unique signal regarding financial constraints. We also conclude regarding the two HP variables, that firm age is likely more informative regarding constraints than is firm size.

4.2 SEO issuance and market conditions

A central finding of our paper is that binding constraints are more prevalent in the equity market than in the debt market. Our results also suggest that debt and equity market constraints might affect firms in different ways. In this section, we consider shocks to aggregate equity and debt market liquidity, and examine whether firms with constraints in each market react in parallel ways following such shocks. For the equity market, we consider yearly changes to aggregate number of public SEOs. For the debt market, we consider growth in the aggregate level of industrial and commercial lending. The premise of these tests is that constrained firms should be more sensitive to market conditions specifically in the market (debt or equity) where their constraints are binding. Hence, equity constrained firms should ramp up their own SEO issuance when aggregate SEO market conditions are favorable and curtail their SEO issuance more when aggregate SEO market conditions are poor. Similarly, debt constrained firms should ramp up their borrowing when aggregate lending to corporations is high.

We thus consider separate OLS regressions in which the dependent variable is each firm's public SEO issuance proceeds scaled by assets (for the equity market test) and each firm's debt issuance scaled by assets (for the debt market test). Our key right-hand side variable of interest is a cross term between a given constraint variable and the aggregate level of SEO activity or lending activity in the given year, respectively. If our constraint measures are valid, we predict that this cross term will be positive and significant for firms constrained in the given market. For example, the test of sensitivity to aggregate equity issuance should only produce a positive and significant coefficient for equity constrained firms, and the analogous test for lending market sensitivity should only produce a positive and significant coefficient for debt market constrained firms.

We compute the aggregate SEO variable as the annual change in the total number of SEOs issued in the given year from SDC Platinum. Aggregate lending is from the Federal Reserve and we consider the annual percentage change in the total amount loaned to industrial and commercial borrowers by U.S. banks.[11] Unlike the control variables and the constraint variable in the regression, which are lagged, the aggregate SEO variable and the aggregate lending variable are not lagged. We are interested in whether constrained firms issue SEOs and debt at exactly the same time there is high aggregate issuance activity. We implement this test by including a cross term equal to the product of a given constraint variable and an aggregate issuance change variable. We also include the two level variables that constitute this cross term as RHS variables, in addition to controls for size and age to control for the predictions of Hadlock

[11] See http://www.federalreserve.gov/releases/h8/current/default.htm.

and Pierce (2010). We also include controls for firm fixed effects and time fixed effects, and we cluster standard errors by firm.[12]

Panel A of Table 8 displays the results of regressions where equity issuance is the dependent variable, and the key RHS variable is based on the change in aggregate SEO activity. Each row displays results for one of the six constraint variables we consider. Rows (1), (2), and (4) show that the cross term (Constraint Variable $\times$ Aggregate SEOs) is highly positive and significant for delay constraints, equity constraints, and private placement constraints. This supports the conclusion that constrained firms issue public SEOs in a way that is more pro-cyclical as compared to unconstrained firms. We also observe a negative result for debt focus constrained firms, no result for the KZ index, and a positive result for the WW index. These results strongly support our central predictions regarding binding equity market constraints, and also that debt focus constraints are distinct from equity market constraints.

Panel B of Table 8 displays the results of analogous tests for debt issuance. The key RHS variable is based on the change in industrial and commercial bank lending activity. Rows (9), and (11) show that the cross term is only positive and significant for debt focus constraints and the KZ index. This supports the conclusion that these constrained firms issue debt in a way that is more pro-cyclical than unconstrained firms. We do not observe significant results for the other constraint variables. These results support our prediction that only firms facing constraints in the debt markets should be sensitive to debt market conditions.

In all, the results in both panels show that both equity and debt market constrained firms face parallel challenges when aggregate equity and debt liquidity are poor. These results also help to validate our conjecture that distinct constraints in the equity and debt markets exist and can be measured. Because any particular shock has unique origins, these results also underscore why response to any shock such as the financial crisis or the mutual fund selling shock, should be different in terms of the type of constrained firm they might impact most.

5. Origins of Constraints

The literature has proposed many potential origins of financial constraints, including asymmetric information, moral hazard, cost of contract enforcement, transaction costs, and debt overhang. It is outside the scope of this paper to examine all of these issues. We instead explore the potential role played by asymmetric information, which is perhaps the most heavily discussed potential source of constraints. In a final test, we also consider covenant violations.

[12] Our results, which we omit to conserve space, are also fully robust if we additionally include controls for sales growth and Tobin's q.

Table 8
Sensitivity of firm issuance to aggregate issuance

Row	Constraint variable considered	Constraint variable	Constraint variable × agg SEOs	Log firm assets	Log assets × agg SEOs	Log firm age	Log age × agg SEOs	Document length	R^2	# obs
Panel A: Public equity SEO issuance										
(1)	Delay investment	0.014	0.047	−0.012	−0.022	0.003	−0.012	0.000	0.09	25,760
		(1.60)	(4.22)	(−7.18)	(−4.76)	(2.32)	(−1.72)	(−0.73)		
(2)	Equity-focus delay	0.017	0.063	−0.012	−0.021	0.003	−0.010	0.000	0.09	25,760
		(1.78)	(4.90)	(−7.29)	(−4.67)	(1.99)	(−1.39)	(−0.73)		
(3)	Debt-focus delay	0.016	−0.032	−0.013	−0.019	0.005	−0.021	0.000	0.09	25,760
		(1.40)	(−2.57)	(−7.54)	(−4.34)	(3.40)	(−2.93)	(−1.03)		
(4)	Priv place focus delay	−0.002	0.086	−0.013	−0.018	0.002	−0.009	0.000	0.09	25,760
		(−0.17)	(5.35)	(−7.61)	(−4.20)	(1.83)	(−1.31)	(−0.85)		
(5)	KZ index	0.009	−0.004	−0.012	−0.019	0.004	−0.020	0.000	0.09	25,760
		(1.96)	(−0.72)	(−7.34)	(−4.21)	(3.30)	(−2.85)	(−1.02)		
(6)	WW index	−0.020	0.062	−0.018	0.009	0.003	−0.015	0.000	0.09	25,760
		(−1.07)	(3.11)	(−8.35)	(0.99)	(2.55)	(−2.11)	(−0.91)		
Panel B: Debt issuance										
(7)	Delay investment	0.002	0.016	−0.023	0.017	0.001	−0.033	0.000	0.49	28,468
		(0.08)	(0.12)	(−4.70)	(1.39)	(0.16)	(−1.36)	(3.95)		
(8)	Equity-focus delay	0.003	−0.036	−0.023	0.017	0.001	−0.032	0.000	0.49	28,468
		(0.12)	(−0.28)	(−4.68)	(1.37)	(0.13)	(−1.32)	(3.94)		
(9)	Debt-focus delay	0.073	0.352	−0.023	0.018	0.001	−0.034	0.000	0.49	28,468
		(2.10)	(2.00)	(−4.71)	(1.41)	(0.21)	(−1.41)	(3.81)		
(10)	Priv place focus delay	−0.011	−0.120	−0.023	0.018	0.001	−0.031	0.000	0.49	28,468
		(−0.35)	(−0.79)	(−4.67)	(1.39)	(0.10)	(−1.28)	(3.91)		
(11)	KZ index	0.011	0.141	−0.023	0.021	0.001	−0.032	0.000	0.49	28,468
		(1.34)	(3.18)	(−4.71)	(1.64)	(0.13)	(−1.34)	(3.93)		
(12)	WW index	−0.101	0.090	−0.027	0.014	0.001	−0.033	0.000	0.49	28,468
		(−2.28)	(0.86)	(−5.08)	(0.99)	(0.13)	(−1.38)	(3.93)		

Panel data OLS regressions with firm and year fixed effects. The dependent variable is the public SEO issuance (panel A) and debt issuance (panel B) of each firm in each year scaled by assets. In Panel A, a key RHS variable is the logarithmic change in the aggregate number of public SEOs (simultaneously measured) economy-wide in the given year. Although this particular variable is not displayed below (as it is subsumed by the year fixed effects), we draw attention to three cross-terms based on this variable: constraint index, log assets, and log firm age cross-terms. In panel B, we run parallel tests but replace the key RHS variable with the logarithmic change in the amount of bank loans issued to industrial and commercial borrowers by U.S. banks economy-wide in the given year. All independent variables (except for the aggregate number of SEOs or aggregate change in bank loans) are lagged one year. We include controls for firm and year fixed effects and standard errors are adjusted for clustering at the firm level. Please see Section 2 for a full discussion of variable definitions. *t*-statistics are reported in parentheses.

To examine the role played by asymmetric information, we first scan the text of all 10-Ks for mentions of proprietary information or trade secrets. This issue is typically discussed in one of two contexts: a 10-K might mention a risk factor noting the potential damages that might arise if proprietary information is leaked, or a 10-K might mention the existence of employment contracts that note the existence of proprietary information and that forbid its leakage. Because in both cases, the discussion notes the need to protect this information, we identify firms with proprietary information risks as firms mentioning one protection word ("protect," "protection," or "safeguard") and one information phrase ("trade secret" OR "trade secrets" OR "proprietary information" OR "confidential information") within a five word window. Our results are not highly sensitive to the width of this window. 28.5% of the firms in our sample have such text and are thus coded as having high levels of asymmetric information.

Because asymmetric information is generally taken as a primitive in theoretical models, we consider regressions in which we examine if constraints in a given year t are related to whether or not the firm has high levels of asymmetric information in year $t-1$, and we include controls for size, age, and R&D in order to further illustrate that our results expand our understanding of constraints beyond the work of Hadlock and Pierce (2010) and Brown, Fazzari, and Petersen (2009).[13]

The results of this test are reported in panels A (with industry and year fixed effects) and B (with firm and year fixed effects) of Table 9. The table shows that our delay investment constraint is indeed related to higher levels of asymmetric information, and also that this result is amplified for equity-focused constrained firms and especially for private-placement-focused constrained firms. In contrast, we find a negative link to asymmetric information for debt-focused constrained firms. These findings are robust in both panels, and the positive links to information for equity and private-placement-focused constraints are significant at the 1% level despite the firm fixed effects and the clustering of standard errors by firm.

We conclude that asymmetric information is likely a strong driver of financial constraints among firms attempting to issue equity, but not for debt market constrained firms. This adds further evidence regarding our initial hypothesis that firms facing constraints in equity and debt markets are different. These results go a step further and suggest that these constraints likely have different origins.

We also note that our results are robust to controls for size, age and R&D. In unreported tests, we also find that the link between constraints and asymmetric information is especially strong among younger firms, and in a more extreme test, that our results regarding information and constraints remain significant

[13] Our results, which we omit to conserve space, are also fully robust if we additionally include controls for sales growth and Tobin's q.

Table 9
Proprietary information, outcomes, and financial constraints

Row	Dependent variable	Proprietary information	Log firm age	Log assets	R&D/ sales	Log document size	R^2	# obs
Panel A: Constraints vs proprietary information (ind. and year fixed effects)								
(1)	Delay constraint	0.018	−0.009	0.003	0.017	−0.018	0.15	37,024
		(9.04)	(−12.84)	(4.99)	(12.23)	(−20.07)		
(2)	Equity-focused	0.020	−0.009	0.000	0.021	−0.010	0.18	37,024
	constraint	(10.68)	(−12.65)	(0.63)	(14.96)	(−11.47)		
(3)	Debt-focused	−0.009	0.000	0.003	−0.005	0.011	0.18	37,024
	constraint	(−9.07)	(−1.17)	(9.13)	(−9.94)	(23.66)		
(4)	Priv place foc	0.023	−0.006	−0.001	0.019	−0.011	0.24	37,024
	constraint	(14.35)	(−10.21)	(−3.32)	(17.21)	(−15.30)		
Panel B: Constraints vs proprietary information (firm and year fixed effects)								
(1)	Delay constraint	0.005	0.000	0.001	0.005	−0.018	0.59	37,024
		(3.03)	(0.22)	(0.40)	(3.31)	(−16.65)		
(2)	Equity-focused	0.005	0.000	−0.001	0.005	−0.009	0.61	37,024
	constraint	(3.21)	(−0.03)	(−0.62)	(4.07)	(−8.67)		
(3)	Debt-focused	−0.002	−0.001	0.000	−0.001	0.011	0.50	37,024
	constraint	(−2.12)	(−1.11)	(0.51)	(−2.10)	(17.05)		
(4)	Priv place foc	0.005	−0.001	0.003	0.006	−0.011	0.61	37,024
	constraint	(3.26)	(−1.37)	(2.94)	(6.27)	(−12.57)		

Row	Dependent variable	Delay constr.	Equity delay constr.	Debt delay constr.	Priv. delay constr.	Log firm age	Log assets	Log doc. size	R^2
Panel C: Covenant violations vs constraints (ind. and year fixed effects)									
(1)	Covenant violation	−0.029				0.001	−0.003	0.012	0.02
		(−2.90)				(1.10)	(−5.62)	(11.87)	
(2)	Covenant violation		−0.031			0.001	−0.003	0.012	0.02
			(−2.96)			(1.11)	(−5.71)	(11.93)	
(3)	Covenant violation			0.174		0.001	−0.003	0.011	0.03
				(9.18)		(1.51)	(−6.51)	(11.02)	
(4)	Covenant violation				−0.116	0.000	−0.003	0.012	0.03
					(−9.38)	(0.57)	(−6.06)	(11.50)	
Panel D: Covenant violations vs constraints (firm and year fixed effects)									
(5)	Covenant violation	−0.001				−0.001	−0.001	0.013	0.18
		(−0.10)				(−0.36)	(−0.83)	(8.13)	
(6)	Covenant violation		0.017			−0.001	−0.001	0.013	0.18
			(0.99)			(−0.36)	(−0.83)	(8.22)	
(7)	Covenant violation			0.100		−0.001	−0.001	0.012	0.18
				(4.40)		(−0.32)	(−0.85)	(7.66)	
(8)	Covenant violation				−0.069	−0.001	−0.001	0.012	0.18
					(−3.69)	(−0.40)	(−0.71)	(7.74)	

Panel data OLS regressions with firm, industry, and year fixed effects as noted in panel headers. Panels A and B examine the link between proprietary information and our constraint variables. Panels C and D examine the link between our constraint variables and outcomes in which the firm reports covenant violations in its capitalization and liquidity subsection of its 10-K in the following year. The sample includes 37,024 firm years from 1997 to 2009 that have a machine-readable capitalization and liquidity subsection. All independent variables are lagged one year. Standard errors are adjusted for clustering at the firm level. Please see Section 2 for a full discussion of variable definitions. t-statistics are reported in parentheses.

even in the subsample of young firms that have zero reported R&D. As our earlier discussion of Figure 2 suggests, these results are also economically large. Finally, we further note that proprietary information concerns exist even in Fama-French-48 industries where R&D is less pervasive: Personal Services, Retail, Transportation, and Meals. In these industries, firms report more proprietary information than nonzero R&D.[14] The fact that these purely informational concerns are especially relevant for constraints among younger firms is likely because it takes time for investors to build trust in opaque firms with higher levels of proprietary information. We thus conclude that asymmetric information is more pervasive than what might stem from small firm size, young firm age, or R&D activity.

In a final test, we consider covenant violations. Our results thus far are consistent with debt focus constrained firms facing relatively high existing debt burdens as these firms have higher leverage. However, these firms also likely have viable investment opportunities as they appear to invest more than their industry peers. One final prediction is that such firms experience difficulties repaying their large debt burdens. We thus examine if our constraint variables are related to ex post outcomes where firms report covenant violations. We consider regressions in which a dummy indicating whether the firm mentions the words "covenant" and "violation" in a twelve-word window in the capitalization and liquidity section of their 10-K is the dependent variable. This variable is equal to one for 1.5% of our firm year observations. These regressions are predictive as all RHS variables are measured in the year prior to the dependent variable.

The results of this final test are reported in panels C (industry and year fixed effects) and D (firm and year fixed effects). The table shows that debt focus constrained firms are more likely than average to experience covenant violations. This finding is significant at the 1% level.[15]

In all, we note four empirical findings that lead us to conclude that debt focus constraints are different from equity focus constraints: (1) panels A and B show a negative relationship between debt focus constraints and our proprietary information variable, (2) panels C and D show that debt focus constraints are related to ex post covenant violations, (3) our constraint variables are scored from a training set of firms which declare that they have an investment opportunity to fund, and (4) Table 3 confirms that these firms have investment rates exceeding industry levels and they also have higher leverage.[16] These findings suggest that debt focus constrained firms have

[14] Thus, for example, we find that in Personal Services almost twice as many young firms declare risks pertaining to proprietary information as there are firms reporting engaging in R&D. This ratio is higher still for Retail, Transportation, and Meals.

[15] We report results using a linear probability model to control for the large number of fixed effects and avoid potential bias that may arise in a logistic model. These results are robust to using a logistic model instead.

[16] In an unreported test, we also note that the results in both panels C and D are robust at the 5% level in the high Tobin's q subsample, but are only robust in the low Tobin's q subsample with industry effects (not with

investment opportunities they wish to fund, but are challenged by high existing debt burdens.

In all, we conclude that equity and debt market constraints are quite different, not only in the impact they have on firm outcomes but also regarding the likely theoretical origins driving both.

6. Conclusion

We develop a methodology for identifying financial constraints using mandated disclosures regarding firm liquidity in 10-K statements. We focus on discussions in which management summarizes their firm's inability to obtain financing for planned investments, and the form of external financing (debt, equity, or private placements of equity) their firm is actively considering. We use this text to construct a broad index of financial constraints, and specific financial constraint measures regarding debt, equity, or private placement focus. Our measures also have advantages over surveys or random samples: they are available for the entire COMPUSTAT panel from 1997 forward, they are produced in response to relatively stable regulation, and we do not have to extend our measures from a small survey to the whole population using statistical models based on potentially unstable reduced-form relations.

We find that text-based measures of constraints correlate with firm characteristics in an intuitive way. For example, equity-focused constrained firms are in industries with high investment, high Tobin's q, low profits, low leverage, and high cash balances. Hence, they are in industries where investment opportunities are abundant, and many rivals are cash rich. However, the relative liquidity position of constrained firms within these industries is such that they have lower than average investment levels (R&D and CAPX) despite having a higher average Tobin's q (consistent with high adjustment costs). These firms also tend to be focused more on R&D than CAPX. Debt-focused constrained firms are diametrically opposite in most ways.

Firms that score high on our constraint measures curtail R&D, capital expenditures, public and private SEO issuance, and debt issuance more than less constrained firms when they receive negative unexpected shocks. We also find that these curtailments are larger for firms with equity-focus constraints and private-placement-focus constraints relative to those with debt-focus constraints. Because the market perceives these equity-focused constrained firms as having good investment opportunities (high Tobin's q), these results strongly support the predictions of Krasker (1986) regarding equity rationing (a form of financial constraints due to information asymmetry).

We further examine the theoretical origins of constraints and find some direct evidence for informational asymmetry: equity market constraints are

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firm effects). This test helps to rule out the hypothesis that debt constraints are driven by failing firms with no real investment opportunities.

more prevalent when firms report risks relating to proprietary information in their 10-K. This further supports Krasker's model, and suggests that constraints in the equity market are driven at least in part by informational asymmetries. In contrast, we find no link between debt market constraints and informational asymmetry. Our results for debt market constraints are most consistent with these firms having viable investment opportunities they wish to fund, but being challenged by high existing debt burdens. These firms invest more than their industry peers, have high leverage, and they frequently report covenant violations in their 10-Ks. Our results also suggest that firms focused on equity and debt financing face different types of constraints, even in terms of constraint origins.

We believe our constraint measures can benefit future research in this area. As we show, our constraint measures outperform other measures used in the literature regarding their ability to predict policy curtailments. In particular, measures of constrained firms such as size, age, and R&D do not fully capture issues relating to shock responses and informational asymmetries, which appear to be pervasive. Existing measures also do not distinguish between equity and debt market constraints, which appear to be quite different.

Appendix A. Regulation

SEC Regulation S-K obligates firms to discuss (1) challenges to their liquidity, (2) their demand for liquidity (investment plans), and (3) the sources of available liquidity, which are further specified as:[17]

(a) liquidity: identify any known trends or any known demands, commitments, events, or uncertainties that will result in . . . the registrant's liquidity increasing or decreasing in any material way. If a material deficiency is identified, indicate the course of action that the registrant has taken or proposes to take to remedy the deficiency. Also identify and separately describe internal and external sources of liquidity, and briefly discuss any material unused sources of liquid assets, and

(b) capital resources: (1) describe the registrant's material commitments for capital expenditures as of the end of the latest fiscal period, and indicate the general purpose of such commitments and the anticipated source of funds needed to fulfill such commitments, and

(2) describe any known material trends, favorable or unfavorable in the registrant's capital resources. Indicate any expected material changes in the mix and the relative cost of such resources.

"Liquidity" is clarified in Instruction 5: "refers to the ability of an enterprise to generate adequate amounts of cash to meet the enterprise's needs for cash...Liquidity generally shall be discussed on both a long-term and short-term basis." We find that firms widely comply, and we find the relevant discussion in a machine-readable subsection of MD&A for roughly 85% of all firms. This subsection is often titled "Liquidity and Capital Resource."[18]

We also note five key attributes of 10-K capitalization and liquidity (CAP+LIQ) disclosures, which if true, would make our identification of constraints most effective. (1) Our approach is more effective if more firms disclose information about liquidity thoroughly and truthfully. (2) Our approach is also more informative if CAP+LIQ sections have a strong verbal "factor structure."

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[17] See, for example, http://www.ecfr.gov/cgi-bin/text-idx?SID=7772b55252984b0217bd2f5aa6e8 fa97&node=se17.3.229_1303&rgn=div8 for the full text of Item 303.

[18] The subsection can also appear with a number of related titles, which we discuss in our Online Appendix 1.

This would hold if various classes of constrained firms discuss issues relating to their constrained status in a similar way. This would allow us to score firms on their degree of constraintedness even if they do not explicitly state they are constrained. (3) Our approach is also more accurate if a common set of rules and requirements govern CAP+LIQ disclosures for all firms in a given year. (4) Our approach to measuring debt and equity constraints separately would also be more accurate if firms constrained in different financial markets are fundamentally different from one another so that differences can be detected. Finally, (5) our approach would be more accurate if uninformative boilerplate content comes in two general forms: content stated by most firms due to SEC rules and content that is common to firms in the same industry likely due to industry conventions. In all, we believe that text in CAP+LIQ filings generally satisfy these conditions. Our strong empirical results regarding constraints further support this conclusion.

Appendix B. Cosine Similarities and Constraint Scores

The binary query methodology described in Section 2 identifies a set of firms that directly indicates constraintedness. However, we are concerned about two potential sources of measurement error. First, some firms may indicate constraintedness broadly in their discussions, but they may not conclude their discussion with a direct statement regarding potential investment curtailment. Second, some firms may be partially constrained, and this would be overlooked using an all-or-nothing direct query approach. Thus, we consider cosine similarity analysis to generate a more informative degree of constraintedness metric.

We score each CAP+LIQ section based on how similar its vocabulary is to those firms in a given training set of interest, while controlling for the presence of standard (boilerplate) text. This method generates a continuous score for each firm, and firms with higher scores are more likely to be constrained. Firms with lower scores are unlikely to be constrained.

Where N denotes the number of unique words in the entire corpus, we define an N-vector for each firm i in each year t as $word_{i,t}$. This vector is populated with the number of times each word corresponding to each of the N elements is used in firm i's CAP+LIQ subsection in year t. We next define the normalized vector for each firm year $norm_{i,t}$, which is $\frac{word_{i,t}}{\sqrt{word_{i,t} \cdot word_{i,t}}}$. This normalization neutralizes the impact of document length and is central to the cosine similarity method, which is widely used in applications in computational linguistics (see Sebastiani 2002).

We compute each firm-year's standard content (boilerplate) $stan_{i,t}$ by computing each firm's similarity to the average content of all firms in the given year. In particular, we first compute $\bar{norm}_t$ as the average of $norm_{i,t}$ across all firms in the given year t. The amount of boilerplate content is then

$$\text{Boilerplate score} = norm_{i,t} \cdot \frac{\bar{norm}_t}{\sqrt{\bar{norm}_t \cdot \bar{norm}_t}}. \tag{B1}$$

The above formulation is thus the cosine similarity between each firm's disclosure and the average disclosure of firms in the given year. Because both vectors in the dot product are normalized to unit length and have nonnegative values, the boilerplate score is bounded in the interval $[0, 1]$ and is thus not subject to outlier problems. Intuitively, higher values indicate that the given firm is disclosing more global boilerplate content. This measure accounts for standard content that is common across all filers, likely due to legal requirements related to SEC filings that might require all firms to make certain statements.

We also account for industry-specific boilerplate content, as firms in the same industry may also make common and uninformative statements. In particular, we first compute $\bar{norm}_{ind[i],t}$ as the average of $norm_{i,t}$ across all firms in the same industry as firm i in a given year t. The amount of industry boilerplate content is then

$$\text{Industry boilerplate Score} = norm_{i,t} \cdot \frac{\bar{norm}_{ind[i],t}}{\sqrt{\bar{norm}_{ind[i],t} \cdot \bar{norm}_{ind[i],t}}}. \tag{B2}$$

Next, we compute each firm-year's degree of financial constraints $delay_{i,t}$ analogously using cosine similarities. In particular, we first compute $\bar{norm}_{delay,t}$ as the average of $norm_{i,t}$ across all firms in the twelve-word-enhanced delay investment training set (as defined in the previous section based on delay list 1 and delay list 2). The degree of delay investment constraints is then

$$\text{Raw delay investment score } = norm_{i,t} \cdot \frac{\bar{norm}_{delay,t}}{\sqrt{\bar{norm}_{delay,t} \cdot \bar{norm}_{delay,t}}}. \tag{B3}$$

The above formulation is thus the cosine similarity between each firm's disclosure and the average disclosure of firms that directly states that they face delay investment financial constraints. Because both vectors in the dot product are normalized to unit length and have nonnegative values, the raw delay investment score is bounded in the interval $[0, 1]$. In a final step, we regress our raw delay investment score variable on the boilerplate score and the industry boilerplate score and define the residual as our main variable "Delay Investment Score."

We compute each firm-year's degree of equity-focused, debt-focused, and private-placement-focused financial constraints analogously. We first consider three training sets. For equity focus constraints, we consider firms in both (1) the twelve-word-enhanced delay investment training set (based on delay list 1 and delay list 2) and (2) in the equity-focused training set (based on the equity-focused list from the previous section). For debt focus constraints, we consider firms in both (1) the twelve-word-enhanced delay investment training set (based on delay list 1 and delay list 2) and (2) in the debt-focused training set (based on the debt-focused list from the previous section). For private-placement-focused constraints, we consider firms in both (1) the twelve-word-enhanced delay investment training set (based on the delay list 1 and delay list 2) and (2) in the private-placement-focused training set (based on the private-placement-focused list from the previous section).

The above three training sets focus on firms that are constrained, and that specifically seek three forms of capital to improve their liquidity. However, these raw training sets contain highly correlated information because some firms will appear in, for example, all three training sets or in two of the three training sets. This is problematic in our setting as our goal is to uniquely measure the attributes of firms that are constrained and that primarily focus on each type of capital. We thus take two additional steps to reduce the correlation of content across these training sets. First, we discard a firm-year from all three training sets if it appears in more than one of the three. Second, for the equity focus constraint training set, we further drop the 25% of firm-years whose vocabulary is most similar (using cosine similarities) to the firms in the debt focus constraint training set. For the debt focus constraint training set, we drop the 25% of firm-years that are most similar to the equity focus constraint training set. These two steps reflect the fact that many firms actively consider both debt and equity, and excluding these firms produces sharper separation of the two constraint variables. For the private-placement-focus constraint training set, we drop the 25% of firm-years that are most similar to the equity focus constraint training set, reflecting the fact that many private-placement-focused firms also actively consider public equity, and our objective is to zero in on firms that more uniquely focus on private equity capital.

Thus, we have three training sets, which we denote as equity-focus constrained, debt-focus constrained, and private-placement-focus constrained. To compute our equity focus constraint variable, we compute $\bar{norm}_{equityfoc,t}$ as the average of $norm_{i,t}$ across all firms in equity-focused constraint training set. The degree of equity-focused delay investment constraints is then

$$\text{Raw equity focus delay investment score } = norm_{i,t} \cdot \frac{\bar{norm}_{equityfoc,t}}{\sqrt{\bar{norm}_{equityfoc,t} \cdot \bar{norm}_{equityfoc,t}}}. \tag{B4}$$

Debt and private placement focus constraints are analogously defined based on their respective training sets:

$$\text{Raw debt focus delay investment score } = norm_{i,t} \cdot \frac{\bar{norm}_{debtfoc,t}}{\sqrt{\bar{norm}_{debtfoc,t} \cdot \bar{norm}_{debtfoc,t}}}. \tag{B5}$$

$$\text{Raw private placement focus delay investment score} = norm_{i,t} \cdot \frac{\bar{norm}_{privplacefoc,t}}{\sqrt{\bar{norm}_{privplacefoc,t} \cdot \bar{norm}_{privplacefoc,t}}}. \quad \text{(B6)}$$

In a final step, we regress each raw constraint variable on the boilerplate score and the industry boilerplate score and define the residuals, respectively, as our main variables "Equity Focus Delay Investment Score," "Debt Focus Delay Investment Score," and "Private Placement Focus Delay Investment Score."

We also compute a "Covenants Violation" score variable using a similar two-step procedure. First, we identify a training set based on firms that mention the words covenant and violation within a twelve-word window. We then compute the average word vector of firms that match this query in each year and thus define the N-vector $\bar{norm}_{covenant,t}$. The degree of proximity to covenant violations is then

$$\text{Raw covenant violation score} = norm_{i,t} \cdot \frac{\bar{norm}_{covenant,t}}{\sqrt{\bar{norm}_{covenant,t} \cdot \bar{norm}_{covenant,t}}}. \quad \text{(B7)}$$

In a final step, we regress our raw covenant violation score variable on the boilerplate score and the industry boilerplate score and define the residual as our main variable "Covenant Violation Score."

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