IFN Working Paper No. 1477, 2023

Non-Financial Liabilities and Effective Corporate Restructuring

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October 27, 2023 *Preliminary*

Abstract

Many countries' insolvency systems focus on restructuring financial liabilities, and ignore operational liabilities such as leases and long-term supplier contracts. We model insolvency procedures with and without operational restructuring options. Such options avoid excessive liquidation of firms with significant non-financial obligations. Ex-ante, this option should increase debt capacity, especially in industries with inputs supplied under executory contract. We test this hypothesis around the introduction of a new law in Israel which facilitated the rejection of contracts, and by comparing capital structures for industries with high lease obligations between the U.S. and other countries. Empirical results confirm that operating restructuring is a key aspect of insolvency.

*We thank David Bardette, Carsten Bienz, Omer Kimhi, Marcus M. Opp, Mahamadhi Ouoba, Per Strömberg, Ivo Welch, Luigi Zingales, and the seminar audience at IFN for comments and suggestions.

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1. Introduction

Managing insolvency and distress is important to credit markets and to economic outcomes everywhere. Yet, the system varies in fundamental and important ways between countries, with significant real effects – for example, Djankov, Hart, McLiesh and Shleifer (2008) report that the overall recovery for insolvent firms' claimants can vary by an order of magnitude between different countries. We propose that non-financial obligations pose an important challenge in many systems. Our starting point is that, just as high financial obligations can be an impediment to successful operation of a firm, non-financial obligations can impede continued operation of a viable business. Non-financial claims are often large: for example, lease obligations constitute twenty-three percent of liabilities in one sample of large Chapter 11 cases, and 71 percent of liabilities at the 90$^{\text{th}}$ percentile (Ayotte 2015).

In Chapter 11 of the U.S. Bankruptcy Code, a key mechanism for managing operating liabilities is the right to reject executory contracts. An executory contract is one where both parties have remaining obligations (one-off transactions do not create executory contracts). Examples of executory contracts are office leases, where the landlord will supply an office and the tenant lease payments, long-term vendor contracts, and licensing agreements. Under Section 365 of Chapter 11, executory contracts can be *rejected* (abandoned), *assumed* (retained), or *assigned* (transferred to a third party). This gives firms considerable ability to reduce their future obligations. Examples of bankruptcy cases where this was important include Kmart and Hertz. For Kmart, the number of leases was large and time short, and the company sold rejection rights to a third party (Gilson and Abbott 2009). For Hertz, which a the time of its Chapter 11 process leased almost half a million vehicles under a "master lease agreement", a key issue was rejecting part of the leases, and the firm argued that these were separate contracts (in the end, Hertz was allowed to retain some vehicles). These cases highlight the important option values embedded in the right to reject a contract.[1]

Outside of the U.S., it remains rare for restructuring laws to explicitly involve operational claims the way Chapter 11 does, and especially to give such unconstrained rights to the debtor company to reject contracts.[2] We develop a model of an insolvent

[1] In the U.S., aircraft leases have a different position from typical executory contracts. Under section 1110 of the bankruptcy code, a debtor has 60 days to cure such leases, i.e. the automatic stay ends at that point. This presumably makes rejection less effective for aircraft leases. See Benmelech and Bergman (2011) for a discussion on the financial implications of insolvency for airlines.

[2] Note that restructuring law is typically separate from bankruptcy outside of the U.S. When we refer

firm with financial and operational obligations, and study how capital structure and insolvency choices depend on whether debtors may reject executory contracts. We characterize outcomes under a restructuring process which allows adjusting both types of obligations (Chapter 11) and one limited to financial claims (most other processes), and also consider a setting without restructuring possibilities.[3]

When both operational and financial claims are addressed simultaneously, it becomes more likely that firm liabilities can be sufficiently reduced for the businesses to survive. In the model, restructuring operations in bankruptcy differs from (re)negotiating because the bankrupt firm may reject contracts. This reduces operating liabilities in Chapter 11, alongside financial debts. Putting all liabilities on the table raises the likelihood of successful restructuring.

The model connects rejection of executory contracts to capital structure and restructuring outcomes. Ayotte (2015) points to the importance of executory contracts for Chapter 11. Outside of the U.S., there is limited evidence on executory contracts. Perhaps this is natural – if the options for changing contracts are limited, tracking them is not important. We therefore focus our tests on the prediction that executory contracts which cannot be rejected, should discourage financial leverage. We test this by sorting industries based on the amount of executory contracts that are typical for U.S. firms. There is significant variation - for example, industries such as retail and hospitality tend to have important non-financial obligations such as leases, wheres some financial firms as well as manufacturing industries tend to have limited obligations of this type.

We test the prediction that a rejection option encourages leverage by comparing industries with high and low executory contract use in corporate capital structure data. We compare the U.S. (where rejection is relatively easy) to everywhere else (where it is impossible, cumbersome, or limited); and we compare Israeli firms before to after a new Company Law introduced in 2019, which allowed rejection of contracts. In both cases, controlling for time and firm fixed (and implicitly, country) effects, we find large and statistically significant positive effects on leverage. In cross-country tests, we estimate that a change in the ratio of executory contracts from the 25^{th} to the 75^{th} percentile (around 4 percent of annual revenues) corresponds to an increase of leverage in the U.S. of 0.02 (average leverage is 0.231), or around 10% higher debt. The Israeli before-

to insolvency law, we think of UK Schemes of Arrangements, all the national processes covered by the EU Insolvency Directive, as well as Chapter 11.

[3]We ignore other differences between systems, such as the treatment of secured debt (Vig 2013), the ability to cram down a plan of reorganization (Richter and Thery 2020), and the status of various types of collateral (Davydenko and Franks 2008).

and after tests produce similar magnitude estimates. Finally, we also test the model's prediction in lending data from Dealscan, i.e. in flow data. High executory contract industries are associated with higher credit volumes in the U.S., as well as possibly lower prices (spreads), consistent with an effect of operational restructuring rules on the debt capacity (higher) and capital structure choices (more debt) of firms.

All the evidence, taken together, suggests that executory contracts matter for financial leverage – the financial debt capacity of firms in industries that rely on executory contracts is significantly affected by a rejection option. This evidence is consistent with our model, which highlights how rejection can avoid liquidation and improve debt capacity. Importantly, the Israeli example suggests that reform in the US direction is possible in other countries, and can be effective outside of the particular institutional setting of Chapter 11. Other countries may be able to similarly implement rejection options.

This paper is structured as follows. In Section 2, we discuss related literature. In Section 3, we introduce the theoretical framework and present our theoretical results. In Section 4, we describe the empirical method and present our empirical results, and in Section 5, we conclude. Proofs and derivations of theoretical results can be found in the Appendix, together with a list of variables.

2. Related literature

The system for handling insolvent and distressed firms is critical to a range of economic and financial outcomes.[4] A key requirement for a successful system is avoiding liquidation of viable firms, and this sometimes necessitates restructuring of liabilities, including non-financial obligations such as those stemming from executory contracts. Eisfeldt and Rampini (2009) argue that financially constrained firms lease capital, whereas unconstrained firms own their capital. This underlines the importance of handling leases in insolvency.

Many contracts are long-term (e.g. Giglio et al. 2014), and will be executory for a large part of their life (i.e., both parties have important remaining obligations). The treatment of executory contracts in U.S. bankruptcy is controlled by Section 365 of the bankruptcy code.[5] Each executory contract is either rejected or assumed – assumed

[4]For example, credit market development (Vig 2013), bank lending (Becker and Ivashina 2022 and Jorda et al. 2022), high yield bond markets (Becker and Josephson 2016), and the efficiency of business liquidation decisions (Bris et al. 2006).

[5]Ayotte (2015) examines important reforms of this section in 2005, including reduced time to make

contracts become an obligation of the debtor, and rejected contracts become general unsecured claims (i.e. a relatively junior claim) of the debtor.[6] Fried (1996) points out that the ability to reject contracts without fully compensating the injured party may be *too strong*, to the point where socially valuable contracts may be rejected (*e.g.*, if a lot of the value has been delivered whereas more of the payments remain). This does not occur in our model, since the executory contract is renegotiated rather than rejected in equilibrium.

Executory contracts are important to U.S. bankruptcy practice. Using hand-collected data on firms that filed for Chapter 11 during the period 1991 to 2004, Lemmon, Ma and Tashjian (2009) show that the leases are rejected extensively in Chapter 11 and that the disposition of lease commitments rivals asset sales as a means of asset reduction in bankruptcy. Ayotte (2015) shows that lease obligations are large in the typical listed company Chapter 11 case, and very large in some cases. Ma and Tashjian (2015) establish that the value of operating leases raise the likelihood that a firm will file for Chapter 11 (rather than restructure out of court), in line with the usefulness of Section 365.

Outside of the U.S., rejection of executory contracts is more difficult. Dávalos (2017) compares the US, German, and US systems and finds that the Spanish system give less incentives to reject value-creating contracts because claims from rejected executory contracts are very senior (treated as administrative expenses). Israel is an important example (Hahn and Kimhi 2021). A new Company Law, in effect since 2019, codified a flexible treatment of executory contracts of restructuring firms. The law gives a debtor 90 days from the start of proceedings to file a motion to reject a contract, and rejection is allowed with very few conditions. Counter parties of rejected contracts have an unsecured claim on the estate. In other words, this is now very similar to the U.S. situation. Ayotte and Yun (2007) point out that the optimal bankruptcy law depends on the capabilities of the legal system. Our assessment is that the option to reject executory contracts is relatively straightforward, and could be implemented in most OECD countries, and this is the assumption behind our cross-sectional tests. However, this conjecture is difficult to verify. It is possible that a reform such as that undertaken in Israel has prerequisites in terms of judge skill sets and legal environment, in order to be

assume/reject decisions.

[6]Countryman (1972) and Countryman (1973) discuss the evolution of the treatment of executory contracts under U.S. bankruptcy code (before the modern Chapter 11). Countryman (1972) defines an executory contract as follows: "...within the meaning of the Bankruptcy Act an executory contract is one under which the obligations of both the bankrupt and the other party to the contract are so far unperformed that the failure of either to complete performance would constitute a material breach excusing the performance of the other" which agrees with current rules.

effective.

3. Theoretical analysis

3.1 Framework

We develop a two-period model of a distressed firm with financial debts and non-financial obligations. A firm has an executory contract with a supplier for the delivery of a quantity β of an input at a unit price of p in period 2. The supplier's opportunity cost of the input is given by $k \in (0, p)$, which represents what the supplier gives up in order to supply the input. This opportunity cost can be thought of as the market value in some secondary use. [7]

In period 1, the firm invests I in a project. The investment is partly financed with debt, in quantity d, and the remainder with equity, in quantity e. We assume a competitive capital market made up of a continuum of identical risk-neutral creditors and a risk-free rate normalized to zero.

Between period 1 and period 2, the realization s of a random variable $S \sim Uni\,[0, 1]$, determining the firm's revenues, is revealed to all parties.

In period 2, the firm has revenues of $\alpha s + \beta q$, where αs are the revenues without the input and $q \in (k, p)$ is a measure of the productivity of the input. In the same period, the contracted payment of the input βp, and gross debt – i.e. the face value of debt plus the corresponding interest rate – denoted D, are due. If profits are positive, they are taxed at a rate $t > 0$.

If the revenues are not enough to cover expenses in period 2, i.e. if $\alpha s + \beta q < D + \beta p$, the firm will enter bankruptcy and be liquidated in the absence of any restructuring. We assume executory claims have priority over revenues in bankruptcy, but that the corresponding unsecured claims are paid zero in case of rejection. We also assume there is a cost $C > 0$ of bankruptcy and that a liquidation implies a net cash flow of $L - C > 0$.

We will study three institutional settings.

N. In the *No restructuring* setting, no restructuring is possible, and insolvent firms

[7] As described in the introduction, an executory contract is one where both parties have remaining obligations. In other words, the initial contracts was long-term and involved ongoing obligations for both parties. Such contracts may be optimal when spot markets are insufficient, for example reflecting asymmetric information before the contract is signed (Fudenberg et al. 1990), if the parties feature bounded rationality (Bolton and Faure-Grimaud 2010) or to reduce renegotiation costs (Klein et al. 1978 and Halonen-Akatwijuka and Hart 2020).

(low realization of s) are liquidated. This corresponds to a traditional bankruptcy process where all assets are sold and all contracts terminated.

F. In the *Financial restructuring* setting, a financial restructuring is available as an alternative to a liquidation. This means that the debts of an insolvent firm can be written down and corresponds fairly well to typical European Union restructuring procedures.

O. In the *Operational and financial restructuring* setting, an operational and financial restructuring is available as an alternative to a liquidation. We model operational restructuring through the right to reject executory claims. This corresponds most clearly to Chapter 11 of the U.S. Bankruptcy Code.

We make the following two assumptions regarding the parameters of the model:

$$C < t(\alpha - \beta(p - q) - L), \tag{A1}$$

$$\beta(p - k) < C. \tag{A2}$$

The first assumption guarantees that there will be a range of outcomes such that the bankruptcy court prefers to perform a financial restructuring rather than to liquidate the insolvent firm. The second assumption guarantees a range of outcomes where the firm is solvent (and also implies shareholders will not receive any payout in a bankruptcy).

We continue by deriving the equilibrium in each of the three institutional settings and thereafter compare the equilibrium outcomes.

3.2 No restructuring

We first analyze the most basic institutional setting, where no restructuring is possible. In this setting, an insolvent firm – i.e. with low realization of S – is liquidated.

Threshold

Solvency, meaning the ability to repay debts, is a key attribute of a firm in the model, and it depends on the realization s of S. The firm is solvent if and only if

$$\alpha s - \beta (p - q) - D \geq 0, \tag{1}$$

i.e. for s above s_I, defined as:

$$s_I := (D + \beta(p-q))/\alpha. \tag{2}$$

In this setting, with only a liquidating process for insolvent firms, the firm is liquidated for realizations of S below s_I.

Equilibrium

In equilibrium, the firm chooses gross debt to maximize the expected value of the firm subject to the constraint that creditors break even in expectation when the insolvency threshold is given by s_I (which is a function of D).

In period 1, the values of equity and debt (henceforth, we will refer to the latter as *net debt*) given D can be formulated as:

$$e = (1-t)\int_{s_I}^{1} (\alpha s - \beta(p-q) - D)\, ds, \tag{3}$$

$$d = (L-C)\int_{0}^{s_I} ds + D\int_{s_I}^{1} ds. \tag{4}$$

Differentiating the concave firm value, $f = d + e$, with respect to gross debt, D, gives the interior first-order condition (a corner solution with $D = 0$ is ruled out by Assumption A1):

$$t(\alpha - D - \beta(p-q))/\alpha + (L - C - D)/\alpha = 0. \tag{5}$$

Denoting equilibrium values of variables in setting $i \in \{N, F, O\}$ by superscript i, we have that:

$$D^N = \frac{t(\alpha - \beta(p-q)) + L - C}{1+t}. \tag{6}$$

Substituting in the insolvency threshold gives:

$$s_I^N = \frac{t\alpha + \beta(p-q) + L - C}{\alpha(1+t)}, \tag{7}$$

and the values of equity and net debt (see the Appendix for calculations):

$$e^N = \frac{(1-t)(\alpha - \beta(p-q) - L + C)^2}{2\alpha(1+t)^2}, \tag{8}$$

$$d^N = \frac{t\left(L - C - \alpha + \beta\left(p-q\right)\right)}{1+t}\frac{t\alpha + \beta\left(p-q\right) + L - C}{\alpha\left(1+t\right)} + \frac{t\left(\alpha - \beta\left(p-q\right)\right) + L - C}{1+t}. \quad (9)$$

3.3 Financial restructuring

Second, we analyze the institutional setting where the insolvent firm is restricted to either a financial restructuring or a liquidation. A financial restructuring is carried out through a write-down of debt of insolvent firms, while equity is eliminated. A write-down could be achieved *in court* or *out of court*. In the latter case, a bond trustee might coordinate and bargain on creditors' behalf.[8]

Thresholds

As in the setting with no restructuring, the firm is solvent if and only if the firm revenue shock is low: $s \geq s_I$ (s_I depends on D). For realizations of S below this level, the firm value equals the value of debt. The value of debt is greater with ongoing operations than in a liquidation provided:

$$\alpha s - \beta\left(p-q\right) \geq L. \quad (10)$$

The bankruptcy court will thus write down debt for s below s_I and above:

$$s_L^F := \left(L + \beta\left(p-q\right)\right)/\alpha. \quad (11)$$

and liquidate the firm for s below this threshold. Assumption A1 implies that the liquidation threshold is strictly below the insolvency threshold. Hence, under this assumptions there will be a range of signals resulting in a financial restructuring.

Equilibrium

In equilibrium, the firm chooses the level of gross debt that maximizes firm value, subject to the constraint that creditors break even in expectation when the insolvency and liquidation thresholds are given by s_I and s_L^F, respectively.

[8]An example of this is Norway, where a bond trustee typically has contractual rights to make payment changes on behalf of investors. This tye of contract is not possible in the U.S., but out-of-court solutions may be found in other ways (see Bolton and Scharfstein 1996).

The values of equity and net debt in period 1 given D can be expressed as follows:

$$e = (1-t)\int_{s_I}^{1} (\alpha s - \beta (p-q) - D)\, ds, \tag{12}$$

$$d = (L-C)\int_{0}^{s_L^F} ds + \int_{s_L^F}^{s_I} (\alpha s - \beta (p-q) - C)\, ds + D\int_{s_I}^{1} ds. \tag{13}$$

Differentiating the concave firm value, $f = d + e$, with respect to gross debt, D, gives the interior first-order condition (a corner solution with $D = 0$ can be ruled out by Assumption A1):

$$t(\alpha - D - \beta (p-q))/\alpha - C/\alpha = 0, \tag{14}$$

implying an optimal gross debt of:

$$D^F = \alpha - \beta (p-q) - C/t, \tag{15}$$

and an insolvency threshold of:

$$s_I^F = 1 - \frac{C}{t\alpha}. \tag{16}$$

Substituting the optimal gross debt D^F in the expressions for the values of equity and net debt gives (see the Appendix for derivations):

$$e^F = \frac{1-t}{2\alpha t^2} C^2, \tag{17}$$

$$d^F = \frac{(L + \beta (p-q))^2}{2\alpha} - C - \frac{C^2 (1-2t)}{2\alpha t^2} + \frac{\alpha - 2\beta (p-q)}{2}. \tag{18}$$

3.4 Operational and financial and restructuring

In the third setting, the insolvent firm may write down debt as well as reject the executory contract and liquidate the firm. The possibility of a rejection makes it possible for the firm to renegotiate the executory contract.

Thresholds

Just like in the two settings above, the firm is solvent if and only if $s \geq s_I$ (which depends on D). For realizations of S below this threshold, the firm will use the rejection option to renegotiate its contract with the supplier, lowering the unit price for the input from p to k.

Creditors prefer to continue the operations of the firm with the renegotiated contract rather than to liquidate the firm if and only if:

$$\alpha s + \beta (q - k) - C \geq L - C. \tag{19}$$

This gives the liquidation threshold:

$$s_L^O := (L + \beta (k - q)) / \alpha \tag{20}$$

Assumption A1 implies that the liquidation threshold is below the equilibrium insolvency threshold and Assumption A2 that the latter is below one.

Equilibrium

In equilibrium, the firm chooses the level of gross debt that maximizes firm value, subject to the constraint that creditors break even in expectation when the insolvency and liquidation thresholds are given by s_I and s_L^O, respectively.

In period 1, the values of equity and net debt given D equal:

$$e = (1 - t) \int_{s_I}^{1} (\alpha s - \beta (p - q) - D)\, ds, \tag{21}$$

$$d = (L - C) \int_0^{s_L^O} ds + \int_{s_L^O}^{s_I} (\alpha s + \beta (q - k) - C)\, ds + D \int_{s_I}^{1} ds. \tag{22}$$

The expected firm value in the same period, $f = d + e$, is a concave function of gross debt, D. Differentiating the firm value with respect to this variable gives the interior first-order condition (once again, a corner solution with $D = 0$ can be ruled out by Assumption A1):

$$(\beta (p - q) + \beta (q - k)) / \alpha + t (\alpha - D - \beta (p - q)) / \alpha - C / \alpha = 0, \tag{23}$$

implying an optimal gross debt of:

$$D^O = \alpha + \beta (q - p) - C/t + \beta (p - k) / t, \tag{24}$$

and the insolvency threshold:

$$s_I^O = 1 - \frac{C}{\alpha t} + \frac{\beta (p - k)}{\alpha t}. \tag{25}$$

Substituting in the expressions for equity and net debt gives (see the Appendix for derivations):

$$e^O = \frac{1-t}{2\alpha t^2}\left(C-\beta\left(p-k\right)\right)^2, \tag{26}$$

$$\begin{aligned} d^O = {} & \frac{\left(L-\beta\left(q-k\right)\right)^2}{2\alpha} - \left(1-2t\right)\frac{\left(\alpha t+\beta\left(p-k\right)-C\right)^2}{2\alpha t^2} \\ & + \frac{\left(1-t\right)\left(\alpha t+\beta\left(p-k\right)-C\right)}{t} + \beta\left(q-p\right). \end{aligned} \tag{27}$$

3.5 Comparing the institutional settings

We conclude the theoretical analysis by comparing the equilibrium outcomes in the three different institutional settings. We will start with the gross debt levels. It follows from Assumptions A1 that gross debt is smaller in setting N than in setting F and it follows trivially from the expressions that gross debt is higher in setting O than in setting F .

Proposition 1 *The following holds for gross debt in the three settings:*

$$D^N < D^F < D^O.$$

The intuition for the inequalities is that the trade-off between the marginal tax benefit from higher gross debt and the incremental cost in terms of a higher likelihood of bankruptcy differs in the three settings. In setting N, bankruptcy is relatively costly since it leads to an inefficient liquidation. In setting, F insolvency is less costly since the firm may continue operations. In setting O, the cost is further reduced since the executory contract can be rejected or renegotiated.

It is also straightforward to order the three liquidation thresholds (recall that the liquidation threshold equals the insolvency threshold in setting N). The left-most inequality is trivial and the right-most inequality follows from Assumption A1.

Proposition 2 *The liquidation thresholds in the three institutional settings satisfy:*

$$s_L^O < s_L^F < s_I^N.$$

The intuition for these inequalities is that more restructuring possibilities makes liquidation unattractive for a wider range of outcomes.

Gross debt determines the insolvency threshold, implying that the probability of insolvency can be ordered as follows in the three settings:

$$s_I^N < s_I^F < s_I^O.$$

Since shareholders are the residual claimants of any cash flow above the insolvency threshold, it follows that the value of equity in the three setting have the reverse order.

$$e^O < e^F < e^N.$$

Continuing with the value of net debt, tedious calculations and Assumptions A1 and A2 give the following result.

Proposition 3 *Net debt in the three settings satisfy:*

$$d^N < d^F < d^O.$$

The last result follows on one hand from the ranking of gross debt in Proposition 1 and on the other hand that creditors are paid more for intermediate realizations of the signal when there are more restructuring possibilities.

We are interested in how the difference in net debt changes in response to changes in the quantity of the input, β. Differentiating the debt differences with respect to β gives us the following result due to Assumptions A1 and A2.

Proposition 4 *Net debt is increasing faster in the quantity of the input in setting O than in the other settings:*

$$\frac{\partial\left(d^O - d^F\right)}{\partial\beta} > 0, \frac{\partial\left(d^O - d^N\right)}{\partial\beta} > 0.$$

Using Assumption A1, it is also straightforward to rank the firm values in the three settings.

Proposition 5 *Firm values in the three settings satisfy:*

$$f^N < f^F < f^O.$$

The possibility of operational restructuring is valuable since it avoids inefficient liquidation.

Finally, we consider the difference in total surplus between settings O and F, $W^O - W^F$. Setting O entails a smaller probability of liquidation, but a larger probability of incurring the bankruptcy cost, resulting in the following expression:

$$\begin{aligned} W^O - W^F &= \int_{s_L^O}^{s_L^F} (\alpha s + \beta (q-k) - L)\, ds - C \int_{s_I^F}^{s_I^O} ds \\ &= \frac{\beta (p-k)}{\alpha t} (t\beta (p-k)\, \alpha/2 - C)\,. \end{aligned} \tag{28}$$

Operational restructuring is thus welfare improving if the bankruptcy cost is small compared the product of the tax rate, the gain from renegotiation, and the expected surplus generated by the firm without the input.

4. Empirical evidence

Our model captures the idea that executory contracts can be important to the viability of an insolvent firm. The model is relevant when executory contracts are important. Ayotte (2015) documents that this is true in Chapter 11 cases, i.e. among distressed U.S. firms. We provide suggestive data from a large set of publicly traded firms.

The key prediction of our model is that, in industries with significant amounts of executory contracts, financial leverage should be low in a system without operating restructuring, and higher in a system that allows operating restructuring (Proposition 3). We examine this empirically in an international cross-section of capital structure data. We use two empirical approaches. First, we consider Chapter 11 more capable of operating restructuring than other systems, and run cross-country capital structure regressions. Second, the 2019 new Company Law in Israel clearly established that contracts could be rejected without reason in restructuring procedures – we consider this an increase in the ability to restructure operating claims, and use this for difference-in-difference tests (assuming the change is more important to industries with wider reliance on executory contracts).

In systems with operating restructuring, as compensation for worse outcomes in distress, executory contract counterparties will ask for higher contracted prices (Proposition 4). In this paper, we do not provide empirical tests of this, but the prediction is strongly connected to the restructuring. The rest of this section presents data sources and then empirical tests.

4.1 Data

We employ two main data sets to investigate the impact of operational restructuring rules in insolvency on credit markets. First, we use Compustat-CapitalIQ to understand how the intensity of executory contract use varies across industries, and to measure the capital structure of firms in various countries. Second, we use Refinitiv LoanConnector Dealscan to collect data on syndicated lending.

Firm level capital structure data comes from Compustat-CapitalIQ; we also use this data set to construct industry-level measures of the typical extent of executory contracts by industry. There are two firm samples: one for the U.S. (Compustat), and one of the rest of the world (CapitalIQ). Accounting variables in these data sets are reported in local currency, and we use average annual exchange rates from the European Central Bank (ECB) Statistical Warehouse to translate all amounts into U.S. dollars. We use Bureau of Labor Statistics price level data to translate data for earlier years into 2022 dollars.

We use U.S. firm level data to calculate average executory contracts at the industry level. Using industry-level variation reduces noise in measurement, and allows us to use detailed accounting data available for U.S. firms for tests on global samples. Standard accounting does not typically identify the contractual relationship underlying expenses and obligations, but several types of costs are associated with long-term contracts and ongoing commitments, and these can be identified in accounting data. We use the variables "Debt Equivalent of Operating Leases", "Capital Leases" and "Net Rental Expenses". The two first items refer to the value of obligations, either capitalized in the balance sheet (capital leases) or capitalized for comparison purposes. Rent is an annual income statement item. We multiply rent by three to approximate typical contractual commitments (our results are qualitatively unchanged if we use two, four or five, instead). Our main measures of executory contract intensity of an industry are the medians of executory contract liabilities normalized by either revenues or assets. We use a single year (2018), because the representation of firms and industries is better for more recent date, because this precedes the Covid-19 pandemic (which may have impacted leases and rents), and because the variables are stable over time (we have similar results using 2014 or 2016 data).

Average executory contracts for Fama-French 30 industries are reported in Table 1. Results are similar with alternative definitions using 12 or 44 industries. The industries with the highest amount of obligations under executory contracts are Retail (27) and Restaurants, Hotels, Motels (28). In both cases, real estate leases are likely a major driver of this. These industries cover U.S. examples of Chapter 11 procedures where rejections play a large role, such as Kmart (industry 27). More recently Payless ShoeSource sold some of its leases (also 27). After these industries, Apparel (7); Healthcare, Medical Equipment, Pharmaceutical Products (8); Communication (21); Personal and Business Services (22) and Transportation (25) have relatively high values. U.S. Chapter 11 cases in these industries include Regal Cinemas and Cineworld (both 22), where movie theater leases were rejected. In contrast, industries Food Products (1); Textiles (10) and Steel Works (12) have low use of executory contracts. Our assumption is that industries vary systematically in the amount of executory contracts they tend to have, and that U.S. firms is representative (detailed data is available for U.S. firms). This appears reasonable given the nature of industries at the top and bottom of Table 1. In the firm panel sample used in regressions, the 25$^{\text{th}}$ and 75$^{\text{th}}$ percentiles of are executory contracts normalized by assets are 0.008 and 0.045, and of executory contracts normalized by revenues 0.005 and 0.068, respectively. The interquartile range is therefore around 0.04 and 0.06 for the two measures.

To test the impact of executory contract rules, we employ data on global firm capital structures using a global sample from Compustat-CapitalIQ. We use accounting data (e.g., leverage, profitability, revenues) as well as information about industry, country and year. The global database contains less detail than for U.S. firms (e.g., regarding lease obligations), so we rely on industry-level variation calculated from U.S. data. Global firm level panel data is used to test the relationship between executory contracts and capital structure. We perform two different tests; a cross-country panel tests, and a difference-in-difference test based on a reform to the Israeli Company Law implemented in 2019. There around 800 k observations for debt, and slightly fewer for book leverage (which requires asset data). Summary statistics for leverage for 2022 is presented in Table 2.

In order to also capture a flow measure of credit supply, we collect Dealscan data on syndicated loans. We start from all term loans made between 2010 and 2023. Revolving credit facilities are excluded since amounts mean something different in the loan category. We focus on new origination (including changes in loan amounts that follow amendments does not change our findings). Finally, we exclude subordinated loans, a small minority (including subordinated loans does not change our results). This leaves 492,973 loans. We aggregate amounts by Fama-French industry, year, and country. There are 10,033 cells with non-zero volumes out of a potential total of around 70 thousand (14 years, 30 industries, 169 countries). For robustness tests, we focus on OECD countries

Table 1: **Use of executory contracts in different industries.**

Fama-French 30 Industry	**Executory contracts over revenues**	**Executory contracts over assets**
Retail	24.0%	33.5%
Restaurants, Hotels, Motels	22.4%	12.0%
Communication	15.8%	9.6%
Personal and Business Services	9.5%	7.5%
Apparel	9.3%	8.0%
Healthcare, Medical Equipment, Pharm. Prod.	8.7%	4.5%
Recreation	7.2%	4.6%
Transportation	6.8%	4.6%
Printing and Publishing	5.1%	5.4%
Business Equipment	3.8%	2.8%
Consumer Goods	3.3%	3.1%
Beer & Liquor	3.0%	2.7%
Tobacco Products	2.8%	3.2%
Coal	2.7%	2.1%
Fabricated Products and Machinery	2.3%	1.7%
Wholesale	2.0%	4.1%
Electrical Equipment	2.0%	1.9%
Utilities	2.0%	1.0%
Petroleum and Natural Gas	1.9%	1.1%
Business Supplies and Shipping Containers	1.7%	2.0%
Aircraft, ships, and railroad equipment	1.7%	1.7%
Construction and Construction Materials	1.6%	1.9%
Automobiles and Trucks	1.6%	1.5%
Chemicals	1.6%	1.4%
Precious Metals, Non-Metallic, and Metal Mining	1.5%	0.8%
Food Products	1.2%	2.0%
Steel Works Etc	0.7%	0.9%
Textiles	0.5%	0.8%
Banking, Insurance, Real Estate, Trading	0.4%	0.1%
Everything Else	1.9%	1.4%

Table 2: **Summary Statistics of Leverage (2022)**

	10th Perc.	Mean	90th Perc.	Std. Dev.	Obs
Israel	0.01	0.279	0.612	0.237	573
U.S.	0.01	0.255	0.591	0.233	5,472
Rest of World	0.00	0.209	0.472	0.187	28,538

only, which produces a sample of 4,768 observations out of a potential total of around 12 thousand.[9] We examine both total amounts of term loans and the number of loans made, and calculate several control variables as straight averages of loan sin a cell - the fraction loans with a sponsor, the fraction of loans with working capital as the stated purpose, and the fraction of loans with deal purpose ("Merger", "Takeover", "Acquisition" or "Leveraged Buyout").

4.2 Empirical tests - Cross-country variation in leverage

In this section, we report tests of the impact of restructuring law on corporate capital structures using the developed and extensive U.S. Chapter 11 machinery for handling non-financial obligations. In particular, we compare leverage in industries where executory contracts tend to create extensive obligations, under the hypothesis that this reduces debt capacity by a little in the U.S. system but by a lot in jurisdictions offering less room for rejection. We consider all other countries the benchmark against which we compare U.S. firms. It is not entirely accurate that no other countries allow restructuring of executory contracts (see next section for an example), but it is generally true. When rejection is possible, it is typically restricted (Dávalos 2017). Our empirical hypothesis is therefore that firms in industries with high executory contracts, leverage should be higher in the U.S. than elsewhere. The regression equation is:

$$d_{it} = \theta X_{it} + \gamma E_j I_c^{treated} + \lambda G_{j\times t} + \eta H_{c\times t} + \epsilon_{it} \tag{29}$$

where d is log of debt or book leverage, i is firm and t year, $j(i)$ the industry of firm i, $c(i)$ the country of firm i, X vector of firm controls, E executory contract intensity of industry j, $I_c^{treated}$ US, and where G and H are industry-year, and country-year dummies (i.e., we saturate for the dimensions $j \times t$ and $c \times t$, and identify off the $j \times c$ dimension). We cluster standard errors both by firm and country. There are 708k (debt) or 642k (leverage) firm-year observations in the regression samples spanning the 2000 to 2022 period (there are fewer observations in the early sample years). The OECD regression sub-samples have 377k and 342k observations, respectively.

Table 3 reports results for leverage regressions comparing U.S. firms to those in other countries, either the full sample or the sub-sample of firms in OECD countries, using the executory contracts measures normalized by assets and revenue, respectively. All

[9]We have also tried including all the cells without loans, by considering the log of a constant (e.g., one) plus the number or value of loans. Results are very similar.

Table 3: **Leverage of U.S. firms compared to those in other countries**

	All Countries		OECD	
	(1)	(2)	(3)	(4)
	Leverage	Debt	Leverage	Debt
Dependent variable mean	0.231	5.659	0.234	5.651
Executory contracts (Revenues)	**0.458*****	**2.399*****	**0.363*****	**1.896*****
	(0.050)	(0.322)	(0.076)	(0.417)
Executory contracts (Assets)	**0.258*****	**1.167*****	**0.217*****	**0.971****
	(0.044)	(0.290)	(0.057)	(0.352)

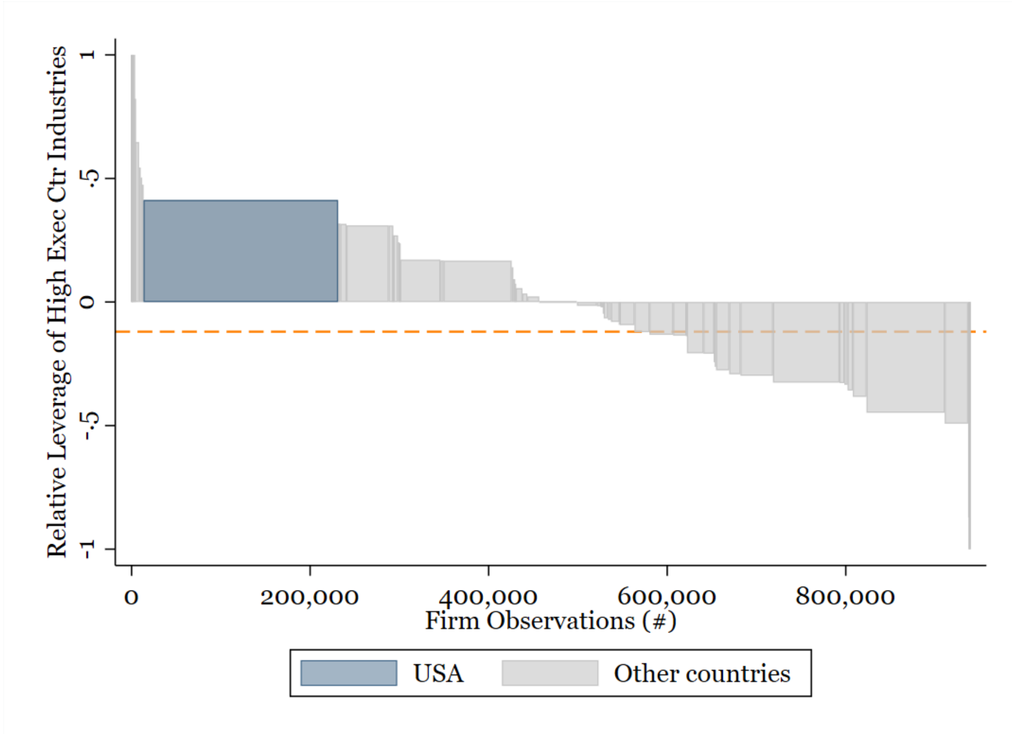
Regressions of book leverage or debt on control variables (dependent variable indicated at the top of each column). Each coefficient refers to one regression. Observations are firm-years. Executory contracts refers to the interaction of an indicator for U.S. firms and the amount of executory contracts, normalized by assets or revenues. All regressions include controls and fixed effects. Standard errors clustered by firm and by industry-year are reported in parentheses.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

coefficients are positive and significant, suggesting that U.S. firms in industries which tend to use executory contracts more, have higher leverage (compared to industries with less such use, and compared to other countries). The coefficients suggest small but potentially important effect; for example, the first coefficient (0.458) implies that a change in the ratio of executory contracts to revenue from the 25th to the 75th percentile (around 0.04) corresponds to an increase of leverage in the U.S. of 0.018 (vs. average leverage is 0.231), or around 10% higher debt (based on the coefficient first row in the second column).

These results suggest that operational obligations incurred through executory contracts reduce debt capacity outside the U.S., as predicted by our model. A potential concern with these results is that the U.S. context might differ in how debt and executory contracts are related due to reasons separate from insolvency law. In the next section, we examine a reform in Israel which allow us to test our hypothesis within a fixed jurisdiction. Finally, to assess how unusual the U.S. relative leverage of high Executory contract

Figure 1: **Country-level coefficients on Executory contract variable**



The figure plots country-by-country coefficients of leverage on Executory contracts use by industry (normalized by revenues), based on Table 2, plotted against the number of observations per country. Y axis cropped at -1 and 1. The average coefficient is zero by construction. The dotted line indicates the average without the U.S. Countries with fewer than 500 observations are omitted from the figure.

industries, we plot country-by-country coefficients in Figure 1.[10] The figure highlights that the U.S. is unusual – the only countries with higher point estimates represent few observations.

[10]Note that the regression is similar but not identical to Table 3 row one, column one. The regression underlying Figure 1 allows separate coefficients in each country. The U.S. point estimate is 0.383 (which exceeds the average of the other coefficients by 0.444, cf. the coefficient reported in the table). Note also that the industry fixed effects absorb the coefficient on the Executory contract variable – the coefficients are all in terms of deviations from the total for the sample, and are zero on average by construction.

4.3 Empirical Tests - leverage changes after Israel's Company Law reform in 2019

Until recently, the treatment of executory contracts during legal restructuring in Israel offered limited options. Prior to 2013, rejection was difficult, and after a 2013 legal case appeared possible under certain conditions. This right to rejection subject to different interpretation by different courts, and case law diverged. In some cases, courts disallowed rejection.

A new Company Law, in effect since 2019, codified and expanded the flexible treatment of executory contracts of restructuring firms. Now, a debtor has 90 days from the start of proceedings to file a motion to reject a contract, and rejection is allowed with few conditions (Hahn and Kimhi 2021). Counterparties of rejected contracts have an unsecured claim on the estate. The World Bank describes the reform as follows: "Israel made resolving insolvency easier through an amendment to its company law allowing the assumption or rejection of executory contracts, granting maximum priority to postcommencement credit, extending the maximum period of moratorium during restructuring proceedings and allowing the sale of secured assets when necessary to ensure a successful restructuring"[11]. In effect, the right to reject executory contracts appears similar to the U.S.

In our empirical tests, we focus on the increased ability to deal with executory contracts starting with the reform to the Company Law, in effect from 2019. We predict that financial leverage will increase following the reform for firms which operate in industries where executory contracts are important. By exploiting the different role of executory contracts across industries, and testing whether leverage increased *more* after the reform in those industries where executory contracts are important (than in industries where they are not), we can include time and industry fixed effects. Therefore, results are independent of aggregate time trends as well as of any industry-specific (but time-independent) determinants of leverage. In essence, the tests have a similar difference-in-difference interpretation as the cross-country but compare Israeli firms before and after the reform instead of U.S. firms to non-U.S. firms. The regression equation is:

$$d_{it} = \theta X_{it} + \gamma E_j I_{ct}^{treated} + \mu F_i + \lambda G_{j\times t} + \eta H_{c\times t} + \epsilon_{it} \tag{30}$$

where d is log of debt or book leverage, i is firm and t year, $c(i)$ represents the country

[11] From https://archive.doingbusiness.org/en/reforms/overview/economy/israel, accessed June 2022.

of firm i, X vector of firm controls, E executory contract intensity of industry j, $j(i)$ industry, $I_{ct}^{treated}$ indicates observations in Israel in 2019 and later, and where F, G, H are firm, industry-year, and country-year dummies (i.e., we saturate for the dimensions $j \times t$ and $c \times t$, and identify off the $j \times t \times c$ dimension). We cluster standard errors both by firm and country. Comparing to the cross-sectional tests above, we can include firm fixed effects (they raise R-squared above 90% in all regressions, but their inclusion makes little difference to the coefficient estimates of interest).

Table 4: **Leverage of Israeli firms around the 2019 Company Law Reform**

	(1)	(2)
	Leverage	Debt
Executory contracts (Revenues)	**0.991*****	**4.169****
	(0.159)	(0.825)
Executory contracts (Assets)	**0.824*****	**3.172*****
	(0.137)	(0.671)

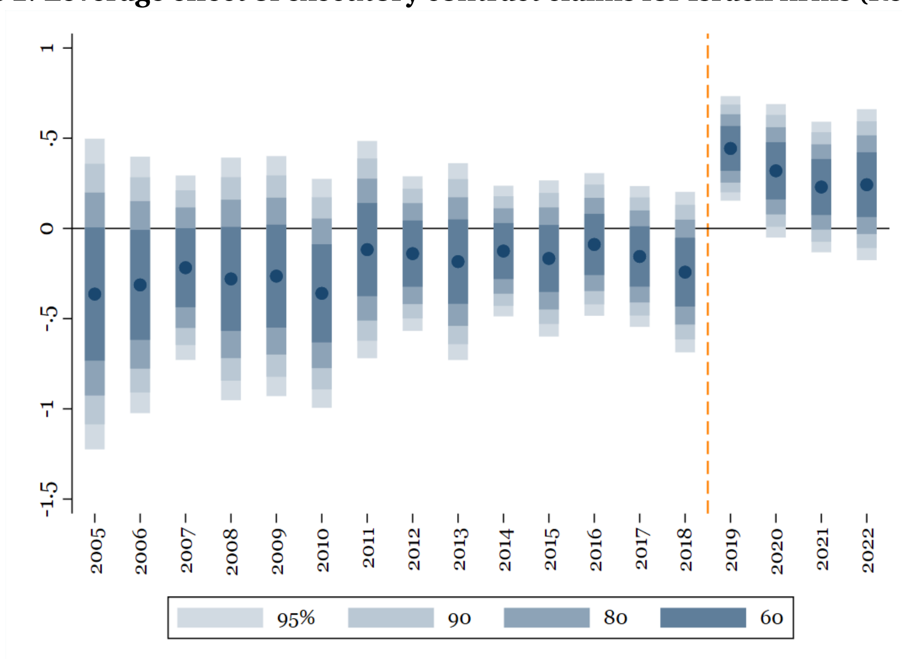
Regressions of book leverage or debt on control variables (dependent variable indicated at the top of each column). Each coefficient refers to one regression. Observations are firm-years. Executory Contracts refers to the interaction of an indicator for Israeli firms after 2019 and the amount of executory contracts, normalized by assets or revenues. All regressions include controls and fixed effects. Standard errors clustered by firm and by industry-year are reported in parentheses.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Results of four regressions are reported in Table 4. Coefficients are about twice the magnitude to the U.S. tests in Table 3 and similarly highly statistically significant (the difference is large and well estimated enough to be significant in itself). The large coefficients imply that high executory contract industries have leverage that is higher by around 2 percentage points (this is about a tenth of the population average for leverage), when insolvency law permits rejection. These before- and after- tests implicitly compare the period 2000-2018 to the period 2019-2021. Once potential challenge to these difference-in-difference estimates is that they require parallel trends – otherwise they may reflect long-term, slow-moving trends, and not a change around the time of the new law. We next turn to year-by-year coefficients to assess the parallel trend assumption.

Figures 2 and 3 plot year-by-year coefficients on the executory contract variables from 2005 onwards. The average for the 2000-2018 corresponds to the pre-period in Table 2, and 2019-2021 to the post-period (the reported coefficient corresponds approximately to the difference between these two averages). Starting from a negative point estimate (Israeli firms in industries with lots of executory contracts have lower leverage), there is a jump in 2019, which continues in 2020-2021. The post-reform period is characterized by a reverse or at least disappearing difference in leverage between high and low executory contract industries in Israel.

Figure 2: **Leverage effect of executory contract claims for Israeli firms (Revenue)**

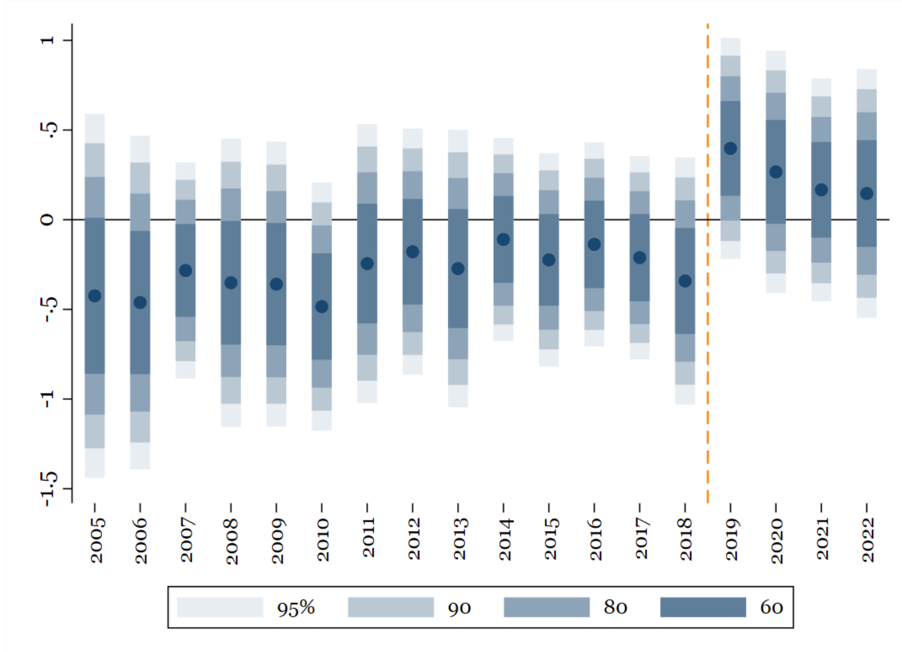


This figure plots year-by-year coefficients of leverage on executory contracts by industry, normalized by revenues, with controls as in Table 2 and errors clustered by firm and by industry-year. Confidence intervals are indicated. The key reform was implemented in 2019.

The Israel figures show two things. First, the effect occurs relatively suddenly in the years following the reform. There is no apparent trend before 2019. Second, 2020 and 2021 (perhaps affected by Covid) are not very different from 2019. This suggests that 2019 was the important year.

Taken together, regressions and graphs suggest that the Israeli Company Law reform allows the same interpretation as the U.S. tests: an option to reject executory contracts, by making operational restructuring more effective, allows higher leverage. Presumably it also allows more successful restructurings, better access to credit for a few industries.

Figure 3: **Leverage effect of executory contract claims for Israeli firms (Assets)**



This figure plots year-by-year coefficients of leverage on executory contracts by industry, normalized by assets, with controls as in Table 2 and errors clustered by firm and by industry-year. Confidence intervals are indicated. The key reform was implemented in 2019.

4.4 Empirical Tests - Cross-country variation in lending volumes

Our final tests consider the flow of loans reported in the Dealscan data base. Although Dealscan contains a large number of loans, there is not enough data to use Dealscan flow data for the Israeli 2019 reform - for example, there are only thirteen term loans in 2018 and eighteen in 2019, and most industry-years have no loans. Therefore, we focus on the difference-in-difference comparison of high and low executory contract industries and the U.S. vs. everywhere else.

We aggregate lending by year and industry and country, and test whether the U.S. sees larger flows in the industries that have high use of executory contracts. Loan value (dollars) and number are summed by country-industry-year. For pricing, raw country-

Table 5: **Lending volume by country and industry**

	Quantity		Price
	(1)	(2)	(3)
	Loan value	Loan number	Loan Spread
Dependent variable mean	7.845	2.858	n/a
Executory contracts (Revenues)	**8.543*****	**5.878*****	**-85.9****
	(0.687)	(0.463)	(39.8)
Executory contracts (Assets)	**6.140*****	**4.131*****	**-40.6**
	(0.537)	(0.404)	(38.2)

Regressions of total term loan origination value or number, or price. The sample covers 2010-2023H2. Observations are industry-year-country. Each coefficient refers to one regression. Executory Contracts refers to the interaction of an indicator for U.S. firms and the amount of executory contracts (normalized). All regressions include controls as well as fixed effects. Standard errors clustered by country are reported in parentheses.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

industry-year averages are noisy (due to variation in, e.g., loan size and collateralization), so we instead average residuals from a regression of loan spread on loan size (log), indicators for loan purpose, fixed effects for secured (by year), country (by year), an indicator for sponsored loans (by year), currency and lender country. The residual of this regression, for each loan, is averaged by cell.

The regression equations for aggregate data by country-industry-year are:

$$d_{ict} = \theta X_{ict} + \gamma E_j I_c^{treated} + \mu F_i + \lambda G_{j\times t} + \eta H_{c\times t} + \epsilon_{it} \quad (31)$$

where d is the value or number of loans, or the average loan spread residual, j is industry, t year, and $c(i)$ country. X is a vector of control variables (the share of loans with sponsor, share used for working capital purposes, and share for transactions purposes), E executory contract intensity of industry j, $j(i)$ industry, $I_c^{treated}$ indicates observations for U.S. firms, and where G and H are industry-year, and country-year dummies (i.e., we saturate for the dimensions $j \times t$ and $c \times t$, and identify off the $j \times c$ dimension). There are 9,317 observations, each representing between one and 2,966 loans (49 on average). We cluster standard errors by country.

Results are reported in Table 5, where each coefficient represents one regression. The coefficients are positive and highly statistically significantly different from zero. The magnitudes implied are large. For example, the first coefficient implies a 41 percent higher lending volume in a U.S. industry as we go from the industry with the 25^{th} to the industry with the 75^{th} percentile of executory contract use, compared to outside the U.S. Coefficients for the OECD sample are slightly larger, corresponding to larger typical lending volumes (for example, there are 49 loans on average in the wider sample, 70 for the OECD sample). The spread regressions are less precisely estimated - one coefficient estimate suggests that loans in high executory contract industries are cheaper in the U.S. than elsewhere, in line with the hypothesis that rejection options increase the debt capacity of firms. We conclude that evidence from the flow of leveraged loans agrees with capital structure evidence on the U.S. credit markets being relatively more generous with credit to industries with high use of executory contracts. In other words, executory contracts reduce debt capacity *less* in the U.S. than elsewhere. The treatment of executory contracts in insolvency is not the only possible explanation for this pattern, but it is perhaps the only one that fits both the cross-country and time-series capital structure evidence and flow evidence from Dealscan.

5. Conclusions

The system for managing insolvent firms is important to economic health and renewal (Bernstein et al. 2019). A particular challenge is posed by the restructuring of insolvent but viable firms (Gertner and Scharfstein 1991), and many countries struggle to approach the successful U.S. system (Djankov et al. 2008, Becker and Josephson 2016 and Vig 2013). We propose that the handling of non-financial obligations – in particular those created by executory contracts such as leases and long-term supply contracts – is a key design variable in insolvency law.

We develop a model where we can allow or disallow operational restructuring through the rejection of executory contracts. The ability to restructure non-financial obligation – what is achieved through rejection of contracts in Chapter 11 – allows more firms to restructure (instead of liquidate) and increases ex-ante financial debt capacity. Since executory contracts are large (we estimate that their value often exceeds 20 percent of assets) and important in many U.S. Chapter 11 cases (Ayotte 2015), we expect this to matter practically to corporate restructuring and credit markets.

We test the model's predictions in international data of leverage and lending. We employ two separate difference-in-difference approaches, relying on the difference of U.S. with the rest of the world, and on the changes to rejection rights embedded in the 2019 reform to Israel's Company Law. We find consistent evidence suggesting that restructuring non-financial obligations increases debt capacity of firms, presumably reducing their cost of capital. We believe that non-financial restructuring should be a target for policy efforts in jurisdictions that wish to avoid the liquidation of viable firms.

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Appendix

A. Net debt and equity

Equity in setting N:

$$\begin{aligned} e^N &= (1-t)\int_{s_I^N}^{1}\left(\alpha s-\beta\,(p-q)-D^N\right)ds, \\ &= \frac{(1-t)\,(\alpha-\beta\,(p-q)-L+C)^2}{2\alpha\,(1+t)^2} \end{aligned}$$

Net debt in setting N:

$$\begin{aligned} d^N &= (L-C)\int_0^{s_I^N} ds + D^N \int_{s_I^N}^{1} ds \\ &= \left(L-C-D^N\right)s_I^N + D^N \\ &= \frac{t\,(L-C-\alpha+\beta\,(p-q))}{1+t}\frac{t\alpha+\beta\,(p-q)+L-C}{\alpha\,(1+t)} + \frac{t\,(\alpha-\beta\,(p-q))+L-C}{1+t} \end{aligned}$$

Equity in setting F:

$$\begin{aligned} e^F &= (1-t)\int_{s_I^F}^{1}\left(\alpha s+\beta\left(q-p\right)-D^F\right)ds \\ &= \frac{1-t}{2\alpha}\left[\left(\alpha s+\beta\left(q-p\right)-D^F\right)^2\right]_{s_I^F}^{1} \\ &= \frac{1-t}{2\alpha t^2}C^2. \end{aligned}$$

Net debt in setting F:

$$\begin{aligned} d^F &= (L-C)\int_0^{s_L^F}ds+\int_{s_L^F}^{s_I^F}\left(\alpha s+\beta\left(q-p\right)-C\right)ds+D^F\int_{s_I^F}^{1}ds \\ &= (L-C)\,s_L^F+\frac{1}{2\alpha}\left[\left(\alpha s+\beta\left(q-p\right)-C\right)^2\right]_{s_L^F}^{s_I^F}+D^F\left(1-s_I^F\right) \\ &= (L-C)\,\frac{L+C-2\beta\left(q-p\right)}{2\alpha}+\frac{\left(D^F-C\right)^2}{2\alpha}+D^F\frac{C}{t\alpha} \\ &= \frac{1}{2\alpha}\left(L^2-C^2-2\left(L-C\right)\beta\left(q-p\right)+\left(D^F\right)^2-2D^FC+C^2+2D^F\frac{C}{t}\right) \\ &= \frac{1}{2\alpha}\left(L^2-2\left(L-C\right)\beta\left(q-p\right)+\left(\alpha+\beta\left(q-p\right)-C/t\right)\left(\alpha+\beta\left(q-p\right)+C/t-2C\right)\right) \\ &= \frac{1}{2\alpha}\left(\left(L-\beta\left(q-p\right)\right)^2-C^2/t^2+2tC^2/t^2\right)-C+\frac{\alpha+2\beta\left(q-p\right)}{2} \\ &= \frac{\left(L+\beta\left(p-q\right)\right)^2}{2\alpha}-C-\frac{C^2\left(1-2t\right)}{2\alpha t^2}+\frac{\alpha+2\beta\left(q-p\right)}{2}. \end{aligned}$$

Equity in setting O:

$$e^O = \frac{1-t}{2\alpha t^2}\left(C-\beta\left(p-k\right)\right)^2.$$

Net debt in setting O:

$$\begin{aligned}
d^O &= L\frac{L-2\beta\left(q-k\right)}{2\alpha}+\frac{1}{2\alpha}\left(\left(\alpha s_I^O\right)^2+2\alpha s_I^O\beta\left(q-k\right)+\beta^2\left(q-k\right)^2\right)+D^O\left(1-s_I^O\right)-Cs_I^O \\
&= \frac{L^2-2L\beta\left(q-k\right)+\beta^2\left(q-k\right)^2}{2\alpha}+s_I^O\frac{\alpha^2 s_I^O+2\alpha\beta\left(q-k\right)-2\alpha D-2\alpha C}{2\alpha}+D^O \\
&= \frac{\left(L-\beta\left(q-k\right)\right)^2}{2\alpha}+D^O \\
&\quad +s_I^O\frac{\alpha t+\beta\left(p-k\right)-C+2\beta t\left(q-k\right)-2\alpha t-2\beta t\left(q-p\right)+2C-2\beta\left(p-k\right)-2Ct}{2t} \\
&= \frac{\left(L-\beta\left(q-k\right)\right)^2}{2\alpha}+\left(1-2t\right)s_I^O\frac{-\alpha t-\beta\left(p-k\right)+C}{2t}-t\alpha s_I^O+D^O \\
&= \frac{\left(L-\beta\left(q-k\right)\right)^2}{2\alpha}+\left(1-2t\right)\frac{\left(\alpha t+\beta\left(p-k\right)-C\right)\left(-\alpha t-\beta\left(p-k\right)+C\right)}{2\alpha t^2}-t\alpha s_I^O+D^O \\
&= \frac{\left(L-\beta\left(q-k\right)\right)^2}{2\alpha}-\left(1-2t\right)\frac{\left(\alpha t+\beta\left(p-k\right)-C\right)^2}{2\alpha t^2} \\
&\quad +\frac{\alpha t-\alpha t^2+\beta\left(q-k\right)-t\beta\left(q-k\right)-C+tC+\beta\left(p-q\right)-t\beta\left(p-q\right)-t\beta\left(p-q\right)}{t} \\
&= \frac{\left(L-\beta\left(q-k\right)\right)^2}{2\alpha}-\left(1-2t\right)\frac{\left(\alpha t+\beta\left(p-k\right)-C\right)^2}{2\alpha t^2}+\frac{\left(1-t\right)\left(\alpha t+\beta\left(p-k\right)-C\right)}{t} \\
&\quad +\beta\left(q-p\right)
\end{aligned}$$

B. Differences in equilibrium values

Net debt difference between settings O and F:

$$
\begin{aligned}
d^O - d^F &= \frac{(L-\beta(q-k))^2 - (L-\beta(q-p))^2}{2\alpha} \\
&\quad - (1-2t)\frac{(\alpha t+\beta(p-k)-C)^2 - C^2}{2\alpha t^2} + \frac{(1-t)(\alpha t+\beta(p-k)-C)+Ct}{t} - \frac{\alpha}{2} \\
&= \frac{\beta(k-p)}{2t^2\alpha} \\
&\quad \cdot \left(p\beta - k\beta - 2C + 2Lt^2 - 2t^2\alpha + 4Ct + 2kt\beta - 2pt\beta + kt^2\beta + pt^2\beta - 2qt^2\beta\right) \\
&= \frac{\beta(p-k)}{2\alpha t^2} \\
&\quad \cdot \left(\beta(p-k)\left(1+t^2\right) + 2t^2(\alpha - \beta(p-q) - L - C/t) + 2(1-t)(C - \beta(p-k))\right)
\end{aligned}
$$

Difference in firm value between settings O and F:

$$
\begin{aligned}
f^O - f^F &= \frac{1}{2t\alpha}\beta(k-p)(2C + k\beta - p\beta - 2t\alpha + 2Lt + kt\beta + pt\beta - 2qt\beta) \\
&= \frac{\beta(p-k)}{2\alpha t}(\beta(p-k)(t+1) + 2t(\alpha - \beta(p-q) - L - C/t))
\end{aligned}
$$

Difference in firm value between settings F and N:

$$
f^F - f^{NO} = \frac{(C - t(\alpha - \beta(p-q) - L))^2}{2t(t+1)\alpha}
$$

C. Proofs

Proof of Proposition 1. The rightmost inequality follows trivially since $p > k$ by assumption. The leftmost inequality follows from Assumption A1 since,

$$D^F - D^N = (\alpha - \beta (p - q) - C/t - L) / (1 + t) .$$

■

Proof of Proposition 2. The left-most inequality follows trivially since $p > k$ by assumption. The rightmost inequality follows from Assumption A1 since,

$$s_L^F - s_L^N = (t (\alpha - \beta (p - q) - L) - C) / (\alpha (1 + t)) .$$

■

Proof of Proposition 3. The rightmost inequality follows since:

$$\begin{aligned} d^O - d^F &= \frac{\beta (p - k)}{2\alpha t^2} \\ &\cdot \left(\beta (p - k) \left(1 + t^2\right) + 2t^2 (\alpha - \beta (p - q) - L - C/t) + 2 (1 - t) (C - \beta (p - k))\right) \end{aligned}$$

which is positive by Assumptions A1 and A2, and $p > k$.

The leftmost inequality follows by Proposition 5 and the fact that

$$e^N > e^F .$$

■

Proof of Proposition 4. The derivatives of the difference in net debt are given by:

$$\begin{aligned} \frac{\partial \left(d^O - d^F\right)}{\partial \beta} &= t^2 (p - k) \frac{\beta (q - k) + (\alpha - \beta (p - q) - L - C/t)}{\alpha t^2} \\ &+ (p - k) \frac{(C - \beta (p - k)) (1 - t) + t\beta (p - k)}{\alpha t^2} , \end{aligned}$$

and

$$\begin{aligned}\partial\left(d^O-d^N\right)/\partial\beta &= \frac{q-k}{\alpha}\left(\alpha-L+\beta\left(q-k\right)+\left(C-\beta\left(p-k\right)\right)\left(1-2t\right)\right)\\ &\quad+\frac{\left(p-q\right)}{\alpha t^2\left(1+t\right)^2}\begin{pmatrix}\left(C-\beta\left(p-k\right)\right)\left(1-t^2\right)\\ +2t^3\left(\alpha-k\beta+q\beta-C/t-L\right)+2\beta\left(p-k\right)t^2\end{pmatrix}\\ &> \frac{q-k}{\alpha}\left(\alpha-L+\beta\left(q-k\right)-C+\beta\left(p-k\right)\right)\\ &\quad+\frac{\left(p-q\right)}{\alpha t^2\left(1+t\right)^2}\begin{pmatrix}\left(C-\beta\left(p-k\right)\right)\left(1-t^2\right)\\ +2t^3\left(\alpha-k\beta+q\beta-C/t-L\right)+2\beta\left(p-k\right)t^2\end{pmatrix}.\end{aligned}$$

Both are positive by Assumptions A1 and A2, and $p > q > k$. ■

Proof of Proposition 5. The rightmost inequality follows by Assumption A1 and $p > k$ since:

$$f^O - f^F = \frac{\beta\left(p-k\right)}{2\alpha t}\left(\beta\left(p-k\right)\left(t+1\right)+2t\left(\alpha-\beta\left(p-q\right)-L-C/t\right)\right).$$

The leftmost inequality follows immediately from:

$$f^F - f^N = \frac{\left(C-t\left(\alpha-\beta\left(p-q\right)-L\right)\right)^2}{2t\left(t+1\right)\alpha}.$$

■

D. List of variables

I	investment
d	net debt
e	expected value of equity in period 1
D	gross debt
C	cost of bankruptcy/restructuring
α	quantity of the stand-alone technology
β	quantity of the input
k	the supplier's opportunity cost of the input
q	productivity of the input
p	unit price of the input
s	signal realization
s_L	liquidation threshold
s_I	insolvency threshold
t	tax rate
N	no restructuring possible
F	financial restructuring possible
O	operational and financial restructuring possible
W	total surplus