Estimating the Benefits of Contractual Completeness*

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Abstract

Covenants allow firms to write more complete debt contracts. I develop a framework to estimate the distribution of benefits that accrue to firms from their ability to write covenants into debt contracts. I show that firms' surpluses from increased contractual completeness reduce to the same sufficient statistic across a wide class of theoretical models of covenants. I provide a revealed preference based method for estimating this sufficient statistic from covenant prices and firms' covenant choices. I use my framework to show that firms earn large surpluses when covenants can be written into debt contracts, on average exceeding the spread paid on a loan. My estimates reveal that among the commonly observed financial covenants, the leverage and interest rate covenants emerge as ones with the largest benefits, lending quantitative credence to several standard theories of covenants which predict these types of covenants. I also show that, once chosen, the benefits from fine tuning covenants are not large, rationalizing the "boilerplate" levels of covenants observed in practice. I conclude by discussing the extensions and limitations of my method. Overall, I provide a framework which can be used to quantitatively study how covenants generate firm benefits by completing debt contracts.

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1 Introduction

How important is the ability to write more complete contracts? In developed economies with sophisticated intermediaries, firms obtain most of their external funds through debt contracts, which contain complex and state-contingent terms known as debt covenants (Gorton and Winton, 2003). These covenants can include performance triggers based on firms' accounting statements, can impose restrictions on financing and investment, and can be finely tailored to firms' needs. In countries with less effective legal systems, on the other hand, firms write simple financial contracts; state-contingent contracts are not used for fear of not being enforced (Lerner and Schoar, 2005). In addition, sophisticated intermediaries are necessary to monitor, enforce and renegotiate more complete, covenant-laden, contracts.

The goal of this paper is to provide a framework which allows me to estimate the benefits (surpluses) that accrue to firms from being able to enter debt contracts containing covenants. Using this method allows me to address several questions. I estimate the magnitude of surpluses, which rationalize the frequent use of covenants in debt contracts as well as their pricing. I examine how important the rich availability of contracts is to firms: I measure which types of covenants provide the largest benefits. I show that utilizing information in covenant prices and covenant choices *simultaneously* in my framework is critical for answering this question. Lastly, I study whether firms would lose large surpluses if they were only allowed to enter boilerplate covenant contracts. Because surpluses arise from resolving financial frictions, my method also provides an alternative way of quantifying financial frictions faced by firms in economies, which do not have intermediaries or a legal system capable of enforcing such contract (Hadlock and Pierce, 2011, and Almeida and Wolfenzon, 2005). Therefore I also quantify one of the benefits that the intermediation sector provides to the non-financial sector. Overall, I provide a framework which can be used to quantitatively study how covenants generate benefits to firms by completing debt contracts.

Debt contracts include covenants to resolve financial frictions, thereby generating surplus for the contracting parties. Models, however, differ on the source of frictions that covenants are meant to alleviate. The early work by Jensen and Meckling (1976) suggests that covenants prevent borrowers from taking ex post inefficient risky projects that expropriate borrowers. Rajan and Winton (1995) show that covenants can act as tripwires, which provide incentives for efficient information acquisition and costly monitoring by intermediaries. Aghion and Bolton (1992) propose yet another alternative, in which covenants efficiently allocate decision rights in a world of unverifiable cash flows and incomplete contracting. I show that these models belong to a large class of models, which differ in the mechanism through which covenants operate and in the nature of the financial friction they resolve, but for which firms' gains from covenant contracting reduce to the same sufficient statistic. This sufficient statistic combines market pricing of covenants and firms' covenant choices. It computes the consequences that restricting contracting choices to a few "boilerplate" covenants has on the surplus earned by firms. One can therefore compute this surplus without taking a stance on which particular financial friction covenants are solving. I then show how to estimate this sufficient statistic from the data.

At the core of the sufficient statistic approach is the insight that, regardless of the model, the basic trade-off firms face regarding covenants is the same. The benefit of covenants is that they increase firms' income pledgeability, relaxing financial constraints (Tirole, 2006). More restrictive covenants increase the lender's power over firms' actions. Lenders can use this power to increase expected payoffs from a given debt contract. For example, covenants can prevent issuance of senior debt, which would dilute the claim of the lender. A violated financial covenant can trigger default before the borrower is unable to make payments, increasing debt repayment. Covenants may also improve the lender's bargaining position in a possible loan renegotiation. Since more restrictive covenants increase lenders' expected payoffs, they are willing to lend more ex ante, relaxing borrowers' financial constraints.

While they provide the benefit of relaxing financial constraints, covenants come at a cost of constraining firms' actions. A covenant can allow the lender to liquidate the firm or impose investment restrictions, even if that is not in the borrower's best interest. If a covenant increases lenders' bargaining power, it decreases borrowers' bargaining power. Further, because covenants alter payoffs, they also change the incentives to invest, choose projects, or liquidate the firm. Stricter covenants then provide additional external funds to the firm but at the cost of limiting firms' actions. The firm trades-off the costs and benefits of different covenant bundles and chooses the most profitable one.

The net gain – surplus – that the firm obtains from a covenant bundle is the income that it generates from the additional funds minus the funds that have to be repaid. I first estimate the additional funds that firms obtain from tighter covenants. The intermediary is willing to charge lower interest rates on loans with tighter covenants, all else equal, because tighter covenants increase its expected income for a given loan. This decrease in the interest rate that firms can obtain if they choose stricter covenants is the market price of covenants. Covenant prices then reflect the additional funds the firm can obtain from including stricter covenants.

Next, I estimate the income the firm generates from tighter covenants using a revealed preference approach. Firms benefit to a different extent from a given change in covenant strictness, either because the benefits of relaxing financial constraints differ or because the covenants constrain them to a different extent. Intuitively, firms that benefit more from covenants choose stricter covenants. Moreover, at the firm's actual covenant choice, it has to be indifferent to a marginal tightening in covenants. To be indifferent, the marginal income from increasing covenant strictness has to equal the marginal increase in expected payments to the intermediary, which is reflected in the covenant price. This first order condition allows me to use observed covenant choices and prices to estimate the amount of total income the firm derives from covenants. Last, I combine all estimates into a sufficient statistic for the losses in surplus firms would incur from restricting contract choice to several boilerplate covenants. To compute the firms' gains from covenant contracting, I compute surplus losses from eliminating covenants altogether.

The central input into the calculations of firms' benefits is an estimate of how the loan interest rate changes with covenant strictness, the price of covenants. Both covenant use and interest rates are correlated with the firm's ability to repay a loan (Nini, Smith and Sufi, 2009). If firm quality is not completely observable to the researcher then this would bias the estimation of covenant prices (Bradley and Roberts, 2004). I address this identification problem by using an estimator proposed by Bajari et al (2012), who show that by using rational expectations one can recover market prices of product characteristics in panel data even in the presence of time varying unobservables. This estimator is well suited for the problem: that expectations are rational and that loan prices correctly reflect all payoff relevant information at the disposal of the contracting parties at the time the loan is made are standard and critical assumptions in the theoretical contracting literature. I estimate the market price of covenants using this estimator. The results confirm that as firms' quality decreases on unobservable dimensions, they indeed choose more covenants, which would bias covenant prices estimated using OLS and standard panel estimators such as first differences or fixed effects.

I show that covenants significantly decrease loan spreads. In the simplest specification I measure covenant tightness by the number of covenants. Adding the median number of covenants in the sample, two, decreases the spread by almost half, $84bp$. Alternatively, a one standard deviation in the number of covenants decreases the spread by one third of a standard deviation. In these and more complex specifications I find that including more restrictive covenants significantly decreases spreads, implying that covenants increase pledged income from debt contracts relaxing financial constraints.

I then use my revealed preference-based approach to show that large benefits accrue to firms when they can enter debt contracts with covenants. For the average firm, the surplus earned exceeds 100% of spreads paid on a loan, and exceeds 20% of the spreads even under the most conservative estimates. In other words, firms' surpluses exceed the revenues from intermediation. These surpluses rationalize the frequent use of covenants in privately placed debt contracts and large covenant prices. Large surpluses also quantify the substantial financial constraints which firms would face in an environment with a less developed intermediary sector or legal system, which is the case in developing economies (Lerner and Schoar, 2005).

Variety in covenant types allows the firm to contract on a wider set of financial measures, completing contracts by encompassing a wider set of states of the world. Using my method, among the commonly observed covenants, the leverage and interest rate covenants emerge as ones with the largest benefits. These are not the most commonly used covenants in the data, showing that utilizing information in covenant prices and covenant choices *simultaneously* in my framework is critical for understanding which covenants are most beneficial to firms.

My framework identifies surpluses, which are consistent with a wide class of covenant models. Therefore it does not distinguish which models contribute more to the estimated surpluses. The leverage and interest rate covenants perform substantially different roles, each of which is broadly consistent with different classes of theory models. These results allow me to speculate which classes of models might be quantitatively relevant, lending quantitative credence to several standard theories of covenants, including the early theories of Jensen and Meckling (1979), and Smith and Warner (1979) and more recent theories such as Aghion and Bolton (1992) and Rajan and Winton (1995).

My estimates reveal a second benefit of firms' being able to choose from a variety of covenant types. The gains generated by any individual covenant type are very skewed, accruing to small subsets of firms. The variety of covenant types, however, allows firms to use the covenant most appropriate to their circumstances. Therefore, gains from contracting with covenants are distributed across a wide set of firms. The largest gains accrue to firms which use more restrictive covenants. These are firms that have been shown to be more financially constrained (Nini, Smith and Sufi, 2009).

Once the firm chooses a covenant type, it can also choose how restrictive that covenant is. I compute that very little surplus would be lost if firms were forced to write boilerplate covenants–covenants in which restrictiveness is fixed at a pre-specified level. This fact might explain why covenants in the data frequently cluster at certain financial ratios: there is little benefit to fine-tuning covenants further.[1]

I conclude by discussing the extensions and limitations of my method. In Appendix A I present a sufficient statistic, which takes a conservative approach to extrapolation when computing surplus. This reduces the potential impact that parametric assumptions may have on the estimates. Even this severe limiting of extrapolation results in large estimates of firms' surpluses. In Appendix B I show how to modify the estimation approach if covenant strictness is not continuous, or if the choice problem is not differentiable. Assuming continuity and differentiability allows for greater expositional clarity throughout the paper. In addition I also discuss the robustness of my results to asymmetric information about borrowers' types, imperfect competition among intermediaries and alternative estimates of covenant prices.

The paper is structured as follows. In Section 2 I present a generic model of covenant contracting and derive the sufficient statistic. In Section 3 I describe the data and Section 4 shows how I estimate the inputs into the sufficient statistic. Section 5 presents the estimates of covenant pricing and surplus calculations. The robustness of these results and their link to welfare is discussed in Section 6. Section 7 concludes.

Relationship to past literature

The availability of covenants generates surplus for the firm by helping it resolve financial frictions. This paper contributes to the literature on pricing and welfare in financial markets, which has extended standard demand and supply tools to environments with information and financial frictions. Risk based pricing (Adams, Einav and Levin, 2009) and credit scoring (Einav, Jenkins and Levin, 2012a; Einav, Jenkins and Levin, 2012b) have been shown to alleviate liquidity and information frictions in subprime auto loans.[2] This paper explores a market for privately placed debt in which demand is generated by firms, not individual consumers. The market is the major source of external funds for firms and displays some interesting differences with consumer markets. In particular, the product space is continuous and firms tailor debt contracts within

[1] For example, over two thirds of leverage covenants specify ratios of 0.50, 0.55, 0.60, or 0.65 even though values of 0.51, 0.52 etc. are also in the data.

[2] Einav, Finkelstein and Schripf (2010) and Einav, Finkelsten and Cullen (2010) quantify welfare losses due to adverse selection in annuities markets and in health insurance, respectively. Bundorf, Levin and Mahoney (2012) show welfare losses from uniform pricing in health insurance markets.

this vast space to suit their needs. This setting is therefore an ideal place to use hedonic demand estimation methods (Bajari and Benkard, 2005 and Bajari et al, 2012).

The paper also contributes to the literature on estimating quantitative capital structure models. For example, Hennessy and Whited (2005, 2007), De Angelo, De Angelo and Whited (2011) and Warusawitharana and Whited (2011) structurally estimate dynamic capital structure models to explore the low leverage puzzle and how it relates to the cost of external finance, as well as how firms rebalance their capital structure and firm responses to market misvaluation.[3] I contribute to this literature by estimating the benefits that firms obtain from optimizing their capital structure choice on the dimension of covenants. Instead of estimating a fully specified structural model, I use the sufficient statistic approach.[4] This approach allows me to nest several models of contracting with covenants and obtain estimates of benefits without specifying the frictions, which structural models must take a stand on. The methodology applied is simple, and provides estimates of firm benefits using a weak assumption of revealed preference for a given estimate of covenant prices. This comes at a cost of a narrower set of counterfactuals than a fully specified structural model could provide.

This paper relates to a large literature on the importance of contractual enforcement for development. Common law counties not only enforce commercial contracts better (Glaeser, Johnson, and Shleifer, 2001, and Djankov, et al., 2003) but also have more developed financial systems and higher growth (Demirgüc-Kunt and Levine, 2001). The most closely related work is by Lerner and Schoar (2005), who show that private equity firms can use state contingent contracts only in countries with an effective legal system, and that the use of such contracts leads to higher valuations and returns. In this paper I provide complementary within-country micro estimates of how important well developed financial markets are. I examine a specific dimension, the provision of debt contracts with covenants, and focus on directly estimating firm benefits.

This paper builds upon and contributes to a large literature on debt contracting with covenants, which has explored the effect of covenant contracting on firms' financing and investment choices (Bradley and Roberts, 2004; Chava and Roberts, 2008; Roberts and Sufi, 2009a and 2009b; Nini, Sufi and Smith, 2009 and 2012; Sufi, 2009; Murfin, 2012). I contribute to this literature by providing the first direct estimate of surpluses that firms obtain in this market. I examine how these surpluses are distributed among firms and link it to the variety of covenants firms can use, and to the ability to finely tailor these covenants. I also provide a new estimate of covenant prices, but the sufficient statistic can easily be recomputed using existing estimates from the literature such as Bradley and Roberts (2004) or potential natural experiment based estimates.

2 Theory

The purpose of this section is to demonstrate that firms' surplus from covenant contracting is determined by the same sufficient statistic in a large class of models. These models can feature state contingent covenants,

[3]See Strebulaev and Whited (2012) for a survey.

[4]See Chetty (2009) for an overview of the sufficient statistic approach.

costly renegotiation of payments and renegotiation of non-pecuniary features such as project choice or investment. I demonstrate this by presenting a generic model, which nests a wide variety of models of financial frictions and covenants. I show that in order to compute the magnitude of firms' benefits from contracting with covenants in this model, the precise nature of the friction does not have to be observed. Instead, a firm's surplus can be expressed as a function of covenant pricing and covenant choices. Therefore, if two models of covenant contracting, which can be nested in this generic model, result in same covenant pricing and covenant choices, then they imply the same gain from covenant contracting. This is the case even if the models differ in the nature of the financial friction the covenants are resolving, the actions the firm and bank are allowed to take etc. I conclude this section by discussing how some canonical models of covenants fit into the generic model.

2.1 Setup and Notation

To formally demonstrate the potential richness of models which can be nested, this section is heavy on notation. A reader who is not interested in the formal argument can skip to Section 2.3. A firm is described by a vector of characteristics ζ. Loans are provided by $k \geq 2$ identical intermediaries. The timeline is the following:

1. Contracting stage: Firm and intermediary enter a loan agreement.
2. Early stage: Firm and intermediary take early actions.
3. State of the world is realized.
4. Late stage: Firm and intermediary take late actions.
5. Payoffs are realized.

In the contracting stage a firm can obtain funds e through a loan contract. The loan contract promises a payment of 1 and a vector of m covenants, $\phi = (\phi_1, ..., \phi_m)$, $\phi_j \in \left[0, \bar{\phi}_j\right]$, where ϕ_j describes the strictness of the $j-th$ covenant , and $\phi_j = 0$ denotes the absence of this covenant. The loan amount implicitly defines the interest rate on the loan, y. Since the promised payment is 1,

$$e \equiv \frac{1}{1+y} \approx 1 - y. \tag{1}$$

Note that y is the *promised* interest rate on the loan, and does not have to equal the actual or expected interest payments on the loan ex post. These can deviate from the promise because the firm does not have the funds to service the payments, or because the interest rate is renegotiated. Intermediaries compete on e, the amount of funds they are willing to provide for a given loan contract. Allowing for imperfect competition among intermediaries does not affect the results (see Section 6.3).

Covenants specify which actions the firm and the intermediary can take. In the early stage, the firm can take an action a_e and the intermediary action b_e (these actions can be vectors). For example, a_e, can be the amount of effort by the manager, choice of investment projects, and/or unverifiable investment into human capital; b_e can be the monitoring effort by the intermediary. The firm can choose among actions, which have not been constrained by covenants $a_e \in A_e(\phi)$, where $A_e(\phi)$ is a product set in $\mathbb{R}^{n_{a_e}}$ and n_{a_e} is the dimensionality of the action a_e.[5] These restrictions might constrain firm investment in particular projects or determine whether it can raise other funding. The bank, similarly, might be allowed to monitor and demand input into the firm's investments decisions, if covenants allow it to do so: $b_e \in B_e(\phi)$ where $B_e(\phi)$ is a product set in $\mathbb{R}^{n_{b_e}}$.

Let S be the set of possible states of the world. Once a state of the world $s \in S$ is realized, actions (or sequences of actions) a_l and b_l can be taken by the firm and intermediary, respectively. These actions can be the choice of a project,[6] choice to renegotiate, make a transfer to the intermediary, or hide income. In the late stage, covenants can award decision rights contingent on the state of the world, so $a_l \in A_l(\phi, s)$ and $b_l \in B_l(\phi, s)$; $A_l(\phi, s)$ and $B_l(\phi, s)$ are product sets in $\mathbb{R}^{n_{a_l}}$ and $\mathbb{R}^{n_{b_l}}$, respectively. For example, if the realized state s results in low profits such that a firm violates a financial covenant then the intermediary obtains the right to accelerate debt payments. Alternatively, the parties can also take actions a_l and b_l that renegotiate the contract and actions that the parties will take, be it payments, investment, the choice of which projects to take and liquidate and so on.

Payoffs. Depending on the realized state of the world and actions taken by the firm and intermediary, the firm generates a gross income of $u(s, a_e, a_l, b_e, b_l, e, \zeta)$ at a cost of $c^f(s, a_e, a_l, b_e, b_l, e, \zeta)$. The gross income can include the verifiable and unverifiable cash flows generated by the firm as well as private benefits. These depend on the actions of the firm and intermediary, as well as the amount of funds, e, that the intermediary provided to the firm. Similarly, the cost can represent real cost of investment, cost of unverifiable investment in human capital, effort not observed by the lender, or renegotiation cost.

This firm also has to service its debt to the intermediary. The ex post payments to the intermediary, $p(s, a_e, a_l, b_e, b_l, e, \zeta)$, compensate it for extending the loan amount e. These payments do nor have to equal the promised payments on the loan captured in the promised interest rate y, for example, if the bank does not have sufficient funds, or if the initial interest rate is renegotiated. $p(\cdot)$ also contains any fees that have not been specified in the initial contract, such as fees resulting from renegotiation. Note that the payoffs do depend on the initial interest rate y defined implicitly by e. The intermediary may also realize some pecuniary and non pecuniary costs of monitoring the loan, including legal fees, or cost of renegotiation ex post, which depend on its actions as well as the actions of the firm $c^i(s, a_e, a_l, b_e, b_l, e, \zeta)$. In addition to affecting payoffs, I also allow for the possibility that early actions change the probability that different states of the world are realized, $\pi(s|a_e, b_e, e, \zeta)$. This can represent a situation in which manager's effort raises

[5] $A = A_1 \times ... \times A_n$ is a product set in $\mathbb{R}^n$ if $A_i \subseteq \mathbb{R}, i = 1, ..., n$.

[6] For ex., firms can choose the size and type of project, or whether a project should be liquidated.

the probability of a good state (moral hazard) or on in which bank's monitoring effort raises the probability of detecting low cashflows.

2.2 Firm and intermediary actions

The payoffs to the firm and the intermediary are, respectively:

$$\begin{aligned}\Pi_f &= u\left(a_e, a_l, b_e, b_l, s, e, \zeta\right) - c^f\left(a_e, a_l, b_e, b_l, s, e, \zeta\right) - p\left(a_e, a_l, b_e, b_l, s, e, \zeta\right) \\ \Pi_i &= p\left(a_e, a_l, b_e, b_l, s, e, \zeta\right) - c^i\left(a_e, a_l, b_e, b_l, s, e, \zeta\right)\end{aligned}$$

The firm and the intermediary choose actions in the late stage, a_l^* and b_l^*, which maximize their expected payoff at that stage of the game, taking the other player's equilibrium action as given, subject to the restrictions that are imposed by covenants conditional on the realized state of the world, $A_l\left(\phi, s\right)$ and $B_l\left(\phi, s\right)$:

$$a_l^* = \underset{a_l \in A_l(\phi,s)}{\arg\max}\, \Pi_f\left(a_e, a_l, b_e, b_l^*, s, e, \zeta\right)$$
$$b_l^* = \underset{b_l \in B_l(\phi,s)}{\arg\max}\, \Pi_i\left(a_e, a_l^*, b_e, b_l, s, e, \zeta\right).$$

Let $\mathbf{a}_l^*\left(\alpha_e, b_e, s, \phi, e, \zeta\right) \equiv \left(a_l^*\left(\alpha_e, b_e, s, \phi, e, \zeta\right), b_l^*\left(\alpha_e, b_e, s, \phi, e, \zeta\right)\right)$ be the actions the firm and the intermediary will take on the equilibrium path in the late stage, if state s is realized, covenants ϕ are in place, and at the early stage the actions are α_e, b_e. Note that the actions in the early stage can affect payoffs to actions in the late stage. For example, the firm can invest in a project that will be difficult to efficiently liquidate, which will change the payoffs to renegotiation in the late stage.

The firm and intermediary choose actions in the early stage, a_e^* and b_e^*, to maximize their respective expected payoffs given the restrictions put in place by covenants $A_e\left(\phi\right)$ and $B_e\left(\phi\right)$:

$$a_e^* = \underset{a_e \in A_e(\phi)}{\arg\max} \sum_{s \in S} \pi\left(s | a_e, b_e^*, e, \zeta\right) \Pi_f\left(a_e, b_e^*, \mathbf{a}_l^*\left(\alpha_e, b_e^*, s, \phi, e, \zeta\right), s, e, \zeta\right),$$
$$b_e^* = \underset{b_e \in B_e(\phi)}{\arg\max} \sum_{s \in S} \pi\left(s | a_e^*, b_e, e, \zeta\right) \Pi_i\left(a_e^*, b_e, \mathbf{a}_l^*\left(\alpha_e^*, b_e, s, \phi, e, \zeta\right), s, e, \zeta\right),$$

Let $\mathbf{a}_e^*\left(\phi, e, \zeta\right) = \left(a_e^*\left(\phi, e, \zeta\right), b_e^*\left(\phi, e, \zeta\right)\right)$ be the actions that the firm and intermediary take on the equilibrium path, given the amount lent, e, and the firm and contract characteristics. Intermediaries compete on loan amount, e, so in equilibrium they are willing to provide loan amounts at which they break even. The amount lent then equals the expected pledged income from the contract reduced by the expected cost of the contract at the equilibrium choices of the firm and the intermediary. The loan amount that the intermediary is willing to provide is implicitly defined by:

$$e = \sum_{s \in S} \pi\left(s | \mathbf{a}_e^*\left(\phi, e, \zeta\right), e, \zeta\right) \Pi_i\left(\mathbf{a}_e^*\left(\phi, e, \zeta\right), \mathbf{a}_l^*\left(\mathbf{a}_e^*, s, \phi, e, \zeta\right), s, e, \zeta\right) \tag{2}$$

Let $e\left(\phi, \zeta\right)$ be the solution to this equation, which implicitly defines the promised interest rate on the loan.

Using the approximation from (1):

$$y(\phi,\zeta)=1-\sum_{s\in S}\pi\left(s|\mathbf{a}_e^*\left(\phi,e\left(\phi,\zeta\right),\zeta\right),e\left(\phi,\zeta\right),\zeta\right)\Pi_i\left(\begin{array}{c}\mathbf{a}_e^*\left(\phi,e\left(\phi,\zeta\right),\zeta\right),\\ \mathbf{a}_l^*\left(\mathbf{a}_e^*,s,\phi,e\left(\phi,\zeta\right),\zeta\right),s,e\left(\phi,\zeta\right),\zeta\end{array}\right)$$

The larger the amount of income that the firm can pledge to the intermediary, the lower is the interest rate on the loan.

In effect, the firm faces a contract market in which it can choose to raise amount $e(\phi,\zeta)$ if it chooses a covenant bundle ϕ. The payoff to a firm ζ from contract ϕ is then:

$$\sum_{s\in S}\pi\left(s|\mathbf{a}_e^*\left(\phi,e\left(\phi,\zeta\right),\zeta\right),e\left(\phi,\zeta\right),\zeta\right)\Pi_f\left(\begin{array}{c}\mathbf{a}_e^*\left(\phi,e\left(\phi,\zeta\right),\zeta\right),\\ \mathbf{a}_l^*\left(\mathbf{a}_e^*,s,\phi,e\left(\phi,\zeta\right),\zeta\right),s,e\left(\phi,\zeta\right),\zeta\end{array}\right),$$

which one can write as the total income generated by firm from this contract $v(\phi,\zeta)$ minus the expected amount that the firm needs to repay, $e(\phi,\zeta)$:

$$=v(\phi,\zeta)-e(\phi,\zeta)$$

where the total income generated by firm is:

$$v(\phi,\zeta)\equiv\sum_{s\in S}\pi\left(s|\mathbf{a}_e^*\left(\phi,e,\zeta\right),e,\zeta\right)\left[\begin{array}{c}u\left(\mathbf{a}_e^*\left(\phi,e\left(\phi,\zeta\right),\zeta\right),\mathbf{a}_l^*\left(\mathbf{a}_e^*,s,\phi,e\left(\phi,\zeta\right),\zeta\right),s,e\left(\phi,\zeta\right),\zeta\right)\\ -c^f\left(a_e^*\left(\phi,e\left(\phi,\zeta\right),\zeta\right),\mathbf{a}_l^*\left(\mathbf{a}_e^*,s,\phi,e\left(\phi,\zeta\right),\zeta\right),s,e\left(\phi,\zeta\right),\zeta\right)\\ -c^i\left(\mathbf{a}_e^*\left(\phi,e\left(\phi,\zeta\right),\zeta\right),\mathbf{a}_l^*\left(\mathbf{a}_e^*,s,\phi,e\left(\phi,\zeta\right),\zeta\right),s,e\left(\phi,\zeta\right),\zeta\right)\end{array}\right]$$

This expression demonstrates that, ex ante, the firm bears the expected cost of monitoring by the intermediary, c^i, through the pricing of the loan in addition to its own cost c^f.

2.3 Contract choice

Even though there is a wide range of actions the firm and intermediary can take ex ante and ex post, and covenants can be state contingent, the choice of the optimal contract reduces to an expression similar to standard consumer choice. The firm chooses which covenants to introduce into the contract, and how restrictive these covenants should be, ϕ, which gives it a payoff of $v(\phi,\zeta)$ at the price of $e(\phi,\zeta)$. The firm chooses the covenant option that maximizes its expected payoff, as long as the contract provides a higher payoff than the outside option of taking a loan without covenants.

$$\phi^*=\arg\max_{\phi}v(\phi,\zeta)-e(\phi,\zeta)\tag{3}$$

To simplify the exposition I assume that $v(\phi,\zeta)$ and $e(\phi,\zeta)$ are differentiable, and their difference is concave for the rest of the analysis. In Appendix B I relax this assumption and analyze the case when ϕ is discrete. The firm chooses covenant strictness such that the marginal benefit of increasing covenant strictness equals the expected payments to the intermediary:

$$v_\phi(\phi^*, \zeta) = e_\phi(\phi^*, \zeta). \tag{4}$$

On the margin, the additional total income generated by covenant inclusion must equal the additional funds the intermediary is willing to lend because of an increase in pledged income. To take equation (4) to the data, it is useful to express loan prices in terms of interest rates. Substituting (1) into (4), we obtain:

$$v_\phi(\phi^*, \zeta) = -y_\phi(\phi^*, \zeta). \tag{5}$$

The additional income generated from tightening covenants on a loan with promised repayment of 1 equals the contemporaneous decrease in the interest rate on the loan. This is the equation I take to the data in Section 4.2.

2.4 Sufficient statistic for firm gains

The surplus that accrues to firms when intermediaries can provide debt contracts for all possible covenant configuration is:[7]

$$\begin{aligned} \mathcal{S}(\zeta) &= v(\phi^*, \zeta) - e(\phi^*, \zeta) \\ &= v(\phi^*, \zeta) + y(\phi^*, \zeta) - 1. \end{aligned}$$

The surplus accruing to firms is the amount of total income generated by the contract chosen by the firm, $v(\phi, \zeta)$, minus the funds lent to the firm, $e(\phi, \zeta)$. The interest rate enters with a positive sign, which seems surprising. However, a higher interest rate implies that fewer resources were lent, $e(\phi, \zeta)$ is smaller. Fewer resources, indirectly, imply a lower $v(\phi, \zeta)$ and lower surplus for the firm.

To compute the loss that firms would suffer from restricted contract choice, let Ω be the restricted space of contracts from which the firm can choose. Let $\phi^*_\Omega = \arg\max_{\phi \in \Omega} v(\phi, \zeta) + y(\phi, \zeta)$ be the contract choice from that set. Then the loss from restricting covenant choices is

$$\mathcal{S}(\zeta \,|\phi \in \Omega) - \mathcal{S}(\zeta) = v(\phi^*_\Omega, \zeta) + y(\phi^*_\Omega, \zeta) - v(\phi^*, \zeta) - y(\phi^*, \zeta) \tag{6}$$

The amount that is generated by a particular covenant is a special case of this sufficient statistic. Let ϕ^*_{-j} be the choice of covenants by the firms if they are not allowed to use covenant j. Then the change in surplus is

$$\mathcal{S}\left(\zeta \,\middle|\phi_j = 0\right) - \mathcal{S}(\zeta) = v\left(\phi^*_{-j}, \zeta\right) + y\left(\phi^*_{-j}, \zeta\right) - v(\phi^*, \zeta) - y(\phi^*, \zeta) \tag{7}$$

In Section 4 I show how to use the covenant pricing and firm covenant choices to estimate $\mathcal{S}(\zeta\,|\phi \in \Omega) - \mathcal{S}(\zeta)$ and $\mathcal{S}^*\left(\zeta \,\middle|\phi_j = 0\right) - \mathcal{S}(\zeta)$.

[7] Under (2) the amount of surplus firms realize is the total welfare that is generated in the market. Section 6.3 discusses how the surplus estimates relate to welfare under imperfect competition.

2.5 Which models can be nested

There is an extensive theoretical literature on financial contracting with covenants and state contingent debt contracting in general.[8] As long a given model is nested within our generic model, the firm's benefits from covenant contracting are determined by the sufficient statistic in (7). The generic model presented above is flexible and can nest a wide variety of models. It can accommodate a comprehensive array of possible covenants: granting restrictions on firms' choices such as investment or leverage, $A(\phi)$, allowing the intermediary varying degrees of involvement in firms' operations, $B(\phi)$, all of which can be state contingent $A(\phi, s)$, $B(\phi, s)$. The action space is general, nesting a wide set of choices for the firm and the intermediary, either before or after the resolution of uncertainty. Thus it can encompass a potentially very complicated game between the intermediary and firm in a normal form setting. Such a setting can easily nest renegotiation over project choice, riskiness or liquidation, and transfers that accompany such renegotiation. The ex post transfers between the firm and the intermediary can be state contingent $p(\mathbf{a}_e^*, \mathbf{a}_l^*, s, e, \zeta)$ and can differ from the ex ante promised interest rate y. This encompasses renegotiated interest payments and fees, which were not initially contracted, but arise during the renegotiation such as amendment fees. Renegotiations can result in non-pecuniary concessions such as changes in investment policy, which are reflected in the payoffs to the firm $u(\cdot)$ and $c^f(\cdot)$ or renegotiation costs captured in $c^f(\cdot)$ and $c^i(\cdot)$.

Below I sketch how some of the canonical models of contracting with covenants are nested in the model above. The early literature follows Jensen and Meckling (1976). The fundamental friction is the conflict of interest, which arises because shareholders may pursue ex post inefficient actions that transfer value from debt-holders. In the case of Jensen and Meckling (1976) these are projects whose mean payoff is lower than the opportunity cost of capital, but have a high variance. Covenants allow the firm to commit not to take these ex post inefficient actions. Within our model the ex post action a_e is the choice of the project, and covenants prevent firm actions which are ex post inefficient: ex post inefficient actions are not part of $A_e(\phi)$.

In the Jensen and Meckling (1976) setting covenants are a blunt tool, which could be costly if actions that are restricted would be efficient in some states. Smith and Warner (1979) recognize that ex post inefficient covenants may be renegotiated to the efficient outcome. For example, suppose that the firm's profits are low and therefore triggered the interest coverage covenant. The firm is in technical default and therefore the intermediary can accelerate the loan and liquidate the firm. Liquidating the firm is then one of the actions in $b_l \in B_l(\phi|covenant\ violated)$. If liquidation is inefficient then the parties could renegotiate the loan payments in the future and each be weakly better off. In this setting, covenants act as tripwires. They allow intermediaries to liquidate the firm before it can take inefficient actions, using renegotiation to prevent too much inefficient liquidation. Berlin and Mester (1992) and Aghion and Bolton (1992) are examples of such models.

Since renegotiation plays a central role in the literature that followed Jensen and Meckling (1976),

[8] For in-depth reviews see Gorton and Winton (2003), and treatments in Bolton and Dewatripont (2004) and Tirole (2006).

it is useful to see how it is nested in the model presented above. Consider Aghion and Bolton (1992),[9] another canonical model, in which covenants allocate potentially broad decision rights among parties and contractual incompleteness is the source of financial frictions. While actions cannot be contracted upon completely, covenants can allocate decision rights conditional on the state of the world. In the example above, if the covenant is violated, the intermediary can choose whether to liquidate the firm, or renegotiate the liquidation. To accommodate this event, notice that the action sets of the firm and the intermediary are potentially large and high dimensional. For example, one of the actions conditional on covenant violation $a_l \in A_l\left(\phi|covenant\ violated\right)$ can be to send a proposal for a renegotiated debt contract. Then the action space of the intermediary, $b_l \in B_l\left(\phi|covenant\ violated\right)$, can encompass declaring technical default or accepting the proposal. This setting is a simple one-shot bargaining game, which gives the bargaining power to the entrepreneur, but significantly more complicated renegotiation games can be formulated in a normal form game setting.

The last class of models focuses on using covenants to provide efficient incentives for intermediaries to monitor the firm. In Rajan and Winton (1995),[10] intermediaries can exert effort to obtain a signal about a borrower's quality that they can use to trigger the covenant or decide on a course of action once a covenant has been triggered. The model above incorporates the intermediary's effort in generating private information through the early action b_e at a cost of $c^i\left(s, a_e, a_l, b_e, b_l, \zeta, e\right) = c^i\left(b_e\right)$. The effort in generating the signal changes the distribution of the states of the world $\pi\left(s|a_e, b_e, e, \zeta\right)$, since now states in which the bank is informed and the covenant is potentially triggered are more likely.

The generic model above can then nest covenant models of monitoring, incomplete contracting, or conflicts of interests. This implies that the welfare created by covenants in these models reduces to the sufficient statistic in (7) regardless of the friction that generates the benefit of covenants.

3 Data

I use loan data from the Loan Pricing Corporation (LPC) DealScan database, which contains syndicated and non-syndicated private loans to firms collected from the Securities and Exchange Commission and other sources (see, for example, Chava and Roberts, 2008, for a discussion of the data). To obtain firms' accounting characteristics I match the data with Compustat using the link from Chava and Roberts (2008) and use the nine most popular financial covenants in the data. I use the Compustat quarterly data to construct firms' characteristics. I exclude utilities and financial firms.[11] I winsorize the accounting variables of the firm at the 1 percent level. I use values lagged by one quarter and drop any observations that do not have

[9]See Aghion, Dewatripont, and Rey (1994) and Harris and Raviv (1995) for models in which the contract assigns bargaining power in renegotiation.

[10]See also Gorton and Kahn (2000).

[11]To construct Q I follow Baker, Stein and Wurgler (2003) : $Q =$(total assets + common shares outstanding * closing stock price - book equity - deferred taxes)/(0.1*total assets +0.1*(total assets + common shares outstanding * closing stock price - book equity - deferred taxes) and set $Q = 10$ if $Q > 10$.

all financial data or data on loan amount or maturity. I restrict my attention to revolving lines of credit and short term facilities.

I present summary statistics in Table 1, Panel A. A central input into the welfare calculation in (7) is the trade-off between the interest rate and covenants included in the loan–the price of covenants $y(\phi, \zeta)$. There is substantial across and within firm variation in loan spreads and the number of covenants included in a loan. Loans on average include 2 covenants with a standard deviation of 0.9. The average spread[12] is $172bp$ with a standard deviation of $112bp$. First differencing of the data reveals that there is also a substantial amount of within firm variation in spreads and the number of covenants used: the standard deviation in the number of covenants is 1 and the standard deviation of loan spread is $104bp$.

There are, however, important differences in between and within firm variation in the data. Panel B shows pair-wise correlations between the loan spread and various firm and loan characteristics. I compare the unconditional correlations to within firm correlations obtained with first differencing. Several correlations change signs after first differencing, among them the crucial correlation between covenants and spreads. The unconditional correlation of 0.06 suggests there a positive relationship between the number of covenants and the spread. Within firm variation, on the other hand, suggests that, as firms add covenants their loan spreads decrease; the correlation is -0.08. The difference in these two sources of variation is important in considering which estimator I use in estimating covenant pricing in the next section.

In addition to measuring how restrictive covenants are by counting their number, I also explore the restrictiveness of individual covenants. The summary statistics are presented in Panel C. Covenants differ in the frequency of their use: the three most frequently used covenants are debt to EBITDA (57% of contracts), fixed charge (42% of contracts), and interest coverage (41% of contracts). There is a substantial amount of variation in how restrictive individual covenants can be. For example, the mean debt to EBITDA covenant requires debt not to exceed 3.9 times the EBITDA of the firm. Conditional on covenants being present, the standard deviation in this covenant is 1.73. I exploit the latter source of variation in estimating covenant prices in the next section**.**

4 Estimation

In Section 2, I show that the sufficient statistic for firm gains requires the estimation of the equilibrium price of covenants, $y(\phi, \zeta)$, and the total amount of income generated by a given debt contract, $v(\phi, \zeta)$. Below I describe how to estimate these quantities in turn. I discuss the identification assumptions in Section 4.3.

[12] In the basic specification I use the all-in-drawn spread, which is the spread paid on each dollar drawn in the basic specification. As a robustness check I also present the results using the all-un-drawn spread, which is the spread paid on each dollar of the credit line which is not drawn.

4.1 Covenant Pricing

I first estimate how the loan spread changes with covenant strictness, i.e. I estimate the price of covenants, $y_{\phi}(\phi,\zeta)$. A generic problem with estimating $y(\phi,\zeta)$ is that the interest rate may reflect firm characteristics, which are unobservable to the researcher, but are correlated with covenant choices. To see the intuition, suppose that firms that are less likely to repay the loan use stricter covenants. This is consistent with Nini, Smith and Sufi (2009) who show that firms, which are worse on observable dimensions, use more covenants. If the ability to repay a loan is not completely observable to the researcher, then covenant price estimates will be biased upwards. The positive bias occurs because the estimated covenant price conflates two effects: the actual covenant price, which reflects the decrease in the interest rate from higher covenant use, and the offsetting bias, because an increase in covenants partially reflects decreasing firm quality and therefore higher interest rates. If unobservable firm quality is time invariant we can use fixed effects or first differences to uncover covenant prices.[13] If, on the other hand, unobservable quality varies over time, fixed effects and first differences will be subject to the same positive bias. Changes in firms' quality that are not observed by the researcher, but are observed by market participants, are very likely. They include changes in future firm profitability, quality of collateral, and a host of other factors that affect loan repayment but are not captured in the contemporaneous observable firm characteristics.

I address these identification problems by exploiting the panel nature of the data and a standard assumption in the contracting literature: that the interest rate correctly reflects all payoff relevant information at the disposal of the contracting parties at the time the loan is made. Bajari et al (2012) propose an estimator for hedonic prices under such assumptions. While I impose standard parametric assumptions on the pricing and transition functions, Bajari et al (2012) show that parametric assumptions are not driving the identification– this pricing function is non-parametrically identified under rational expectations. The derivation below follows Bajari et al (2012).

Let vector ζ_{jt} describe all attributes of firm j at time t, and ϕ_{jt} the contract characteristics which are relevant for the income pledged to the intermediary and therefore the interest rate on the loan. The firm and loan characteristics play the same role: they alter the loan interest rate. Let $(\zeta_{jt},\phi_{jt}) \equiv (x_{jt},\xi_{jt})$ where x_{jt} is a vector of characteristics observable to the researcher such as leverage and covenant strictness, and ξ_{jt} captures the ability of the firm to repay a loan, which is not observable to the researcher. ξ_{jt} evolves over a period $\Delta t = t' - t$ following a Markov process parametrized by

$$\xi_{jt\prime} = \xi_{jt} e^{\tau\Delta t} + \eta_{jt\prime} \tag{8}$$

The observable firm and contract characteristics, and the time to next contract, evolve over time as

$$\begin{pmatrix} x_{jt'} \\ \Delta t \end{pmatrix} = \tilde{G}(x_{jt},\xi_{jt}) + \nu_{jt'}, \tag{9}$$

[13] This also assumes that the price of these characteristics is time invariant.

where $\tilde{G}(\cdot)$ is a linear function and

$$\begin{aligned} E\left(\eta_{jt\prime}|I_t\right) &= 0 \\ E\left(\nu_{jt\prime}|I_t\right) &= 0 \end{aligned} \tag{10}$$

Therefore $\eta_{jt\prime}$ and $\nu_{jt'}$ are the unexpected innovations in unobserved and observed firm and contract characteristics, respectively, conditional on information available at time t , I_t. For example, one component of $\tilde{G}(\bullet)$ is the expected increase in covenant use given a firm's characteristics at time t, and the corresponding component of $\nu_{jt'}$ is the unexpected change in covenant use. Another component is the time to next loan, Δt, which could vary depending on the state of the firm, for example, because of expected renegotiation. Economically, assumptions (10) are equivalent to the statement that loan prices correctly reflect all payoff relevant information at the disposal of the contracting parties at the time the loan is made. This assumption is common to models of contracting with covenants. These innovations in observed and unobserved firm characteristics can be correlated:

$$\eta_{jt\prime} = H\nu_{jt\prime} + \varepsilon_{jt'}, \tag{11}$$

where H is a vector. If, as in the example above, decreases in unobservable quality (increases in $\xi_{jt\prime}$) lead to more covenant use, then the component of H that is multiplying unexpected covenant use is positive.

The interest rate is determined by loan and firm characteristics at the time the loan is made.

$$y_{jt'} = \alpha + \Gamma x_{jt'} + \xi_{jt'} \tag{12}$$

Γ contains covenant prices– the coefficients on covenants – and is the vector of interest. Note that a higher $\xi_{jt'}$ corresponds to a higher interest rate, so a lower quality firm has a higher $\xi_{jt'}$. Since $E\left(\xi_{jt'}|x_{jt'}\right) \neq 0$, Γ cannot be estimated using OLS. Unobservable quality at time t',$\xi_{jt'}$, is the sum of the expected change in unobservable quality from time t, and its unexpected change. Formally, substituting (8) for $\xi_{jt\prime}$ the interest rate is

$$y_{jt'} = \alpha + \Gamma x_{jt'} + \xi_{jt} e^{\tau\Delta t} + \eta_{jt\prime}$$

Market participants observe the unobserved (to the researcher) firm quality, and take it into account in pricing the loan. One can obtain the unobserved firm quality at time t by inverting loan pricing (12):

$$\xi_{jt} = y_{jt} - (a_t + \Gamma x_{jt})$$

Substituting it into the previous equation I obtain

$$y_{jt'} = \alpha + \Gamma x_{jt'} + \left(y_{jt} - (\alpha + \Gamma x_{jt})\right) e^{\tau\Delta t} + \eta_{jt\prime} \tag{13}$$

Note that if unobservable quality is fixed, $\tau = 0$, and the changes in unobserved quality are not correlated with changes in observable firm characteristics, such as covenant use, $E\left(\eta_{jt\prime}|x_{jt'} - x_{jt}\right) = 0$, this equation can be consistently estimated using first differences.[14] Because the innovations in unobserved quality $\eta_{jt\prime}$ are potentially correlated with innovations in observed firm or contract characteristics from (11), there is a correlation between $\eta_{jt\prime}$ and $x_{jt'}$, biasing the estimates of covenant prices, Γ. In the example above, firms use more covenants as their quality declines. The time to next contract, Δt, could be endogenous to $\eta_{jt\prime}$ as well, for example, because of renegotiation (Roberts and Sufi, 2009b; Roberts, 2010). To address this correlation, substitute for ξ_{jt} in (9), and define a linear function $G(\cdot)$ as $\tilde{G}\left(x_{jt}, \xi_{jt}, \Delta t\right) = \tilde{G}\left(x_{jt}, y_{jt} - (\alpha + \Gamma x_{jt}), \Delta t\right) = G\left(x_{jt}, y_{jt}, \Delta t\right)$. Intuitively, market participants take unobservable quality at time t, ξ_{jt}, into account when loan prices, y_{jt}, are set. Conditioning on price y_{jt} in addition to observables, x_{jt}, therefore has the same information content as conditioning on unobservable quality, ξ_{jt} in addition to x_{jt}. I estimate

$$\begin{pmatrix} x_{jt'} \\ \Delta t \end{pmatrix} = G\left(x_{jt}, y_{jt}\right) + \nu_{jt'} \tag{14}$$

from the data. I predict a firm's observable characteristics,$x_{jt'}$, such as covenant use, at time t' from its observable characteristics, x_{jt}, and the interest rate, y_{jt}, at time t. Because expectations are rational (9 or, equivalently, $E\left(\nu_{jt\prime} | x_{jt}, y_{jt}\right) = 0$), the expected evolution of covenants, $G(\cdot)$ is identified from the data. Further, the predictable variation in covenants, $G\left(x_{jt}, y_{jt}\right)$ only conditions on information at time t, and is therefore exogenous to innovations that occur after time t, including the change in unobservable quality $\eta_{jt\prime}$. The predictable variation can then be used as the identifying source of variation.

I implement this instrument using the control function approach in the spirit of Heckman and Rob (1984) and Imbens and Newey (2009). Inverting (14) supplies an estimate of the unexpected innovations in observed loan and firm characteristics:

$$\hat{\nu}_{jt'} = x_{jt'} - \hat{G}\left(x_{jt}, y_{jt}\right), \tag{15}$$

where $\hat{G}(\cdot)$ is an estimate of $G(\cdot)$. I substitute the unexpected change in unobserved quality, $\eta_{jt\prime}$, in (13) with (11) and the innovation of observable characteristics with its estimate results in the estimation equation, $\hat{\nu}_{jt'}$:

$$y_{jt'} = \alpha + \Gamma x_{jt'} + \left(y_{jt} - (a_t + \Gamma x_{jt})\right) e^{\tau \Delta t} + H \hat{\nu}_{jt\prime} + \varepsilon_{jt'} \tag{16}$$

$\varepsilon_{jt'}$ is then orthogonal to innovations in observable quality and information at time t, I_t . I estimate this equation using GMM and the moment condition

$$E\left(y_{jt'} - \left(\alpha + \Gamma x_{jt'} + \left(y_{jt} - (a_t + \Gamma x_{jt})\right) e^{\tau \Delta t} + H \hat{\nu}_{jt\prime}\right) | x_{jt'}, \Delta t, x_{jt}, \hat{\nu}_{jt\prime}, y_{jt}\right) = 0.$$

Let $\hat{\Gamma}_{\phi_i}$ be the estimated coefficient on covenant ϕ_i from (16). $\hat{\Gamma}_{\phi_i}$ is then the covenant price of covenant ϕ_i, and the vector of covenant prices is the parameter of interest. I also estimate ancillary parameters: the evolution of the unobservable characteristic, τ, correlation in innovations between observable and unobservable

[14]If $\tau = 0$ we can rewrite (13) as $y_{jt'} - y_{jt} = \Gamma\left(x_{jt'} - x_{jt}\right) + \eta_{jt\prime}$.

characteristics, H, and the constant α.

4.2 Estimating firm benefits: sufficient statistic

In this section, I describe how to compute the empirical counterpart of the sufficient statistic for the surplus firms would lose if covenant choices were restricted (7), given an estimate of covenant prices. The expression in (7) requires two quantities: the price of covenants and the total income generated by the debt contract. In the previous section I estimate a vector of covenant prices, where $\hat{\Gamma}_{\phi_i}$ is the empirical equivalent of $y_{\phi_i}(\phi, \zeta)$. In this section, given an estimate of covenant pricing, I estimate $v(\phi, \zeta)$ using revealed preference.

Recall that the covenant choice problem of the firm reduces to a simple expression in (3). If a firm chooses a certain covenant bundle, it does so because it gives it a higher payoff than any alternative covenant bundle. The payoff a firm obtains from a given covenant bundle can be expressed as total income generated by firm ζ from contract ϕ, $v(\phi, \zeta)$. This is reduced by the amount borrowed by the firm, $e(\phi, \zeta)$, or alternatively, $1 - y(\phi, \zeta)$, where $y(\phi, \zeta)$ is the interest rate on the loan. The firm chooses covenants such that:

$$\phi^* = \arg\max_{\phi} v(\phi, \zeta) - (1 - y(\phi, \zeta))$$

To estimate $v(\phi, \zeta)$ I parameterize it. I discuss the role that the parametric restrictions play in identification in Section 4.3..

$$v\left(\phi_{j,t}, \zeta_{j,t}\right) = \gamma\left(\zeta_{jt}\right) + \sum_i \beta_{i,j,t} \log\left(1 + \phi_{i,j,t}\right) \tag{17}$$

where j indexes the firm, t time and i the covenant. $\phi_{i,j,t}$ is the strictness of covenant i, chosen by firm j at time t. $\beta_{i,j,t}$ is the parameter of interest, which captures the size of the benefits the firm can extract from a covenant. ζ_{jt} are firms' non-covenant characteristics, and $\gamma\left(\zeta_{jt}\right)$ is the value contributions of these characteristics.

For the specification to rationalize loans with no covenants, the absence of covenants cannot be infinitely costly. I therefore normalize the payoff to a loan with no covenants at $\gamma\left(\zeta_{jt}\right)$, since ($\log(1+0) = 0$). The parameterization in (17) is very flexible and allows a separate parameter (random coefficient $\beta_{i,j,t}$) for each firm and covenant choice, placing no restrictions on their distribution. That means that every firm can benefit to a different extent from covenant inclusion. Moreover, a firm could have a relatively high benefit of including covenant 1 and low benefit of including covenant k.[15] Since the goal of the paper is to evaluate the impact of covenant contracting, I leave the value contributions of non covenant characteristics, $\gamma\left(\zeta_{jt}\right)$, unspecified.

[15] Each contract choice can identify as many unknown parameters as there are first order conditions, i.e. the number of priced firm and contract characteristics.

Using the parameterization in (17), the firm's covenant choice problem is

$$\max_{\phi_{1,j,t},\ldots,\phi_{n,j,t}} \gamma\left(\zeta_{jt}\right)+\sum_{i}\beta_{i,j,t}\log\left(1+\phi_{i,j,t}\right)-\left(1-y\left(\phi_{i,j,t},\zeta_{jt}\right)\right)$$

I use the first order condition for each observed covenant choice $\phi^{*}_{i,j,t}$ (eq. (5) in Section 2) to estimate $\beta_{i,j,t}$ (Continuity and differentiability of the objective function are not necessary. For discrete choice, where the first order conditions do not apply, see Appendix B):

$$\begin{aligned}\frac{\beta_{i,j,t}}{\left(1+\phi^{*}_{i,j,t}\right)} &= -y_{\phi_i}\left(\phi^{*}_{i,j,t},\zeta_{jt}\right)\\ \beta_{i,j,t} &= -y_{\phi_i}\left(\phi^{*}_{i,j,t},\zeta_{jt}\right)\left(1+\phi^{*}_{i,j,t}\right)\end{aligned} \tag{18}$$

The result is intuitive: since the interest rate decreases in covenant tightness, $-y_{\phi_i}\left(\zeta_{i,j,t},\phi_{i,j,t}\right)$ is positive. Firms which choose more restrictive covenants for a given change in the interest rate do so because they benefit most from covenant inclusion and have the highest $\beta_{i,j,t}$. I obtain an estimate of $\beta_{i,j,t}$ by replacing the price of covenants, $y_{\phi_i}\left(\zeta_{i,j,t},\phi^{*}_{i,j,t}\right)$, with its empirical equivalent. Let $\hat{\Gamma}_{\phi_i}$be the coefficient on covenant i from (16), then

$$\hat{\beta}_{i,j,t}=-\hat{\Gamma}_{\phi_i}\left(1+\phi^{*}_{i,j,t}\right). \tag{19}$$

When a firm chooses not to use a particular covenant, $\phi^{*}_{i,j,t}=0$, a point estimate of $\hat{\beta}_{i,j,t}\left(\phi^{*}_{i,j,t}=0\right)$ is not identified. Any $\hat{\beta}_{i,j,t}\leq-\hat{\Gamma}_{\phi_i}$ is consistent with the firm choice so I can only bound $\hat{\beta}_{i,j,t}$. In the counterfactuals I compute, $\hat{\beta}_{i,j,t}\left(\phi^{*}_{i,j,t}=0\right)$ does not play a role, so I do not explicitly incorporate the bounds in the estimation and set $\hat{\beta}_{i,j,t}\left(\phi^{*}_{i,j,t}=0\right)=-\hat{\Gamma}_{\phi_i}$.

I use the estimates to compute firms' losses from restricting covenant choices derived in (6). Suppose that firms can only choose a boilerplate covenant j with a covenant strictness $\tilde{\phi}_j$, rather than any $\phi_j\in\left[0,\bar{\phi}_j\right]$. I first compute a firm's covenant choice when faced with these boilerplate options. The firm chooses covenant $\tilde{\phi}_j$ if the payoff is higher than a contract with no covenants, if:

$$\hat{\beta}_{i,j,t}\log\left(1+\tilde{\phi}_i\right)+\hat{\Gamma}_{\phi_i}\tilde{\phi}_i>0.$$

Substituting in for $\hat{\beta}_{i,j,t}$ from (18), the firm chooses covenant $\tilde{\phi}_j$ if

$$-\hat{\Gamma}_{\phi_i}\left[\left(1+\phi^{*}_{i,j,t}\right)\log\left(1+\tilde{\phi}_i\right)-\tilde{\phi}_i\right]>0$$

I then compute the surplus loss that results in these restricted choices as in (6) by applying (17) and (19) :

$$\begin{aligned}
&\mathcal{S}\left(\zeta_{j,t}\left|\phi_i \in \left\{0, \tilde{\phi}_i\right\}\right.\right) - \mathcal{S}\left(\zeta_{j,t}\right) = \\
= &\begin{cases} v\left(\zeta_{j,t}\left|\phi_i = \tilde{\phi}_i\right.\right) + y\left(\zeta\left|\phi_i = \tilde{\phi}_i\right.\right) - v\left(\phi^*, \zeta\right) - y\left(\phi^*, \zeta\right) & for \quad \phi_i = \tilde{\phi}_i \\ v\left(\zeta_{j,t}\left|\phi_i = 0\right.\right) + y\left(\zeta_{j,t}\left|\phi_i = 0\right.\right) - v\left(\phi^*, \zeta\right) - y\left(\phi^*, \zeta\right) & for \quad \phi_i = 0 \end{cases} \\
= &\begin{cases} \hat{\Gamma}_{\phi_i}\left[\left(1+\phi^*_{i,j,t}\right)\log\frac{\left(1+\phi^*_{i,j,t}\right)}{\left(1+\tilde{\phi}_j\right)} - \phi^*_{i,j,t} + \tilde{\phi}_j\right] & for \quad -\hat{\Gamma}_{\phi_i}\left[\left(1+\phi^*_{i,j,t}\right)\log\left(1+\tilde{\phi}_j\right) - \tilde{\phi}_j\right] > 0 \\ \hat{\Gamma}_{\phi_i}\left[\left(1+\phi^*_{i,j,t}\right)\log\left(1+\phi^*_{i,j,t}\right) - \phi^*_{i,j,t}\right] & for \quad -\hat{\Gamma}_{\phi_i}\left[\left(1+\phi^*_{i,j,t}\right)\log\left(1+\tilde{\phi}_j\right) - \tilde{\phi}_j\right] \leq 0 \end{cases}
\end{aligned} \tag{20}$$

The sufficient statistic in (20) is a function of observed covenant choices, $\phi^*_{i,j,t}$, covenant prices, $\hat{\Gamma}_{\phi_i}$, and the contracting restrictions $\tilde{\phi}_j$. A convenient feature of the surplus expression is that it scales with the covenant price, $\hat{\Gamma}_{\phi_i}$. One can then easily evaluate firms' surplus for different price estimates from the literature instead of the one obtained in (16).

When I compute the firms' surplus I extrapolate the calculation away from firms' actual decisions. One has to be cautious when extrapolating sufficient statistics out of sample without a fully specified structural model. In Appendix A I provide a formula that provides a conservative bound on surplus, which is less subject to out of sample extrapolation concerns as well as the parametric assumptions underlying it.

As a special case of this expression I can compute how much surplus would be lost by a given firm if covenant contracting were not available. To compute the loss for not being able to contract on covenant j, I subtract the surplus that the firm obtains at its current contract choice from the surplus the firm would obtain if covenant ϕ_j were not offered:

$$\mathcal{S}\left(\zeta_{j,t}\left|\phi_j = 0\right.\right) - \mathcal{S}\left(\zeta_{j,t}\right) = \hat{\Gamma}_{\phi_i}\left[\left(1+\phi^*_{i,j,t}\right)\log\left(1+\phi^*_{i,j,t}\right) - \phi^*_{i,j,t}\right] \tag{21}$$

To compute losses if no covenants were allowed, I sum over all covenant types i.

4.3 Identification discussion

I now discuss the identification of the parameters in the model that I am estimating: the price of covenants Γ_ϕ from (16) and the joint distribution of random coefficients $\beta_{i,j,t}$ in (17). As I show in Section 2, the contracting problem of covenant choice (3) boils down to a problem similar to consumer choice in hedonic demand models such as Bajari and Benkard (2005). The total income $v\left(\phi, \zeta\right)$ plays the role of consumer utility, and $-y_\phi\left(\phi, \zeta\right)$ the role of covenant price. Therefore I rely on hedonic demand estimation tools to estimate the parameters.

4.3.1 Identification of covenant prices

The identification of covenant prices requires rational expectations in setting prices and a panel structure of the data.[16] While the version of the estimator in Section 4.1 uses linear pricing and transition func-

[16] Bajari and Benkard (2005) provide the technical assumptions to guarantee the existence of a pricing function.

tions, Bajari et al (2012) show the estimator is nonparametrically identified under the assumption of rational expectations.

Consider the example in which firms choose more covenants when their unobservable quality worsens, so a first differences estimator would be biased.[17] The Bajari et al (2012) estimator decomposes changes in covenants into expected and unexpected changes, given the information at the time at which the previous loan was made, t. Because of rational expectations, the predictable variation in covenants is already captured in prices at t, and therefore exogenous to innovations that occur after t. The predictable variation can then be used as the identifying source of variation. With enough data one can follow the same approach if the pricing function and transitions of observable and unobservable characteristics are non-parametrically specified.

The assumption of rational expectations is quite natural in the contracting setting. First, invoking rational expectations might be more realistic when the parties are intermediaries and firms, rather than individual consumers. Loans are priced by sophisticated intermediaries who engage in such transactions on a regular basis and are experienced in this market. In the context of covenant pricing, rational expectations imply that financial intermediaries understand that firms' conditions change over time, and that intermediaries adjust the interest rates appropriately given their information. Second, models of contracting with covenants rely strongly on rational expectations to begin with. Parties take actions such as investment and monitoring choices based on expectations of future contingencies, including actions and payoffs conditional on the state of the world. Covenants are efficiently chosen because covenant prices correctly reflect future contingencies. If these expectations are not correct, then using contracting to shape future contingencies is also of limited use and surplus consequences are difficult to pin down.

4.3.2 Identification of total income

In the estimation of total income I impose assumptions on the nature of the firm's payoff function. Below, I discuss the role these assumptions play in the identification of total income, and how they can be relaxed.

Identifying the random coefficients $\beta_{i,j,t}$ in (17) relies on the weak assumption of revealed preference given a consistent estimate of covenant prices. These covenant prices can be recovered using the estimator described above, or alternatively, using existing estimates from the literature (Bradley and Roberts, 2004), or with a natural experiment. Firms are optimizing and choose the covenant bundle that gives them the highest payoff given covenant pricing. Firms which choose more covenants obtain higher payoffs from covenant inclusion.

The specification I estimate is extremely flexible. I impose no parametric restrictions on the distribution of the random coefficients $\beta_{i,j,t}$. The joint distribution of firms' preferences over covenants is estimated nonparametrically. Bajari and Benkard (2005) show that the critical condition for nonparametric identification of the joint distribution of random coefficients is that the product set is continuous: financial covenants

[17] The rational expectations estimator provides consistent estimates if first differences assumptions are satisfied. If rational expectations hold, then we can directly test for these assumptions by examining the parameters τ and H.

are continuous, since they specify ratios of financial variables.

I impose parametric restrictions on the payoff function, which are helpful with limited data. However, with many observations per firm, the parametric assumptions can be relaxed and the payoff function can also be specified non-parametrically if we assume that firm's preferences for covenants are stable over time, if $\beta_{i,j,t} = \beta_{i,j}$ for all t. Further, in Appendix A I compute a sufficient statistic which is less sensitive to parametric assumptions, because it limits the amount of extrapolation used to compute it.

For the purposes of estimation, I also assume that the payoff function of the firm is continuous, differentiable and that the firm is able to choose from a continuous set of covenants. These assumptions are made for expositional convenience. In Appendix B, I provide bounds for the sufficient statistic if covenant choice is discrete to show how one can estimate surplus if these assumptions do not hold.

5 Results

5.1 Covenant pricing: simple model

In this section I estimate how the inclusion of additional covenants changes the interest spread of the loan. I first use the number of covenants to measure how restrictive the contract is for the borrower. This specification ignores the vast contractual richness that is at the disposal of parties in this market, but allows for a transparent intuition for the results. It also provides a benchmark against which one can evaluate how adding more realistic contract richness in Section 5.3 affects the estimates of firms' surpluses.

The results from the rational expectations (RE) estimator are presented in Column 1 of Table 2. Introducing an additional covenant decreases the loan spread by $42bp$. Consider a loan with no covenants that is charged a mean loan spread of $150bp$. Adding the mean number of covenants, 2, allows the lender to extract enough income in expectation to decrease the loan spread by $84bp$ or more than half. Alternatively, a one standard deviation in the number of covenants, 0.9, decreases the loan spread by one third of its standard deviation. Relative to the mean and the standard deviation of spreads, this is an economically large change. In addition to negative covenant prices, the prices of non-covenant loan characteristics also have the correct signs. Larger loans and loans of higher maturity should require weakly higher spreads. The estimated coefficients have positive and statistically significant coefficients.

One important reason to use the RE estimator is the concern that firms' unobservable quality changes over time, and changes in unobserved quality are correlated with changes in covenant use. The estimates confirm this view. First, firms' unobservable quality decays in expectation. The coefficient of -1.56 (τ in eq. 16) implies a 5.3 month half-life of unobservable quality.[18] One possible explanation for the decay is that unobservable quality becomes observable over time: it appears in firms' profitability, or the choices the firm makes in the future. Alternatively, a firm might have simply had an abnormal quarter and is reverting

[18]The control function coefficient on the unexpected innovation in the time to a new loan is positive, suggesting that the choice of when to take on a new contract is correlated with innovations firms' ability to repay, consistent with Roberts and Sufi (2009b) and Roberts (2010).

$\frac{\partial(\beta_{j,t}\log(1+\phi_{j,t}))}{\partial\phi_{j,t}}$,

back to its observable characteristics.

Second, the coefficient on the control function for the number of covenants is positive and statistically significant. It demonstrates that unexpected increases in firms' covenant use, given their past loans and characteristics, are correlated with higher spreads. Therefore, firms *choose* to include more covenants as their ability to pledge income declines, and this decline is not captured in its entirety by observable firm characteristics.

It is useful to compare the RE estimates to those from OLS and FD, which are presented in columns 2 and 3 of Table 2. RE estimates indicate that unexpected decreases in unobservable quality are correlated with higher covenant use. This selection mechanism should result in a positive bias in covenant prices using OLS and FD. This is confirmed in the data: the estimates are significantly smaller (less negative) than those from RE. The OLS coefficient on the number of covenants is $-5bp$, and statistically significant at 10 percent. The FD coefficient is 60 percent larger than OLS: introducing an additional covenant decreases the loan spread by $8bp$.

Comparing OLS results to FD estimates shows that the same bias that is driving the difference between FD and RE is also at work in the cross-section. Relative to OLS, the FD specification removes the time invariant component of borrower's ability to generate pledgeable income. Relative to FD, OLS then conflates two effects: first, firms, which over time choose more covenants, are charged lower spreads. This variation is captured by FD. Second, firms which, all else equal, generate less pledged income, sign contracts that contain more covenants in the cross-section, which biases the OLS relatively more than FD.

The last piece of evidence that OLS and FD estimators are biased, and that correcting for this bias is important, can also be seen in the estimated effects of maturity and loan amounts on spreads. Both OLS and FD result in negative coefficients on these variables, which suggest that these estimators are biased. The RE estimator, on the other hand, predicts the correct, positive sign on loan size and maturity, which are also statistically significant.

5.2 Total income and firm gains: simple model

5.2.1 Intuition with numbers: Rationalizing covenant choices and prices

Estimating covenant prices recovers the expected pledged income that the lender can expect from a debt contract. The second stage of the estimation combines covenant prices with individual firm covenant choices to recover how changing the covenants structure affects total income produced. Then I use these estimates in computing firms' net gains. I discuss the robustness of these results in Section 6.

I use (19) to estimate the non-parametric distribution of the parameter $\beta_{j,t}$. To see the intuition, consider a firm that signed a contract with five covenants. Prima facie, since it chose a covenant heavy contract, the firm finds covenant inclusion very valuable. The marginal income from the fifth covenant is $\left.\frac{\partial(\beta_{j,t}\log(1+\phi_{j,t}))}{\partial\phi_{j,t}}\right|_{\phi_{j,t}=5} = \frac{\beta_{j,t}}{1+5}$, which is accompanied by a marginal decrease in the spread of 42 bp. At the optimum the borrower has to be indifferent on the margin, $\frac{\beta_{j,t}}{6} = 42\ bp$, so $\beta_{j,t} = 42 * 6 = 252$. In contrast, the borrower who chose the median number of covenants, 2, places lower value on including covenants in the contract. The firm either considers covenant restrictions more costly or it requires less external capital. The borrower has to be indifferent between adding the second covenant and increasing income by $\left.\frac{\partial\left(\beta_{j,t}\log\left(1+\phi_{j,t}\right)\right)}{\partial\phi_{j,t}}\right|_{\phi_{j,t}=2} = \frac{\beta_{j,t}}{3}$ and decreasing the loan spread by $42bp$, implying $\hat{\beta}_{j,t} = 126$. This estimate implies that given a set of covenants, this borrower generates one half of the income of the borrower with $\hat{\beta}_{j,t} = 252$. Because this borrower values covenants less, she chooses fewer covenants. The distribution of $\beta_{j,t}$ is presented in Table 3, with a mean of 124 and standard deviation of 38, revealing a substantial variation in the benefits firms derive from covenant inclusion.

We can use the estimates of $\hat{\beta}_{j,t}$ and $\hat{\Gamma}$ to compute the change in the total amount of income produced by covenant choices of different firms, $v\left(\phi_{j,t}, \zeta_{j,t}\right) - v\left(0, \zeta_{j,t}\right)$, as well as the surplus they realize using (21). To see the intuition, consider the firm with $\hat{\beta}_{j,t} = 252$. The firm obtains $4*42 = 168bp$ of additional funding for a contract with face value of \$1. It uses these funds to create an additional income of $252\log 6 = 452bp$. The net surplus is the income minus the change in resources borrowed to create this income: $425 - 168 = 242bp$. Including 5 covenants therefore relaxes this firm's financial constraints to the degree that, holding the amount of financing it obtains fixed, it would be willing to pay an additional $242bp$ higher loan spread to be able to contract with covenants.

The distribution of gains is not even across firms. The median contract uses 2 covenants and $\hat{\beta}_{j,i} = 126$. Applying (21), the surplus generated is $54bp$, less than a third of the surplus of $\hat{\beta}_{j,t} = 252$. The smaller gain is a consequence of smaller additional income generated, $138\ bp$, but also fewer resources borrowed to generate this income, $84\ bp$. These calculations illustrate that firms, which use the most covenants, realize the largest gains. These results are consistent with the previous literature, which finds that financially constrained firms use the most covenants, (Nini, Smith and Sufi, 2009).

5.2.2 Contracting without covenants in the simple model

The calculations in the above allow me to quantify the size of the benefits that firms realize from covenant contracting. To systematically evaluate firms' gains from covenant contracting, I compute the change in surplus (21) and loan spreads that would result if intermediaries could only offer debt contracts without covenants. I do that for every loan in the sample. Figure $1a$ shows that fewer spreads cluster close to 0 and the distribution of spreads shifts to the right after covenants are abolished. The increase in spreads compensates intermediaries for lower expected income. The mean spread of $255bp$ (Table 3, Panel B) represents an almost 50 percent increase relative to observed spreads. Abolishing covenants reduces the surplus on average by $59\ bp$ per \$1 of loan face value. Contracting without covenants leads to the same firm surplus as being able to contract with covenants, but with intermediaries charging $59bp$ higher spreads, holding all else equal. An alternative way to interpret the magnitude of the estimates is to compare firms' surplus losses to the actual spreads. One can think about spreads as approximating revenues from intermediation–the mean surplus that firms would lose by not being able to contract with covenants represents 52% of the spread.

My estimates imply that large benefits accrue to firms when they can enter debt contracts with covenants, represent approximately half of the "revenues" from intermediating these loans. These estimates imply significant financial frictions that firms would face in an environment, which did not support such sophisticated debt contracts, either because of the poor quality of the intermediaries or the legal system. The losses in surplus can differ from an increase in interest rates, which firms would face in such an environment. In other words, suppose one were able to observe differences in loan interest rates across countries with different ability to enforce covenants, holding all else equal. Large interest rates would reflect a decrease in income that the firm can promise to the intermediary. By computing surplus losses one can quantify the loss in investment opportunities, which occur because firms are more financially constrained.

The estimates in (Table 3, Panel B) also show that, as the intuition above suggests, the gains from covenants are not evenly distributed: the 90^{th} percentile firm gains $105bp$ per $\$1$ or 107% of the spread, while the 10^{th} percentile firm gains 16 bp or 4% of the spread. Large surpluses are needed to rationalize the frequent use of covenants in privately placed debt contracts and large covenant prices. Large differences in covenant benefits are necessary to rationalize the heterogeneity in covenant use among firms, especially given the large average benefit of covenants.

5.2.3 Boilerplate contracting in the simple model

Intermediaries offer debt contracts that are tailored to individual firms. The menu of potential debt contracts involves how many and which covenants the contract will contain and how restrictive individual covenants are. What would happen if covenants were still available, but firms were restricted to choosing among a small number of "boilerplate" covenants? In other words, how important is it, that covenants complete contracting to the extent they do. I take a first stab at estimating the importance of covenant variety by restricting the number of covenants intermediaries can offer in debt contracts. I explore this question in more depth once I incorporate more realistic contract richness in Section 5.3.

I first limit the contract choices of firms to two debt contracts: a debt with no covenants, and a debt with 2 covenants, the median in the data. Most firms already choose one of these contracts. Further, for firms that choose a different contract, these two contracts are still in the vicinity of their optimal choice. Therefore this counterfactual provides a lower bound on the importance of variety of covenant choices. Facing this limited contract choice, firms which use covenants in the data still choose covenants in the counterfactual. For firms that did not choose 2 covenants in the data, the restricted contract set results in changes in loan spreads and a loss in surplus. The distribution of loan spreads is presented in Figure $1b$. Spreads increase for firms which originally chose more than 2 covenants and decrease for firms that would have chosen 1 covenant.

I use (20) to compute the surplus decline associated with decreased covenant choices and present the results in Table 3, Panel C. The decrease is not very large; firms are willing to pay a $4bp$ higher spread on average to maintain a flexible choice of covenants rather than be limited to two boilerplates. A small loss is expected: approximately half of the firms already choose one of these contracts when choices are not restricted. These firms do not experience losses. Moreover, for firms which choose 1 or 3 covenants, choosing 2 covenants is close to their optimal choice. While the decline in surplus is not very large, it still represents almost 7% of gains achieved through contracting with covenants.

To further explore the importance of variety in covenant choices, I first consider the market in which only debt with 3 covenants is offered in addition to plain, 0 covenant debt. Firms which would have chosen 1 covenant prefer to instead choose a contract with no covenants. The resulting spreads nevertheless decline on average, since firms which would have otherwise chosen 2 covenants now choose 3 instead. The decline in firms' surplus is larger than before at $7bp$ (Table 3, Panel C), since firms' choices are less optimal. The largest loss, $14bp$, occurs in the counterfactual where covenant contracts are restricted to 1 covenant only in addition to 0 covenant debt. This loss in surplus represents 24% of the total loss that would be caused by removing covenants completely.

These estimates suggest that firms obtain large benefits from being able to enter debt contracts which contain covenants. Even if firms' choices are severely restricted to a few boilerplate covenants, they still realize almost three quarters of the surplus. Interpreting these results broadly, they imply that courts in developing countries may not need the expertise to enforce a wide range of sophisticated debt contracts. Being able to enforce a few boilerplate contracts would already provide large benefits. I explore the magnitude of the costs of boilerplate contracts in more detail in the section below.

5.3 Individual covenants

Counting the number of covenants to measure their restrictiveness takes a simplistic view of contracting in this market. In particular, it underestimates the amount of fine tuning of debt contracts that can be achieved in reality. In this section, I examine the full richness of covenant choices: firms choose among different covenant types and, further, choose how restrictive each covenant should be. Covenant choice in this section is continuous so the debt contract can be fine tuned to the firm: in the previous section a firm could choose among 10 debt contracts; in this section it chooses from a product set in $\mathbb{R}^9$. Incorporating more realistic contractual richness allows me to examine differences between covenants and obtain better estimates of the cost of boilerplating in this market.

The key input into the calculations for firms' surpluses in (20) and (21) is the pricing of different covenants. In the previous section, there was only one price: the price for increasing the number of covenants. In this section each covenant has its own price, which is the change in the spread that accompanies an increase in the strictness of a given covenant. For ease of comparison and interpretation, I normalize all covenants such that an increase in the variable represents an increase in how restrictive the covenant is. To map the data to the model in Section 2, the absence of covenant takes a value of 0. Therefore I normalize all covenants, which use the level of debt in the numerator by subtracting their value from the highest value in the dataset.[19]

Covenant prices are estimated using the RE estimator presented in Section 4.1. The results are presented in Table 4. Seven out of nine coefficients are negative, implying that as the covenant becomes more restrictive, the loan spread decreases. The coefficient on the debt service covenant is positive, but both statistically insignificant and economically small. As in the previous specification, larger loan amounts and longer maturity loans require larger spreads. The coefficient on the short term debt to EBITDA covenant is the only covenant that is not priced as predicted by theory.[20] A possible reason is that it is the least used covenant in the data, which decreases the ability to estimate its joint evolution with other firm characteristics. In computing firms' surpluses, I focus on the seven covenants with negative coefficients. The interest coverage and leverage ratio covenants have the largest effect on covenant pricing: a one standard deviation change in covenant strictness decreases the loan spread by $39bp$ and $23bp$, respectively. This is sizeable relative to a standard deviation in spreads of $112bp$.

Covenant pricing measures the additional pledged income that is generated by increasing covenant strictness. To estimate how much total income is generated by covenant inclusion, I estimate the distribution of random coefficients $\beta_{i,j,t}$ in (17) using the individual borrower's first order condition, (19). There is a first order condition for every covenant choice the firm makes, so I estimate the joint distribution of $\beta_{i,j,t}$ for all covenant types. Further, since the covenant space is continuous, we can obtain better (non-parametric) estimates of the distribution of $\beta_{i,j,t}$ than in the previous section. I use the estimates of $\beta_{i,j,t}$ to address several questions.

5.3.1 Contracting without covenants

I first use my estimates to compute the size of firms's surpluses once we account for the full richness of covenants. Results are presented in Panels A and B of Table 5. Eliminating all covenants would result in an average spread increase of $51bp$ and a surplus loss of $85bp$ for every $\$1$ of face value. For the average firm, the surplus represents 118% of the spread (Panel C of Table 5). The median surplus loss from eliminating covenant contracting is $55bp$, and even the 25^{th} percentile firm loses $25bp$ of surplus. Comparing these results to those in Section 5.1 and Section 5.2 illustrates that introducing realistic contract richness is important, resulting in higher surplus losses,[21] which are more evenly distributed among firms. To better understand the source of these large gains I next study which covenant types generate most surplus and how the variety of covenant types affects the distribution of surpluses among firms.

[19] For example, suppose the firm's Debt to EBITDA covenant changes from 4 to 5. This represents a looser covenant, and the difference in the data is -1.

[20] Neither OLS, nor FD, estimate a negative coefficient on this covenant and also have wrong coefficients on loan amount and maturity.

[21] In discrete choice models with i.i.d. taste shocks, consumer surplus mechanically increases as the product space fills-up. This force is not driving the increase in surplus in this hedonic model.

5.3.2 Types of covenants

Firms can choose among different types of financial covenants. I examine the role that different covenant types play in generating the large surpluses estimated above by computing the loss of surplus (21) and changes in spreads (16) from eliminating one covenant from a set of possible debt contracts. Results are presented in Panels A and B of Table 5. Leverage ratio and interest coverage covenants have the largest impact on firms' surpluses. Firms would on average be willing to pay $37bp$ in addition to their current spreads, holding all else equal, to maintain access to the current covenant selection rather than contract without the leverage ratio covenant. This premium is $24bp$ for the interest coverage covenant. Even though the leverage ratio covenant has a larger impact on surplus than the interest coverage covenant, the increase in spreads is on average smaller, $11bp$ versus $30bp$. Therefore, while the leverage covenant generates less pledged income, it also does not constrain efficient actions of the firm.

The leverage ratio and interest coverage covenants are not the most frequently used covenants (see Table 1). They do, however, have large covenant prices. If a covenant is used a lot, this implies that the benefit of using it exceeds the cost of doing so for a large number of firms. The magnitude of the benefit, however, depends on the covenant price. This result shows that utilizing information in covenant prices and covenant choices *simultaneously* in my framework is critical for understanding which covenants are most beneficial to firms.

My framework identifies surpluses, which are consistent with a wide class of covenant models. Therefore it does not distinguish which models contribute more to the estimated surpluses. The leverage and interest rate covenant perform substantially different roles, however, allowing us to speculate, which classes of models might be quantitatively relevant. The leverage covenant prevents firms from increases in leverage. Large surpluses from this covenants lend quantitative credence to early theories of Jensen and Meckling (1979), and Smith and Warner (1979), in which covenants explicitly forbid ex post inefficient actions, such as expropriating debtholders with leverage increases. Interest rate covenants, on the other hand, act as tripwires, signaling low cash-flows of the firm, which leads to lender intervention suggesting that more recent theories such as Aghion and Bolton (1992) and Rajan and Winton (1995) also address quantitatively important frictions.

My estimates reveal a second benefit of firms' being able to choose from a variety of covenant types. The gains from individual covenant types are very skewed, accruing to a small set of firms. For example, while the mean surplus generated by the leverage covenant is $37bp$, the standard deviation of these gains is $74bp$ (Panel B of Table 5). The gains from covenants contracting on the whole are much more evenly distributed: firms, which face different frictions, choose the covenant that is most appropriate for their situation.

5.3.3 Costs of boilerplate covenants

Once the firm chooses a covenant type, it can also choose how restrictive that covenant is. Suppose intermediaries offer all types of covenants. How restrictive each covenant is, however, cannot be chosen, but is instead fixed at a pre-specified, "boilerplate," level. I compute how much surplus would be lost if firms were forced to write boilerplate covenants. To see if one can obtain large losses I choose suboptimal boilerplates that are significantly different from the mean covenants firms use in the data. I first compute the surplus if intermediaries can only offer very tight boilerplate covenants at 90^{th} percentile strictness among contracts that employed that covenant. The second calculation allows only very loose boilerplates set at the 10^{th} percentile level. The results are presented in Table 6. In both cases the losses of firms' surplus are small, on the order of $3-4bp$, and are concentrated in the interest coverage covenant. While losses across these two counterfactuals are similar in magnitude, their sources are somewhat different. If intermediaries only offer very strict boilerplate covenants, the adjustment is on the extensive margin and fewer firms choose to use that covenant: 8% of firms, which chose the interest coverage covenant in the data, choose not to use this covenant in the counterfactual. If only loose boilerplate covenants are offered, on the other hand, firms would like to constrain themselves more in order to obtain more funds ex ante. These counterfactuals might explain why covenants in the data cluster at certain financial ratios[22]–surplus increases from fine-tuning them further are small.

6 Discussion and robustness

In this section I discuss the robustness of results to alternative measurement of spreads, and the impact that imperfect competition and asymmetric information would have on the estimation and results presented above. In Appendix A I present an alternative sufficient statistic, which is less subject to extrapolation concerns, and therefore, relaxes the concerns about the parametric assumptions in estimating it. I relax the assumption of continuous choice in Appendix B.

6.1 Alternative estimates of covenant pricing

One advantage of the sufficient statistic, (21), is that it is linear in covenant price. The results can therefore easily be recomputed for alternative estimates of the covenant price. For example, Bradley and Roberts (2004) find that a one percent increase in the spread results in a 70% increase in the likelihood of having more than two financial restrictions. Within our framework that translates to a $70bp$ decrease in the spread per additional covenant. Using their estimates, for example, would result in gains that are 67 percent larger than using my estimates.

6.2 Robustness to alternative spreads

Loans can have several promised interest rates. In the baseline specification I use the all-in-drawn spread, which is the spread paid on each dollar of the loan that the firms draws down. As a robustness check in Table 7, I present results using the all-un-drawn spread, which is the spread paid on each dollar of the credit line

[22] For example, over two third of leverage ratio covenants in the data have leverage ratios of 0.50, 0.55, 0.60, or 0.65, and over 40 percent of interest coverage covenants have ratios of 2, 2.5 or 3 even though in-between values are also observed in the data.

which is not drawn. Measured in basis points, the covenant price is significantly smaller then measured with the spread on drawn funds, at $4bp$ (see Table 7, Panel A). This is not surprising, since spreads on un-drawn funds are generally lower–the mean is $32bp$, compared to the mean spread on drawn funds of $172bp$. Relative to the mean spread, adding the mean number of covenants, 2, allows the lender to extract enough income in expectation to decrease the un-drawn spread by $8bp$ or approximately 25% of the mean. Alternatively, a one standard deviation in the number of covenants, 0.9, decreases the un-drawn spread by 18% of the standard deviation ($21bp$). While smaller than the effect of covenant inclusion on spreads of drawn funds, the effect of covenant inclusion on spreads of undrawn funds is still economically large.

Next, as in Section 5.2 I compute the change in surplus (21) and loan spreads that would result if intermediaries could only offer debt contracts without covenants for every loan in the sample. Abolishing covenants reduces the surplus on average by 6 bp per $\$1$ of loan face value. Contracting without covenants leads to the same firm surplus as being able to contract with covenants, but with intermediaries charging 25 percent higher spreads on un-drawn funds, holding all else equal. The frictions that can be resolved by covenants then represent approximately one quarter of the "revenues" from un-drawn fees representing a large gain from contracting. These results suggest that the ability to incorporate covenants into debt contracts generates substantial gains for firms on the dimensions of un-drawn spreads as well.

Intermediaries realized payoffs can depart from promised interest payments reflected in drawn and un-drawn spreads. These spreads are frequently renegotiated and new fees, which have not been specified in the initial contract, can be added, such as fees resulting from renegotiation. The intermediary may also realize some pecuniary and non pecuniary costs of monitoring the loan, including legal fees, or cost of renegotiation ex post, which depend on its actions as well as the actions of the firm. As I discuss in Section 2, the ex ante, promised, interest rates contain the relevant information about intermediaries payoffs from the perspective of firms' surpluses. Any fees, which have not been specified ex ante are therefore already accounted for in the estimation.

6.3 Competition and Welfare

A standard assumption in finance is that there is a perfectly elastic supply of capital and perfect competition among intermediaries. I use the same assumption when I impose that (2) holds: the loan amount equals the expected income of the intermediary. This assumption would be violated, for example, if the banking market was oligopolistic, if banks had a relationship with firms,which would allow them to extract rents, or if the supply of capital were constrained. This assumption, while stark, has no effect on the estimation: covenant pricing the firm faces is estimated using rational expectations (16), and does not make assumptions on the nature of competition.[23] The estimation of the random coefficients (19) for the total income generated by the firm is likewise unaffected by the nature of competition,[24] since it is based on the firm's first order condition

[23] For an extended discussion, see Bajari et al (2012).

[24] Bajari and Benkard (2005) show that the distribution of random coefficients in hedonic models of demand is estimated independent of competition.

given the market price of covenants.

Under assumption (2) the sufficient statistic can be interpreted more broadly than I had interpreted it up to this point. Total benefit to society, welfare, that is generated from covenant contracting comprises the gains to firms and intermediaries. Under perfect competition and elastic supply of capital, intermediaries obtain no surplus, so only surplus accruing to borrowers enters the welfare calculation. In other words, under assumption (2), the sufficient statistic represents an estimate of welfare generated by covenant contracting. Under imperfect competition or increasing marginal cost of intermediation activities, intermediaries also realize some producer surplus. Then the sufficient statistic in (21) is a lower bound on total welfare. One could identify producer surplus with additional parametric restrictions on the marginal cost of intermediation and the nature of competition.

6.4 Asymmetric Information

I assume that lenders and borrowers are symmetrically informed about borrower's quality, although some of this information is potentially unobservable to the researcher. Suppose that is not the case, and borrowers have more information about their ability to repay a loan than the lender. The model presented in Section 2 can easily nest adverse selection but it comes at the expense of substantially more cumbersome notation. The difference from the symmetric information case arises in covenant pricing in (2): with asymmetric information the price is conditional on the information set of the lender, and the market price takes into account the equilibrium sorting of borrowers. The total income generated, on the other hand, is conditional on the information available to the borrower.

Asymmetric information has little impact on the estimation itself. The interpretation of covenant pricing (16) changes: with asymmetric information the estimated price is conditional on the information set of the intermediary. The unobservable quality $\xi_{jt\prime}$ in Section 4.1 is the belief about borrower's quality that is in the information set of the lender, but not observed by the econometrician. The estimated price is nevertheless the market price of covenants from the perspective of the borrower. The estimation of the random coefficients $\beta_{i,j,t}$ in (17) is based on the firm's first order condition (19) and is conditional on the firm's information. Therefore it is unaffected by asymmetric information.

Asymmetric information can have an impact on counterfactual prices and surplus estimates. In the counterfactual, in which contracting with covenants is not possible, the sorting of firms into the simple debt contract without covenants may change, and so would the spreads. Surplus losses from removing covenant contracting would be larger than I estimate. I estimate firms' surplus if the debt contract were still available. However, if the absence of covenants leads to market break-down, the total losses would be even larger. Therefore, the sufficient statistic in (21) is a lower bound on total surplus firms obtain from covenant contracting.

7 Conclusion

I estimate the amount of surplus that accrues to firms from being able to enter more complete debt contracts, which contain covenants, using a sufficient statistic approach. This approach allows me to nest different models of financial contracting, rather than take a stance on which friction is driving covenant contracting. I provide a framework to estimate this sufficient statistic from covenant prices and firms' covenant choices using revealed preference for identification.

I then use my revealed preference based approach to show that large benefits accrue to firms when they can enter debt contracts with covenants. For the average firm, the surplus earned exceeds 100% of the the spreads paid on a loan, and exceed 20% of the spreads even under the most conservative estimates. I use my framework to study how different types of covenants contribute to this surplus, showing that utilizing information in covenant prices and covenant choices *simultaneously* is critical for understanding this question. Among the commonly observed financial covenants, the leverage and interest rate covenants emerge as ones with the largest benefits, lending quantitative credence to several standard theories of covenants. Once chosen, the benefits from fine tuning covenants are not large, rationalizing the "boilerplate" levels of covenants observed in practice.

My estimates show that an effective intermediation sector provides large benefits to the non-financial sector. Lerner and Schoar (2005) show that the intermediation sector can do so only if it is supported by an effective legal system. Therefore, these estimates quantify one channel through which an effective legal system creates value for the non-financial sector.

The analysis in this paper can be extended in several ways. The sufficient statistic approach is not specialized to privately placed debt contracts–the analysis could be extended to other forms of financing with contractual features other than covenants. Within the current setting, estimating the supply side of covenant contracting would provide estimates of the surplus earned by intermediaries. Taking a stand on the nature of the friction that covenants resolve, and structurally estimating a model would lead to a richer set of counterfactuals. Further, embedding contracting with covenants in general equilibrium may yield interesting insights over and above the partial equilibrium results in this paper.

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A Appendix: Extrapolation

When I compute the firms' surplus of covenant contracting using (21), I extrapolate the surplus calculation away from firms' actual decisions. One has to be cautious when extrapolating sufficient statistics out of sample without a fully specified structural model. Below I provide a formula that provides a conservative bound on surplus, which is less subject to out of sample extrapolation concerns. The marginal covenant that the firm adds provides a smaller benefit than any inframarginal covenant. The calculation of this surplus is also least subject to bias, since it is closest to a firm's actual decision. The sufficient statistic below conservatively assumes that all inframarginal covenants provide the same surplus as the marginal covenant

$$\begin{aligned}\mathcal{S}^{*}\left(\zeta_{j,t}\left|\phi_{j}=0\right.\right)-\mathcal{S}\left(\zeta_{j,t}\right) &= \left(\hat{\beta}_{j,t}\left(\log\phi_{j,t}-\log\left(\phi_{j,t}+1\right)\right)-\hat{\Gamma}_{\phi}\right)\phi_{j,t}\\ &= -\hat{\Gamma}_{\phi}\phi_{j,t}\left(\left(1+\phi_{j,t}\right)\log\frac{\phi_{j,t}}{\left(\phi_{j,t}+1\right)}+1\right)\end{aligned}$$

The results are presented in Table A1, Panel 1. The standard deviation of firms' gains under this formula is $1bp$. This low standard deviation implies that the estimated gains are very similar across firms with different covenant choices, even if revealed preference intuition implies significantly different covenant preferences. The results suggest that this formula is extremely conservative. Even under this conservative formula, firms' gains are approximately $18bp$, which is lower than $59bp$ under the computation in (21), but still economically large.

B Appendix: Discrete choice

In Section 5.1 I count the number of covenants to measure covenant tightness. Because the choice is discrete, borrowers are not able to choose the number of covenants that would make them indifferent on the margin. Instead of point identification in the continuous case, discrete choices place bounds on β. The firm, which chooses a positive number of covenants, ϕ, has to prefer choosing ϕ covenants to choosing $\phi+1$ covenants and to choosing $\phi - 1$ covenants. Firms which choose 0 covenants have to prefer 0 covenants to 1:

$$\begin{array}{ll} V\left(\phi_{j,t},\zeta_{j,t}\right) \geq V\left(\phi_{j,t}+1,\zeta_{j,t}\right) & \text{for all } \phi_{j,t} \\ V\left(\phi_{j,t},\zeta_{j,t}\right) \geq V\left(\phi_{j,t}-1,\zeta_{j,t}\right) & \text{for } \phi_{j,t} > 0 \end{array}$$

Applying the parameterization (17), the bounds on $\hat{\beta}_{j,t}$ are determined by:

$$\begin{array}{ll} \frac{-\hat{\Gamma}_\phi}{\log\frac{\left(\phi_{j,t}+1\right)}{\phi_{j,t}}} \leq \hat{\beta}_{j,t} \leq \frac{-\hat{\Gamma}_\phi}{\log\frac{\left(\phi_{j,t}+2\right)}{\left(\phi_{j,t}+1\right)}} & \text{for } \phi_{j,t} > 0 \\ 0 \leq \hat{\beta}_{j,t} \leq \frac{-\Gamma_\phi}{\log\frac{\left(\phi_{j,t}+2\right)}{\left(\phi_{j,t}+1\right)}} & \text{for } \phi_{j,t} = 0 \end{array}$$

The β obtained by assuming continuous choice, $\hat{\beta}_{j,i} = -\hat{\Gamma}_\phi\left(\phi_{j,t}+1\right)$, lies between these bounds. With bounds on $\hat{\beta}_{j,t}$ I obtain the equivalent of (21). For firms which choose a positive number of covenants $\phi_{j,t} > 0$:

$$\frac{-\Gamma_\phi}{\log\frac{\phi_{j,t}+1}{\phi_{j,t}}}\log\left(\phi_{j,t}+1\right)+\Gamma_\phi\phi_{j,t} \leq \mathcal{S}\left(\zeta_{j,t}\right)-\mathcal{S}^*\left(\zeta_{j,t}\left|\phi_{j,t}=0\right.\right) \leq \frac{-\Gamma_\phi}{\log\frac{\phi_{j,t}+2}{\phi_{j,t}+1}}\log\left(\phi_{j,t}+1\right)+\Gamma_\phi\phi_{j,t}$$

and 0 for $\phi_{j,t} = 0$

The results are presented in Table A1, Panel 2. Even at the lower bound, the estimates show that welfare benefits are on average 29% of loan spreads, and represents a significant firm gain from being able to write debt contracts containing covenants.

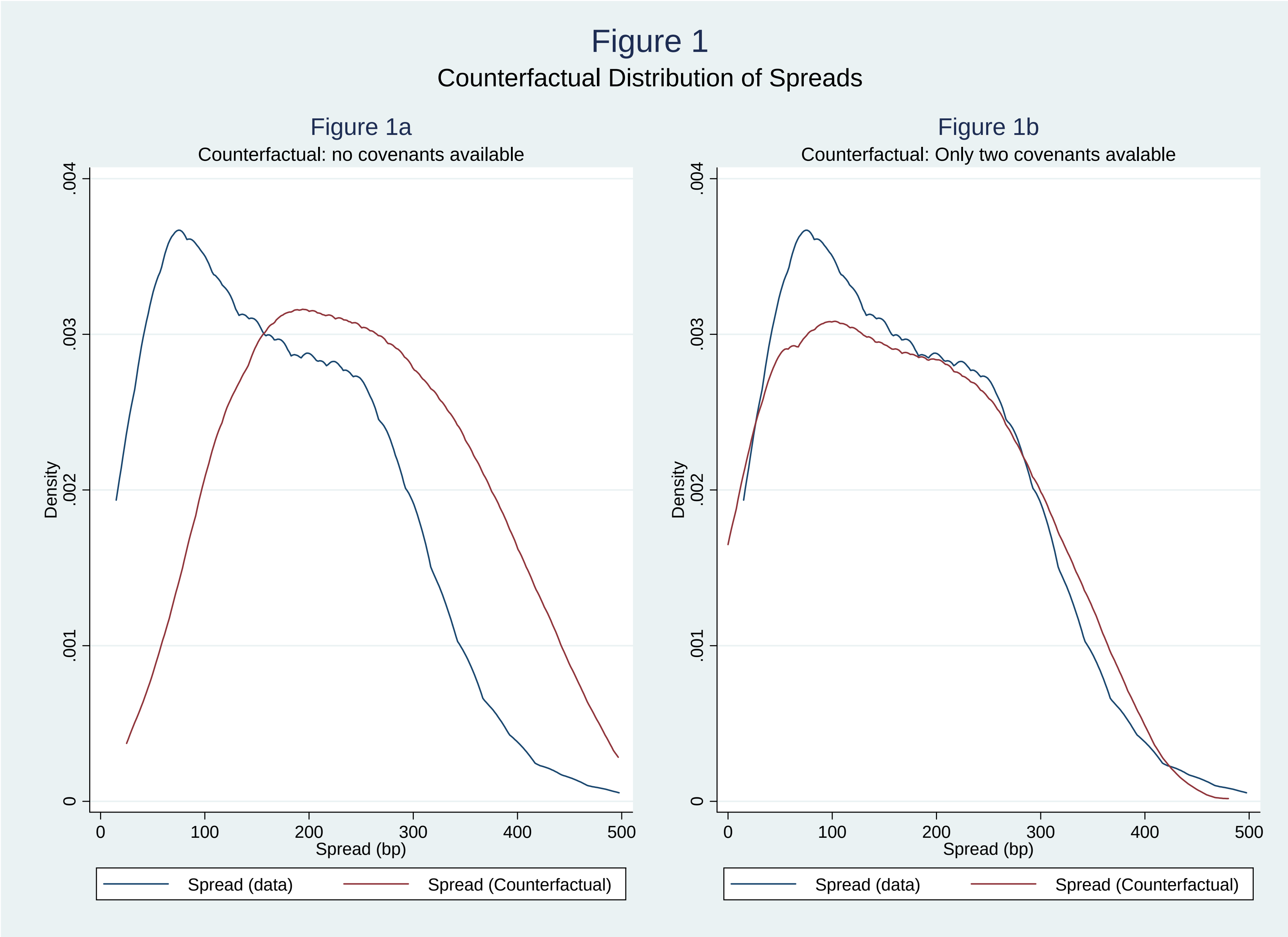
Figure 1
Counterfactual Distribution of Spreads
Figure 1a
Counterfactual: no covenants available
Figure 1b
Counterfactual: Only two covenants avalable
Density
0
.001
.002
.003
.004
0
100
200
300
400
500
Spread (bp)
Spread (data)
Spread (Counterfactual)

Table 1: Summary Statistics

Panel A presents summary statistics of private credit agreements. FD denotes that the observations was obtained using first differencing within a given firm. Spread units are bp, Maturity is loan maturity in months, Number of Covenants is defined as the number of financial covenants in a loan. Panel B presents pairwise correlations of the loan spread with loan and firm characteristics. First Difference denotes that the observations were first differenced within the firm. Panel C presents summary statistics on covenants. Frequency denotes the share of loans that constrain a given covenant.

Panel A: Summary Statistics				
Loan Characteristics	Mean	Median	St. Dev	N
Spread	172.27	150.00	111.91	4080
Number of Covenants	1.99	2.00	0.94	5102
Log Amount	18.38	18.42	1.48	4080
Maturity	48.29	37.00	377.82	4080
Spread (FD)	15.34	0.00	104.00	2696
Number of Covenants (FD)	-0.10	0.00	0.96	2696
Firm characteristics				
Log Assets	6.04	5.99	1.75	4080
CAPX to Assets	0.02	0.01	0.02	4080
Cash to Assets	0.07	0.03	0.11	4080
St. Debt to Assets	0.05	0.02	0.10	4080
Debt to Assets	0.30	0.29	0.23	4080
Cashflow to Assets	0.04	0.04	0.03	4080
Q	1.60	1.41	0.71	4080

Panel B: Pairwise correlations with loan spread		
	Full Sample	First Difference
Number of Covenants	0.06	-0.08
Log Amount	-0.02	-0.06
Maturity	-0.02	-0.01
Log Assets	-0.36	0.12
CAPX to Assets	0.00	-0.03
Cash to Assets	0.05	-0.03
St. Debt to Assets	0.09	0.01
Debt to Assets	0.17	0.04
Cashflow to Assets	-0.21	-0.01
Q	-0.15	-0.02

Panel C: Individual Covenants					
	Frequency	Mean	Median	St. Dev	N
Debt to EBITDA	0.57	3.87	3.50	1.73	2342
Debt to Net Worth	0.10	2.21	1.50	3.84	413
Leverage Ratio	0.20	0.62	0.60	0.45	816
Short Term Debt to EBITDA	0.10	3.19	3.00	1.27	401
Current Ratio	0.11	1.32	1.20	0.51	458
Debt Service	0.08	1.49	1.25	0.65	317
Fixed Charge	0.42	1.49	1.25	0.63	1732
Interest Coverage	0.41	2.63	2.50	0.96	1655

Table 2: Covenant Pricing

The BCD column presents the estimates using the estimator presented in Section 4.1. Time to new loan is the time between two loans (in years), CF denotes control functions, and Year FE year fixed effects, Other Control Functions denotes the presence of control functions for observable firm and loan characteristics, which are not presented individually. The OLS column presents results estimated using OLS, and FD results using estimated using first differences. Reported standard errors are clustered on firm (*** denotes significance at the 1% level, ** at the 5% level and * at the 10% level).

	BCD	OLS	FD
Dependent variable	Spread (bp)	Spread (bp)	Spread (bp)
Number of Covenants	-41.54***	-4.803*	-7.763***
	(8.241)	(2.475)	(3.005)
Log Amount	10.68***	-0.761	-2.964***
	(1.697)	(0.996)	(0.998)
Maturity	3.390***	-0.00590***	-0.00158
	(0.528)	(0.00107)	(0.00132)
Log Assets	-31.82***	-24.74***	22.23***
	(2.394)	(1.328)	(5.038)
CAPX to Assets	164.6	-15.70	-109.2
	(151.4)	(80.90)	(95.73)
Cash to Assets	37.33	60.18***	-20.41
	(38.26)	(21.09)	(25.27)
St. Debt to Assets	2.676	-54.62*	7.552
	(36.21)	(30.29)	(27.11)
Debt to Assets	43.65**	106.5***	5.783
	(20.54)	(13.92)	(16.50)
Cashflow to Assets	94.10	-405.6***	-24.57
	(157.2)	(76.27)	(66.95)
Q	-16.11***	-22.49***	3.571
	(6.043)	(3.720)	(4.187)
Time to new loan	-1.532***		
	(0.0859)		
Control Function			
CF Number of Covenants	96.05***		
	(21.50)		
CF Log Amount	-65.93***		
	(11.18)		
CF Maturity	-209.1***		
	(31.07)		
CF Time to new loan	86.01***		
	(12.78)		
Year FE	Y	Y	Y
Other Control Functions	Y		
Constant	125.6***		
	(18.98)		
Observations	2,696		

Table 3: Beta and Counterfactuals

Panel A presents the distribution of the random coefficient beta from eq. (19) using the specification from Section 4.2. Panels B and C present the distribution of the change in spreads (in bp) and surpluses from the counterfactual described in Section 5.2. Panel B presents the counterfactual in which no covenants are allowed. In Panel C contracting is restricted to the stated choice of covenants in addition to a contract without covenants.

Panel A: Distribution of beta					
	Mean	St. Dev.	p10	p50	p90
beta	124.34	38.03	83.09	124.63	166.17
Panel B: Intermediaries cannot offer debt with covenants					
Equal Weighted					
Change in Spread	254.83	120.22	111.41	242.83	407.83
Change in Surplus (bp)	-59.42	41.41	-105.41	-53.67	-16.00
Change in Surplus (% of Spread)	-0.52	0.48	-1.07	-0.40	-0.06
Loan Size Weighted					
Change in Spread					
Change in Surplus (bp)	59.58	41.49	16.05	53.83	105.73
Change in Surplus (% of Spread)	0.52	0.48	0.06	0.40	1.08
Panel C: Restricted Covenant Choice					
2 covenants					
Change in Spread	4.60	32.66	-42.04	0.00	42.04
Change in Surplus (bp)	-3.95	6.27	-7.95	0.00	0.00
Change in Surplus (% of Spread)	-0.03	0.05	-0.09	0.00	0.00
3 covenants					
Change in Spread	4.60	32.66	-42.04	0.00	42.04
Change in Surplus (bp)	-3.95	6.27	-7.95	0.00	0.00
Change in Surplus (% of Spread)	-0.03	0.05	-0.09	0.00	0.00
1 covenant					
Change in Spread	4.60	32.66	-42.04	0.00	42.04
Change in Surplus (bp)	-3.95	6.27	-7.95	0.00	0.00
Change in Surplus (% of Spread)	-0.03	0.05	-0.09	0.00	0.00

Table 4: Covenant pricing and Beta

Column 1 presents the estimates using the estimator presented in Section 4.1. Time to new loan is the time between two loans (in years), CF denotes control functions, and Year FE year fixed effects. Firm Controls are the same as in Table 2. Reported standard errors are clustered on firm (*** denotes significance at the 1% level, ** at the 5% level and * at the 10% level). Column 2 presents the unconditional mean and standard deviation of the random coefficient beta from eq. (19) for each covenant using the specification from Section 4.2.

		Beta	
	Spread (bp)	Mean	St. Dev
Debt to EBITDA	-0.194	5.00	4.13
	(0.419)		
Debt to Net Worth	-0.675***	5.50	14.26
	(0.192)		
Leverage Ratio	-0.885***	12.21	22.68
	(0.221)		
Short Term Debt to EBITDA	2.896***		
	(0.695)		
Current Ratio	-3.348	3.54	1.40
	(8.028)		
Debt Service	6.014		
	(7.627)		
Fixed Charge	-6.810	11.45	5.90
	(5.200)		
Interest Coverage	-27.47***	56.49	39.02
	(4.455)		
Quick Ratio	-0.331	0.07	0.01
	(12.55)		
Log Amount	6.261***		
	(1.884)		
Maturity	2.098***		
	(0.595)		
Time to new loan	-1.536***		
	(0.119)		
Firm Controls	Y		
Year FE	Y		
Control functions	Y		
Constant	142.7***		
	(29.20)		
Observations	2,696		

Table 5: Counterfactual, removing covenants

The table present the distribution of the change in spreads (in bp) and surpluses from the counterfactual described in Section 5.3. Panel A presents the changes in spreads (in bp) that result from eliminating individual covenants one at a time. Total represents the change if all covenants were eliminated. Panel B presents the corresponding changes in surplus (in bp) and Panel C changes in surplus (share of the spread).

	Mean	St. Dev.	p10	p50	p90
Panel A: Change in Spread					
Debt to EBITDA	5.23	4.53	0.00	8.78	9.42
Debt to Net Worth	4.77	14.16	0.00	0.00	43.68
Leverage Ratio	11.41	22.84	0.00	0.00	57.12
Short Term Debt to EBITDA	0.00	0.00	0.00	0.00	0.00
Current Ratio	0.50	1.52	0.00	0.00	3.35
Debt Service	0.00	0.00	0.00	0.00	0.00
Fixed Charge	4.24	5.67	0.00	0.00	11.81
Interest Coverage	29.52	39.53	0.00	0.00	83.10
Quick Ratio	0.01	0.07	0.00	0.00	0.00
Total	50.51	46.17	0.00	49.20	113.22
Panel B: Change in Surplus					
Debt to EBITDA	-14.21	12.33	-25.83	-23.50	0.00
Debt to Net Worth	-15.73	46.68	-141.13	0.00	0.00
Leverage Ratio	-37.02	74.11	-185.39	0.00	0.00
Short Term Debt to EBITDA	0.00	0.00	0.00	0.00	0.00
Current Ratio	-0.26	0.99	-1.29	0.00	0.00
Debt Service	0.00	0.00	0.00	0.00	0.00
Fixed Charge	-2.42	4.16	-6.96	0.00	0.00
Interest Coverage	-24.36	37.64	-70.50	0.00	0.00
Quick Ratio	0.00	0.05	0.00	0.00	0.00
Total	-84.56	90.66	-211.96	-55.36	0.00
Panel C: Change in Surplus / Spread					
Debt to EBITDA	-0.13	0.18	-0.34	-0.08	0.00
Debt to Net Worth	-0.15	0.66	-0.38	0.00	0.00
Leverage Ratio	-0.63	1.62	-2.48	0.00	0.00
Short Term Debt to EBITDA	0.00	0.00	0.00	0.00	0.00
Current Ratio	0.00	0.01	0.00	0.00	0.00
Debt Service	0.00	0.00	0.00	0.00	0.00
Fixed Charge	-0.02	0.06	-0.06	0.00	0.00
Interest Coverage	-0.29	0.79	-0.91	0.00	0.00
Quick Ratio	0.00	0.00	0.00	0.00	0.00
Total	-1.18	1.95	-3.67	-0.40	0.00

Table 6: Restricting Covenant choice

The table present the distribution of the change in spreads (in bp) and surpluses from the counterfactual described in Section 5.3.3. Column 90th (10th) percentile presents the results from the counterfactual in which covenant use is restricted to the 90th (10th) percentile strictness of a given covenant within the sample. Each line presents the results from restricting one covenant at a time. Total shows the results from restricting all covenants. Change in Covenant Use shows the probability that a covenant will not be used in a given contract after choices have been restricted, conditional on being present in the contract in the first place.

Change in Covenant Use	90th percentile	10th percentile
Debt to EBITDA	-0.04%	-0.04%
Debt to Net Worth	-0.24%	-0.24%
Leverage Ratio	0.00%	0.00%
Short Term Debt to EBITDA	0.00%	0.00%
Current Ratio	-3.90%	-0.43%
Debt Service	0.00%	0.00%
Fixed Charge	-5.25%	-0.81%
Interest Coverage	-7.88%	-0.48%
Quick Ratio	-14.56%	0.00%

Change in Spread (bp)	90th percentile		10th percentile	
	Mean	St. Dev.	Mean	St. Dev.
Debt to EBITDA	-0.042	0.243	0.254	0.354
Debt to Net Worth	-0.038	0.428	0.102	0.512
Leverage Ratio	-0.004	0.177	0.014	0.182
Short Term Debt to EBITDA	0.000	0.000	0.000	0.000
Current Ratio	0.043	0.513	0.129	0.693
Debt Service	0.000	0.000	0.000	0.000
Fixed Charge	0.726	2.834	1.441	3.246
Interest Coverage	1.683	16.477	12.662	22.588
Quick Ratio	0.000	0.005	0.005	0.054
Total	2.369	16.838	14.606	22.270

Change in Surplus (bp)	90th percentile		10th percentile	
	Mean	St. Dev.	Mean	St. Dev.
Debt to EBITDA	-0.008	0.045	-0.011	0.033
Debt to Net Worth	-0.003	0.041	-0.003	0.028
Leverage Ratio	0.000	0.008	0.000	0.007
Short Term Debt to EBITDA	0.000	0.000	0.000	0.000
Current Ratio	-0.049	0.221	-0.028	0.325
Debt Service	0.000	0.000	0.000	0.000
Fixed Charge	-0.624	0.922	-0.364	1.315
Interest Coverage	-2.585	4.841	-3.835	9.552
Quick Ratio	-0.001	0.017	-0.001	0.033
Total	-3.270	4.912	-4.243	9.532

Table 7: Commitment Spread

The spread used in the calculations in this table is the all-un-drawn spread. Panel A presents the estimates using the estimator presented in Section 4.1. Controls are Log Assets, CAPX to Assets, Cash to Assets, St. Debt to Assets, Debt to Assets, Cashflow to Assets, Q and Time to new loan, Year FE denotes year fixed effects, Control Functions denotes the presence of control functions for observable firm and loan characteristics. Reported standard errors are clustered on firm (*** denotes significance at the 1% level, ** at the 5% level and * at the 10% level). Panel B presents the distribution of the change in spreads (in bp) and surpluses from the counterfactual in which no covenants are allowed described in Section 5.2.

Panel A: Covenant Pricing

Dependent variable	Spread (bp)
Number of Covenants	-4.13**
	(1.833)
Log Amount	1.41***
	(0.405)
Maturity	0.517***
	(0.116)
Year FE	Y
Controls	Y
Control Functions	Y
Constant	13.5***
	(3.72)
Observations	2,524

Panel B: Counterfactual

	Mean	St. Dev.	p10	p50	p90
Change in Spread	32.11	21.08	10.00	27.50	50.00
Change in Surplus (bp)	-6.00	4.13	-10.52	-5.36	-1.60
Change in Surplus (% of Spread)	-0.25	0.23	-0.47	-0.21	-0.04

Table A1: Extrapolation and Discrete Choice bounds

Panel A presents the decrease in surplus from the specification in Table 3, Panel B, computed using the limited extrapolation sufficient statistic from Appendix A . Panel B presents the bounds on the estimates of beta from Table 3, Panel A, and the change in surplus from counterfactuals in Table 3, Panel B using the approach described in Appendix B.

Panel A: Extrapolation					
	Mean	St. Dev.	p10	p50	p90
Surplus (bp)	-17.72	1.01	-18.73	-17.92	-16.00

Panel B: Discrete choice bounds					
Beta	Mean	St. Dev.	p10	p50	p90
Lower bound	101.42	40.78	60.10	102.74	144.81
Upper bound	144.44	38.52	102.74	144.81	186.69
Change in Surplus (bp)					
Lower bound	-36.63	35.41	-75.77	-29.56	0.00
Upper bound	-80.47	48.11	-133.83	-75.77	-29.56
Change in Surplus (% of Spread)					
Lower bound	-0.29	0.33	-0.67	-0.20	0.00
Upper bound	-0.72	0.64	-1.52	-0.55	-0.12