Debt Renegotiation and Investment Decisions Across Countries*

Giovanni Favara[†] Erwan Morellec[‡] Enrique Schroth[§] Philip Valta[¶]

November 18, 2013

Abstract

We develop a model of corporate decisions that endogenizes levered firms' choices with respect to investment, asset sales, and risk-taking. Using this model, we show that debtor friendly bankruptcy laws can mitigate the distortions in corporate policies due to conflicts of interests between shareholders and creditors. Notably, we demonstrate that bankruptcy laws favoring debt renegotiation reduce underinvestment, limit asset sales, and decrease incentives for risk-taking when firms are near insolvency. We test these predictions on a panel of 19,466 firms across 41 countries with different bankruptcy codes and find robust support for our theory.

Keywords: Debt renegotiation; Debt Overhang; Investment decisions; Asset sales; Risk-taking.

JEL Classification Numbers: D83; G24; G31; G32; G35.

*Financial support from the Swiss Finance Institute and from NCCR FINRISK of the Swiss NSF is also gratefully acknowledged. The usual disclaimer applies.

[†]Federal Reserve Board. E-mail: giovanni.favara@frb.gov.

[‡]Swiss Finance Institute, EPFL, and CEPR. E-mail: erwan.morellec@epfl.ch.

[§]Cass Business School, City University London. E-mail: enrique.schroth.1@city.ac.uk.

[¶]HEC Paris. E-mail: valta@hec.fr.

1. Introduction

A central result in corporate finance theory is that, as a firm approaches financial distress, key corporate decisions such as investment and risk-taking get distorted by conflicts of interests between shareholders and creditors. Notably, the expectation of a low shareholder recovery in distress leads shareholders to invest too little in the firm's assets, either by rejecting positive net present value (NPV) projects – the debt overhang effect of Myers (1977) – or by selling assets in place, and to take on too much risk – the risk-shifting effect of Jensen and Meckling (1976). The goal of this paper is to examine the effects of bankruptcy codes on these adverse investment incentives and to determine whether they can be mitigated by a bankruptcy code that favors debt renegotiations over asset liquidations.

To illustrate the potential effects of bankruptcy codes on corporate choices, we start our analysis by developing a parsimonious, two-period model that endogenizes a levered firm's decisions with respect to investment, asset sales, and risk-taking. The model considers a firm with an opportunity to invest in a risky project. This firm must raise risky debt to finance part of the capital expenditure. After debt has been issued, the firm can choose to increase the risk of the project. It can also reduce the scale of the project by selling part of its assets before debt maturity.

Using this model, we show that risky debt (*i*) reduces the value of the project to shareholders by truncating their cash flows in default, (*ii*) encourages shareholders to increase risk by giving them an option to default, and (*iii*) distorts capital reallocation by fostering asset sales before debt maturity. We also show that bankruptcy codes that favor debt renegotiations increase shareholders' expected recovery in default and, therefore, decrease the effects of risky debt on investment and asset sales. Lastly, we demonstrate that the prospect of a debt renegotiation decreases the convexity of shareholders' claim on the firms' assets and therefore decreases incentives for risk-taking when the firm approaches distress.

One benefit of the model is that all the predictions regarding its three outcome variables relate to the same characteristics of the bankruptcy code, i.e. debt renegotiation frictions, and to the same firm characteristics, i.e. the firm's probability of default. Another benefit is the inclusion of asset sales in our analysis. Indeed, the empirical variation in investment across countries is significantly reduced by the fact that there are many zeros, implying that

the distribution of investment within many countries is severely skewed. In this respect, the model allows us to better exploit the international data by also considering the option to sell assets. As we show in the paper, fixed asset growth rates or PPE growth rates – one of our main proxies for asset sales – exhibit significant variation across countries, allowing us to identify large differences associated with differences in debt renegotiation frictions.

To test the predictions of the model, we use a panel of 19,466 firms across 41 countries with heterogeneous bankrutpcy codes. The core of our identification strategy consists in exploiting the exogenous variation in the characteristics of the debt enforcement procedure documented in the survey by Djankov, Hart, McLeish, and Shleifer (DHMS, 2008). In this survey, DHMS show that bankruptcy laws vary substantially across countries and that one important source of heterogeneity in the bankruptcy procedure is the amount of provisions against the renegotiation of debt contracts. In our empirical analysis, we adopt the measure for the probability of debt renegotiation failure used by Favara, Schroth and Valta (2012), which averages characteristics in the DHMS survey that add frictions to debt renegotiations. This measure provides the main source of cross-country variation of shareholders' expected recovery during financial distress. Our empirical tests relate each outcome variable, i.e. investment, asset sales, and risk-taking, to the interaction between renegotiation failure and firm-specific measures of default risk.

The empirical analysis delivers three main results. First, we show that distressed firms in countries favoring debt renegotiation do not cut investment as much as equally debt-overhung firms in countries that block or limit debt renegotiation. The differences are large and are economically significant, even though we bias results against us by considering that firms are distressed if their default probability is larger than 50%. Second, we find that distressed firms are significantly less likely to sell assets in countries where they expect to successfully renegotiate their debt. Finally, we find that distressed firms in countries with fewer renegotiation frictions take less risk than their counterparts in countries with stricter debt enforcement. The largest economic effects are for asset sales.

A series of robustness checks confirm these results. Importantly, we show that the results are not an artifact of sample selection across countries. In such a wide cross section, it is possible that differences in debt enforcement would bias the selection in countries with

weak debt enforcement towards firms that are unlikely to default. We test our hypotheses using sub-samples of firms that are similar on observable dimensions that are likely to affect investment and risk-taking decisions across countries. Namely, we define firms in countries with strict debt enforcement procedures as 'treated' firms, and match them to 'control' firms that are similar to the treated firms except for the fact that they are in countries where the bankruptcy procedure is more debtor friendly. Our results are almost identical.

If anything, our results are stronger after controlling for unobservable firm, industry, or country characteristics driving differences in investment, assets sales, and risk-taking across countries. Moreover, we find that the effect of debt enforcement is not only associated with variation in average investment, asset sales, and risk-taking across countries, but also within the firm. Such additional identification power is provided by the fact that our panel is long, i.e. 18 years, and therefore exhibits large time variation of the probability of default.

Overall, our paper makes three contributions. The first contribution is to the literature on the real effects of bankruptcy laws. The strategic default literature has shown that bankruptcy codes with fewer renegotiation frictions lead to larger debt reductions in default to the benefit of shareholders and, therefore, reduce equity risk.[1] Consistent with this view, deviations from absolute priority caused by debtor friendliness of bankruptcy laws have recently been shown to have important effects on equity returns both in the U.S. (see Garlappi, Shu and Yan (2007) and Hackbarth, Haselmann and Schoenherr (2013)) and internationally (see Favara, Schroth and Valta (FSV, 2012)). While these studies analyze equity risk under the assumption that asset risk is given and independent of bankruptcy laws, we show in this paper that renegotiation frictions increase asset risk, thereby leading to an increase of equity risk. Our analysis therefore suggests that some of the effects documented in prior studies may be due to the endogenous response of shareholders' investment and risk choices to expected bankruptcy outcomes.

Our paper also contributes to the literature examining the relation between creditor rights and firm decisions. In this literature, stronger creditor rights appear to decrease risk-taking (Acharya, Amihud and Litov (2011)) and innovation (Acharya and Subramanian (2009)). We argue that one reason for the apparent inconsistency between these results and ours is

[1] See, e.g. Fan and Sundaresan (2000), François and Morellec (2004), or Davydenko and Strebulaev (2007).

that we use a measure which (i) is specifically designed to capture debt renegotiation frictions and not the rights of creditors in general and (ii) provides a richer characterization because it incorporates several additional dimensions of the debt enforcement procedure. However, we show that these results are not at odds with ours because the effects of creditor rights on risk-taking switch signs once the firm is closer to default. Therefore, our main contribution to this literature is to show that the effects of debt enforcement on corporate choices depend very much on the distance to default.

The paper closest to ours in this literature is Becker and Stromberg (2012). They show that a strengthening of managerial fiduciary duties to creditors mitigates underinvestment and risk-shifting incentives for a firm near insolvency. In apparent contrast, we find that underinvestment and risk-shifting distortions are mitigated with higher shareholders' expected recovery rates. That is, debt overhang distortions can also be resolved by leaving debtors in control while increasing their expected claim on the assets in bankruptcy. Together, these two sets of results show that the bankruptcy code can improve efficiency near insolvency by giving control to whoever (creditors or debtors) expects a higher recovery in bankruptcy.

Finally, our paper also relates to the literature on investment and debt overhang. This literature has provided evidence of the debt overhang channel in the U.S. by forcefully establishing a negative relation between investment and creditors' expected recovery (see e.g. Hennessy (2004) or Hennessy, Levy, and Whited (2007)). We complement this literature by showing that an important component in the creditors' expected recovery, and therefore the debt overhang channel, is the number of frictions to debt renegotiation in bankruptcy codes. We also demonstrate that debt overhang and renegotiation frictions in default have large ex ante effects on other corporate decisions, such as asset sales or risk-taking.

The remainder of the paper is organized as follows. Section 2 outlines the model and derives testable predictions. Section 3 describes the data and discusses our measures of renegotiation frictions, corporate investment, asset sales, and risk-taking. Section 4 presents our main empirical results. Section 5 presents robustness tests. Section 6 concludes.

2. Model

In this section, we construct a 2-period model that illustrates the interplay between bankruptcy procedures and corporate investment, asset sales, and risk-taking. This model allows us to formalize testable hypotheses that we take to the data in the following sections.

2.1. Model without assets sales

Throughout the model, agents are risk neutral and equilibrium interest rates are zero. We consider a model with three dates, $t = 0$, $t = 1$, and $t = 2$. At time $t = 0$, a firm can invest an amount K in a project with unlevered value $v > K$. The return on the project is governed by a binomial process, so that in each period the asset value can increase by a factor $z > 1$ with probability p or decrease by a factor $z^{-1} < 1$ with probability $(1 - p)$. At date $t = 2$, the project can therefore take three values: z^2v, v, or $z^{-2}v$.

To examine the effects of corporate debt and bankruptcy codes on corporate investment and risk-taking, we assume that the firm has to issue debt with promised payment $z^{-2}v < F < v$ due at time $t = 2$ to finance the investment project. The assumption that $z^{-2}v < F$ insures that default occurs with positive probability in the model. The assumption that $F < v$ implies that default only occurs in the bottom-most node at time $t = 2$. This second constraint may be viewed as a collateral constraint. We assume that in default a fraction α of asset value is lost as a frictional cost. Because liquidation is costly, there exists a surplus associated with renegotiation in default. Following Fan and Sundaresan (2000), Garlappi and Yan (2011), and Favara, Schroth and Valta (2011), Nash bargaining in renegotiation allows shareholders to get a fraction η of the renegotiation surplus. Finally, to account for renegotiation frictions, we follow Davydenko and Strebulaev (2007) and consider that debt renegotiation can fail with probability f in default.

Consider first the effects of bankruptcy codes on initial investment. In the model, managers act in the best interest of shareholders and choose investment policy to maximize equity value. As a result, the firm invests in the project if the value of equity after investment exceeds the cost of investment to shareholders, i.e. if

$$E_0(v; F) - [K - D_0(v; F)] \geq 0.$$

In this relation, $E_0(v;F)$ is the value of equity at time $t=0$ after investment, $D_0(v;F)$ is the value of corporate debt at time $t=0$, and $K - D_0(v;F)$ is the contribution of shareholders to the cost of investment. Because $z^{-2}v < F < v$, it is optimal for shareholders to default on the debt contract at time $t=2$ in the bottom-most node. Therefore, we have

$$E_0(v;F) = p^2\left(z^2 v - F\right) + 2p\,(1-p)\,(v-F) + (1-p)^2\,\eta\alpha\,(1-f)\,z^{-2}v, \tag{1}$$

and

$$D_0(v;F) = p^2 F + 2p\,(1-p)\,F + (1-p)^2\,[(1-f)\,(1-\eta\alpha) + f(1-\alpha)]z^{-2}v. \tag{2}$$

These equations reflect the fact that the firm defaults on the debt contract at time $t=2$ with probability $(1-p)^2$. In default, outstanding claims are renegotiated. Renegotiation succeeds with probability $(1-f)$, in which case shareholders appropriate a fraction $\alpha\eta$ of the value of the bankrupt firm $z^{-2}v$. In these equations, the risk-neutral probability of an increase in asset value is $p = \frac{1-z^{-1}}{z-z^{-1}}$. Using equations (1) and (2), the definition of the risk-neutral probability of an up move, and solving for the investment policy that maximizes shareholders value allows us to get the following result.

Proposition 1 *Shareholders invest in the project only if the cost of investment satisfies*

$$K < K^{\max} \equiv v - \alpha v z^{-2} f\left(\frac{z-1}{z-z^{-1}}\right)^2.$$

Corporate investment decreases renegotiation frictions f in that $\frac{\partial K^{\max}}{\partial f} < 0$.

Proposition 1 shows that risky debt in the firm's capital structure reduces equity value and leads to underinvestment, a result first uncovered by Myers (1977). Second, it shows that underinvestment should be more or less severe depending on the country's bankruptcy law. In particular, our model predicts that given two firms with identical assets and bankruptcy costs, the firm facing more renegotiation frictions ex post should have a lower propensity to invest ex ante.

The next question we are interested in is that of the effects of bankruptcy codes on risk-taking. Suppose that shareholders can increase risk just after investing in the project. In the model, an increase in z corresponds to an increase in the possible spread of values for

the project and, therefore, in project risk. Using the definition of equity in equation (1), the fact that the risk-neutral probability of an increase in asset value is $p = \frac{1-z^{-1}}{z-z^{-1}}$, and simple algebraic manipulations, we get that the effect of an increase in z on equity value is:

$$\frac{\partial E_0(v;F)}{\partial z} = \frac{2\left[v\left(1-\eta\alpha\left(1-f\right)\right)+Fz\right]}{\left(1+z\right)^3} > 0,$$

so that

$$\frac{\partial^2 E_0(v;F)}{\partial z \partial f} = \frac{2\eta\alpha v}{\left(1+z\right)^3} > 0.$$

The above derivations show that shareholders' have incentives to increase risk after debt has been issued in that $\frac{\partial E_0(v;F)}{\partial z} > 0$, a result first uncovered by Jensen and Meckling (1976). This is simply due to the fact that shareholders own an option to default and that the value of this option increases with uncertainty. The derivations also show that the propensity to increase risk increases with renegotiation frictions. Indeed, by reducing the value of shareholders' claim in default, renegotiation frictions increase the convexity of equity value and make it more attractive for shareholders to increase risk. These results are summarized in the following Proposition:

Proposition 2 *Shareholders have incentives to increase risk after debt has been issued. Shareholders risk-taking incentives increase with renegotiation frictions f.*

2.2. Introducing assets sales

Suppose that the firm can sell a fraction λ of its assets for a price $\lambda\Theta$ at time $t = 1$ and that the proceeds from the asset sale are stored within the firm to make the debt payment at time $t = 2$, as in Diamond and Rajan (2011). Under the assumption that asset sales are sufficient to guarantee that the condition $(1-\lambda)\,vz^{-2} + \lambda\Theta vz^{-1} > F$ is satisfied, there is no default at time $t = 2$. Therefore, shareholders find it optimal to sell a fraction λ of the firm's assets in the low node at time $t = 1$ if:

$$\underbrace{\left(1+\lambda\left(\Theta-1\right)\right)vz^{-1}-F}_{\text{Equity value with asset sales}} > \underbrace{p\left(v-F\right)+\left(1-p\right)\eta\alpha\left(1-f\right)z^{-2}v}_{\text{Equity value without asset sales}}$$

where we have used the fact that $p + (1-p)\, z^{-2} = z^{-1}$. Rewriting this condition gives:

$$\underbrace{\lambda\,(\Theta - 1)\, v z^{-1} + (1-p)\left(v z^{-2} - F\right)}_{\text{PV of asset sales to shareholders}} > \underbrace{(1-p)\,\eta\alpha\,(1-f)\, z^{-2} v}_{\text{Expected value in default}}$$

When making decisions with respect to assets sales, shareholders balance the potential surplus they can get by selling the assets to a better user and the value they get in default if there is no asset sale. By selling assets and keeping the proceeds from asset sales as cash in the firm, shareholders reduce the risk of corporate debt and transfer wealth to debtholders. As a result, the NPV of the asset sale to shareholders is equal to the NPV of the asset sale to the firm net of the wealth transfer to debtholders in the low cash flow state. Simple algebraic manipulations of this above relation lead to the following result:[2]

Proposition 3 *Shareholders sell a fraction λ of their assets if the potential gain to the firm associated with the asset sale satisfies*

$$\Theta > 1 + \frac{F z^2 - v\,(1 - \eta\alpha\,(1-f))}{\lambda v\,(1+z)} \equiv \Theta^{\min}.$$

Shareholders incentives to sell assets increase with renegotiation frictions f in that $\frac{\partial \Theta^{\min}}{\partial f} < 0$.

Our results on asset sales provide an additional illustration of the distortions introduced by debt financing in corporate policy choices. In the model, shareholders may refrain from selling part of their assets to a better user – thereby preventing efficient capital reallocation – because of the value transfer that goes to debtholders in the low cash flow state where the firm is insolvent. This is another form of the underinvestment problem identified by Myers (1977). One key difference with the standard debt overhang problem, however, is that shareholder friendly bankruptcy laws increase the severity of this problem. That is, when capital reallocation is efficient, asset sales are desirable and deviations from absolute priority in default reduce total welfare by reducing shareholders' incentives to divest.

[2]Alternatively, suppose that shareholders can sell part of the firm's assets at time $t = 1$ and distribute the proceeds as a dividend (i.e. debt is not collateralized). They will do so in the bottom node if

$$\Theta > \frac{\eta\alpha\,(1-f)\, v + z\,(v - F)}{v\,(1+z)} \equiv \Theta^{\min}.$$

Again, shareholders' incentives to sell assets increase with renegotiation frictions f in that $\frac{\partial \Theta^{\min}}{\partial f} < 0$.

The next questions we are interested in are those of the effects of bankruptcy codes on risk-taking and on initial investment. To address these questions, assume that the price offered to the firm for its assets at time $t = 1$ is a random variable that can take two possible values $\overline{\Theta} > 1 > \underline{\Theta}$ with equal probability, so that the probability of an asset sale in the high node at time $t = 1$ is $\frac{1}{2}$. Suppose that shareholders can increase risk just after investing in the project. When shareholders have the option to sell assets at time $t = 1$, equity value is given by

$$\begin{aligned} E_0^S(v;F) &= p^2\left(z^2 v - F\right) + 2p\left(1-p\right)\left(v - F\right) + \frac{1}{2}\left(1-p\right)^2 \eta\alpha\left(1-f\right) z^{-2} v \\ &\quad + \frac{\lambda v}{2}\left[pz + \left(1-p\right) z^{-1}\right]\left(\overline{\Theta} - 1\right) 1_{\overline{\Theta} > \Theta^{\min}} + \frac{1}{2}\left(1-p\right)^2\left(vz^{-2} - F\right). \end{aligned}$$

Using the fact that the risk-neutral probability of an increase in asset value is $p = \frac{1-z^{-1}}{z-z^{-1}}$ and simple algebraic manipulations, we get that the effect of an increase in renegotiation frictions f on risk shifting incentives $\frac{\partial E_0^S(v;F)}{\partial z}$ is not affected by asset sales in that:

$$\frac{\partial^2 E_0^S(v;F)}{\partial z \partial f} = \frac{2\eta\alpha v}{\left(1+z\right)^3} > 0.$$

Lastly, consider the initial investment decision. Using the same step as in Section 2.1, it is immediate to show that shareholders invest in the project only if the cost of investment satisfies

$$K < K^{\max} \equiv v + \frac{\lambda v}{2}\left(\overline{\Theta} - 1\right) 1_{\overline{\Theta} > \Theta^{\min}} - \frac{\alpha z^{-2} v f (1 + 1_{\overline{\Theta} < \Theta^{\min}})}{2}\left(\frac{z-1}{z-z^{-1}}\right)^2.$$

Again, corporate investment decreases renegotiation frictions f in that $\frac{\partial K^{\max}}{\partial f} < 0$.

Before turning to the empirical analysis, we summarize below the main testable hypothesis coming out of our model:

HYPOTHESIS 1: *Corporate investment decreases with renegotiation frictions in default.*

HYPOTHESIS 2: *Assets sales increase with renegotiation frictions in default.*

HYPOTHESIS 3: *Corporate risk-taking increases with renegotiation frictions in default.*

In the remainder of the paper, we test hypotheses 1 through 3 on a sample 19,466 firms across 41 countries with different bankruptcy codes.

3. Data and empirical method

3.1. Data

Our data include all the countries in the Worldscope data base whose bankruptcy code is described in the DHMS survey. The sample covers 41 countries for the period 1993-2010. We collect accounting data in U.S. Dollars from Worldscope and stock price data in U.S. Dollars from CRSP (for U.S. firms) and Datastream (for the rest of the world). Our panel is unbalanced because we do not require that the firms exist for the whole sample period. We exclude financial services firms (first SIC code digit equal to six), utility firms (first two SIC digits equal to 49), and government related firms (first SIC digit equal to 9). We also drop firm-years with negative or zero total assets or sales, and firm-years for which the (absolute value of) negative EBITDA is larger than total assets. Such severely distressed firms are not encompassed by our model and are therefore removed to be sure our results are not impacted by their behavior (see Bris, Koskinen, and Nilsson (2009)). Our results are robust to relaxing these constraints. We winsorize the variables in our sample at the 1st and 99th percentile to minimize the effects of outliers or coding errors in Worldscope. Our final sample consists of 19,466 firms (150,757 firm-year observations) from 41 countries.

We collect data on debt renegotiation failure from the paper by Favara, Schroth, and Valta (2012). For robustness, we also use the creditor rights index by Djankov, McLiesh, and Shleifer (2007). We also collect other country-level variables, such as the origin of the legal system (see La Porta, López de Silanes, Shleifer, and Vishny (1997)), and data on GDP growth and GDP per capita from the Worldbank. Finally, we obtain average creditors' recovery rates at the three-digit SIC level from Altman and Kishore (1996). Table 1 contains the definitions of the main variables in our data set.

Insert Table 1 Here

3.1.1. Renegotiation frictions

In the model, a high value of renegotiation frictions f indicates that any attempt by shareholders to renegotiate debt obligations is likely to fail. Therefore, a higher f implies stricter

enforcement rules for debt contracts. In other words, creditors are better protected against shareholders' in case of default.

We measure renegotiation frictions using the data from the DHMS international survey of debt enforcement procedures. In this survey, attorneys and judges who pratice bankruptcy law in 88 countries are asked to describe how an identical case of a firm defaulting on its debt is treated. Based on these responses, DHMS report country-specific measures of the quality of debt enforcement, some of which form the basis of our analysis.

In our empirical analysis, we follow Favara, Schroth and Valta (2012) and define *Renegotiation failure* as the average of several different binary indicators in DHMS. The chosen indicators are those that objectively characterize the debt renegotiation procedure, and include the rights of creditors to seize and sell debt collateral without court approval; to enforce their claims in an out-of-court procedure; to approve the appointment of an insolvency administrator and dismiss it; and to vote directly on the reorganization plan of a defaulting firm. The index also includes information on whether an insolvency procedure cannot be appealed, and whether management is automatically dismissed during the resolution of the insolvency procedure.[3] As a result, this index captures impediments to shareholders' ability to renege on the outstanding debt, whether through a formal insolvency procedure or outside of court. By construction, the *Renegotiation failure* index ranges from zero to one: the higher the score, the less likely that shareholders will recover anything in case of default. A detailed description of the construction of this index can be found in the Appendix.

Insert Table 2 Here

Table 2 shows that the average value of the *Renegotiation failure* index in our sample is 0.56, with a standard deviation of 0.24. The bankruptcy codes of common law countries, such as Australia, Great Britain, Hong Kong, New Zealand and Singapore include a large number of provisions that add frictions to the debt renegotiation process. In fact, these countries have the maximum score of 1. On the other side of the spectrum, China and Chile score 0. The majority of countries in the sample are concentrated around values of 0.45

[3]The DHMS survey also includes a few other characteristics of the bankruptcy code that either do not relate directly to the debt renegotiation procedure, e.g., rights of appeal to liquidation outcomes, or reflect the practitioners' subjective views about the process, e.g., expected costs and time to payment.

and 0.58, including Japan and the US. According to this measure, debt renegotiations are expected to succeed with relatively high probability in countries with a French origin to the legal system, e.g., France, Italy, and the Netherlands. Conversely, debt renegotiations are relatively unlikely in, e.g., Austria, Finland, or Hungary, as well as Thailand or Turkey.

Although the survey, and thus our index of debt enforcement, refers to 2005, we assume that it describes adequately the characteristics of a country's bankruptcy procedure over time, on the premise that a country's approach to insolvency is deeply rooted in economical, political, and societal values, which are very persistent features of a country's environment.[4]

Table 2 also shows that the number of firms varies substantially across countries, with the U.S. and Japanese firms respectively accounting for 19.33% and 16.42% of the sample observations. We show below that the results continue to hold when we exclude both U.S. and Japanese firms from the sample.

3.1.2. Debt overhang

To measure debt overhang, we follow Hennessy (2004) and use the product of leverage, the estimated probability of default, and the creditor's expected recovery ratio conditional on default (see also Hennessy, Levy, and Whited (2007) and Alanis and Chava (2012)). However, we amend this measure in two important ways. First, whereas Hennessy (2004) uses Moody's default rates implied by the bond's credit rating class, we estimate the default probability based on Bharath and Shumway's (2008) approximation of the Merton distance-to-default model. The main reason for this alternative measure of default probability is the lack of credit rating availability for our international sample of firms. Second, we let the creditors' recovery rate depend not only on the industry recovery but *also* on the country's bankruptcy code. Thus, we allow for higher expected recovery rates in jurisdictions with a more creditor friendly insolvency law.

Specifically, our measure of debt overhang depends on firm-specific leverage and default

[4]The only changes to the bankruptcy code in our sample occured in Israel (1995), Russia (1994, 1998, and 2004), Spain (2004), Sweden (1995), and Thailand (1993). Our main results are unaffected after excluding from the sample all observations in these countries in the years up to the last bankruptcy code change before the DHMS (2008) survey.

probability, on industry-specific recovery rates, and on country-specific debt renegotiation frictions, and is given by

$$Overhang_{i,j,c,t} = Leverage_{i,t} \times DP_{i,t} \times Recovery\ rate_j \times Renegotiation\ failure_c \quad (3)$$

where $Leverage_{i,t}$ is firm i's book leverage in year t, $DP_{i,t}$ is firm i's default probability based on Bharath and Shumway's (2008) approximation of the Merton distance-to-default model, the $Recovery\ rate_j$ is the recovery rate of industry j, and $Renegotiation\ failure_c$ measures frictions in debt renegotiations in the event of default in country c.

Note that the product $Recovery\ rate_j \times Renegotiation\ failure_c$, which measures the industry-country specific recovery rate, imputes the US industries recovery rates from Altman and Kishore (1996) to the same industries abroad. The implicit assumption is that differences in recovery rates across countries but within the same industry are due only to differences in the bankruptcy code, i.e., that the 'base' recovery rates are given by technological characteristics of the industry, which are common across countries. In additional tests, we adjust the U.S. recovery rates to take into account differences in country-specific recovery rates estimated by Djankov, Hart, McLiesh, and Shleifer (2008). The results, however, are virtually identical.

Table 2 shows that our *Overhang* measure, which is crucial to our analysis, varies significantly both within and across countries. Not surprisingly, this variable is strongly correlated with the *Renegotiation failure* index (correlation coefficient of 0.87, untabulated).

3.1.3. Investment, asset sales, and risk-taking

We study the effects of debt overhang on three main outcome variables: investment, asset sales, and risk-taking. We measure *Investment* as capital expenditures in year t divided by gross property, plant, and equipment (PPE) in year $t-1$.[5] The average investment rate is rather stable across countries, despite the remarkable heterogeneity in our sample. The average is 0.12 with a standard deviation of 0.16.

As capital expenditures are truncated at zero, they are not informative about whether the firm is selling or buying assets. Therefore, we use *Assets growth* and *PPE growth* as

[5]Results are very similar if we instead use net PPE in the denominator.

indicators of asset sales. *Assets growth* is the growth in total assets from year $t-1$ to year t. *PPE growth* is the growth in net PPE from year $t-1$ to year t. Additionally, we follow Atanassov and Kim (2009) and identify asset sales as the years with large negative changes in total assets or net PPE. Specifically, the binary variables *PPE sales* and *Asset sales* equal one if *PPE growth* and *Assets growth* are less than -15%, respectively, and 0 otherwise.[6] The results are robust to alternative cutoff levels (-10% and -20%). Table 2 shows that *PPE sales* exhibits relatively more variation than *Investment*, both within and across countries.

To measure asset risk, we follow John, Litov, and Yeung (2008) and compute the volatility of the ratio of EBITDA to assets over over eight years, between years t and $t-7$, requiring at least five available observations. While *EBITDA-to-assets vol* is a widely used measure of asset risk, by construction, it may not immediately capture the effects of unexpected shocks to creditors' recovery rates. Therefore, we use two other measures of risk-taking that are based on market prices of equity and, as a consequence, should incorporate these effects more readily due to their forward-looking nature. Specifically, we follow Bartram, Brown and Stulz (2012) and use the *Equity returns vol*, which equals the annualized standard deviation of weekly stock returns (Friday-to-Friday).[7] Finally, we follow Bharath and Shumway (2008) and compute the *Implied assets vol* as the average of the annual equity and debt volatilities, weighted by the market equity and debt face values.

3.1.4. Other Firm and Country Level Controls

We summarize all the other controls used in the analysis in Table 3. For the majority of the variables in the data set, the variation is mostly between rather than within firms. This is

[6] Alternative approaches to measure asset sales in the literature include the uses of keyword searches for 'asset', 'sale', and 'divestiture' within 8K filings with the SEC (Lang, Poulsen and Stulz(1995)), reductions in the number of industry segments per firm reported in Compustat (Schlingemann, Stulz and Walkling (2002)), diverstiture data from SDC (Schlingemann, Stulz and Walkling (2002)) and plant-level data (Yang (2008)). The data required to implement these approaches in our international cross-section is unavailable.

[7] The stocks of some firms in our sample are not frequently traded. Hence, by computing returns based on weekly data, these firms show zero returns. This could bias downward our volatility estimates. To address this issue, we exclude from the sample firms with very high proportions of zero returns. The current sample uses a cutoff of 90%, but the results are robust to lower cutoff levels. The results are also robust to using returns and volatilities based on daily stock prices.

not surprising for some variables, such as leverage, which are known to have large permanent components (Lemmon, Roberts and Zender (2008)). *Default probability* exhibits relatively more within firm variation and, as a result, *Overhang* also has a relatively high within firm variation. The first-difference variables, such as *PPE growth*, and the assets sales variables, also have more within firm variation. Therefore, we expect these data to identify more effectively the effects predicted by our model via the assets sales channel.

Insert Table 3 Here

Some of our tests will also include firm-specific proxies of shareholders' bargaining power in default. Building on previous literature (see e.g. Davydenko and Strebulaev (2007), Garlappi, Shu, and Yan, (2008), Favara, Schroth and Valta (2012)), we use Berger, Ofek and Swary's (1996) measure of the proportion of intangible assets (*Intangibility*) and the proportion of shares held by the firm's insiders to total shares outstanding (*Insiders' share*) to proxy for shareholder's ability to extract rents in default.[8] *Intangibility* is expected to increase shareholders' bargaining advantage in default because the creditors' threat to liquidate the assets becomes weaker as intangible assets are expected to be more heavily discounted. Shares held by insiders may also play an important role in debt renegotiations because larger insider ownership could increase the insiders' incentives to work in the interest of all shareholders and therefore improve their coordination.

We also control for growth opportunities with the market-to-book ratio (*Market-to-book ratio*), which is the total book value of assets plus market capitalization minus book equity, divided by total assets (Tobin's average Q), and for the available cash flow (*Cash flow-to-capital ratio*) on the account that investment is sensitive to cash flow for firms facing financial constraints. Other control variables include the logarithm of total assets (log(*Total assets*)), the level of *EBITDA-to-assets*, and the proportion of long-term debt, i.e., *LT-debt-to-assets*.

Finally, we use country-level variables to account for additional variation in the countries' legal institutions, creditor rights, and economic growth. Notably, we control for the origin of the country's legal system to account for unobservable characteristics of the insolvency code. The categories for the origins of legal system can be French, German, Scandinavian,

[8]These holdings include shares owned by officers, directors, their immediate families, and shares held in trust by pension programs.

Socialist or Common law. The log of *GDP per capita* and *GDP growth* are also included to control for other cyclical factors influencing firms' growth opportunities.

3.2. Empirical method

In the classic debt overhang problem, shareholders of a levered firm underinvest in positive NPV projects because the value created by new investment is mostly captured by creditors. Hennessy (2004) uses a dynamic investment model with adjustment costs to show that, empirically, the debt overhang effect produces a negative relationship between investment rates and creditor recovery rates.

Our model captures the same dependency between investment and creditors' recovery, but makes explicit the link between recovery rates and the probability of a successful debt renegotiation. As such, we operationalize the predictions of our model using the following empirical specification for the investment rate of firm i in year $t+1$:

$$\begin{aligned} \textit{Investment}_{i,t+1} = \alpha_i + \eta_t + \beta_Q \times \textit{Market-to-book ratio}_{i,t} \\ + \beta_{CF} \times \textit{Cash flow-to-capital}_{i,t} + \beta_O \times \textit{Overhang}_{i,j,c,t} + u_{i,t}. \end{aligned} \tag{4}$$

This specification is identical to Hennessy (2004) except for the measure of debt overhang, which we define as in equation (3). Clearly, any model of debt overhang, including ours, predicts that β_O is negative. We will estimate these models using different fixed effects estimators for α_i, year effects for η_t, and Erickson and Whited's (2002) higher order GMM estimator to correct for measurement error in Tobin's Q.

To assess the role of debt renegotiation frictions in our cross-country sample, we run the following pair of regressions:

$$\begin{aligned} \textit{Investment}_{i,t+1} = \alpha_i + \eta_t + \beta_Q \times \textit{Market-to-book ratio}_{i,t} + \beta_{CF} \times \textit{Cash flow-to-assets}_{i,t} \\ + \beta_{O1} \times \textit{Leverage}_{i,t} \times DP_{i,t} \times \textit{Recovery rate}_{j,t} + u_{i,t}, \end{aligned} \tag{5}$$

and

$$\begin{aligned} \textit{Investment}_{i,t+1} = \alpha_i + \eta_t + \beta_Q \times \textit{Market-to-book ratio}_{i,t} + \beta_{CF} \times \textit{Cash flow-to-assets}_{i,t} \\ + \beta_{O1} \times \textit{Leverage}_{i,t} \times DP_{i,t} \times \textit{Recovery rate}_{j,t} \\ + \beta_{O2} \times \textit{Overhang}_{i,j,c,t} + \beta_f \times Renegotiation failure_c + u_{i,t}. \end{aligned} \tag{6}$$

These two regression models allow us to test for the role of *Renegotiation failure* in the international cross-section. For this variable to have a relevant effect, the coefficient β_{O2} in equation (6) not only must be negative and significant, but also large relative to β_{O1} in both equation (5) and equation (6).

For assets or PPE growth, we use a similar linear specification, where we replace the dependent variable in (4) by either *Assets growth* or *PPE growth*. That is,

$$\begin{aligned} \textit{Assets growth}_{i,t+1} = \alpha_i + \eta_t + \gamma_Q \times \textit{Market-to-book ratio}_{i,t} \\ + \gamma_{CF} \times \textit{Cash flow-to-assets}_{i,t} + \gamma_O \times \textit{Overhang}_{i,j,c,t} + u_{i,t}, \end{aligned}$$

where our model predicts that $\gamma_O < 0$. Similarly, for assets sales, we use the following probabilistic model

$$\begin{aligned} Pr[\mathbf{1}_{\{\textit{assets sale in } t+1?\}} = 1] = \; & \Phi(\delta_Q \times \textit{Market-to-book ratio}_{i,t} \\ & + \; \delta_{CF} \times \textit{Cash flow-to-assets}_{i,t} + \delta_O \times \textit{Overhang}_{i,j,c,t}), \end{aligned} \tag{7}$$

where $\Phi(.)$ is the cumulative normal density function and $\mathbf{1}_{\{\textit{assets sale in } t+1?\}}$ is given by either *Assets sales* or *PPE sales*. In this specification, our model predicts that $\delta_O > 0$.

While the literature testing investment regressions is well developed, there is a paucity of studies that provide guidance as to how to specify risk-taking regression models. We employ the following very parsimonious specification to analyze risk-taking:

$$\textit{Risk}_{i,t+1} = \alpha_i + \eta_t + \psi_O \times \textit{Overhang}_{i,j,c,t} + \text{controls} + \nu_{it}, \tag{8}$$

where the model predicts that distressed firms in countries where debt renegotiations are unlikely would take more risk than equally distressed firms in countries that favor debt renegotiations, i.e., $\psi_O > 0$.

Besides time and firm or industry-country fixed effects, and the effect of *Overhang*, which is central to this paper, we include some of the control variables used by the previous literature. We control for the origins of the country's legal system, which has been found to capture large differences in average risk levels across countries by Acharya, Amihud, and Litov (2011). We include firm size to account for risk differences across firms that may simply be due to age differences. Similarly, we control for the country's economic development,

which would also explain differences in risk across firms, with the country's log(*GDP per capita*) and *GDP growth*. Further risk-taking tests also include a host of firm-specific controls found in the literature: the *Market-to-book ratio*, the level of *EBITDA-to-assets*, and the proportion of long-term debt, i.e., *LT-debt-to-assets* (see Becker and Stromberg (2012), Eisdorfer (2008) and Gilje (2013)).

4. Results

This section presents the results of our tests for investment, asset sales, and risk-taking. The next section presents robustness tests.

4.1. Investment

Table 4 presents the main results for corporate investment.[9] Column (1) shows the estimates of a standard Hennessy (2004) investment regression in a world-wide sample of firms. The debt overhang term in this specification is defined identically to Hennessy's (2004), with the only difference that we use Merton-model implied default probabilities calculated using the Bharath and Shumway (2008) method. The recovery rates for debt are identical, and U.S. industry-specific rates are extrapolated to the corresponding industries in each country.

Insert Table 4 Here

The results are by and large consistent with Hennessy's (2004), except for one expected difference: the R^2 is lower in the international cross section. Otherwise, Tobin's Q relates positively to investment. The cash flow ratio is also positively related to investment, suggesting that financing constraints affect investment too. Finally, the debt overhang measure that excludes variation in debt enforcement across countries has a negative effect on investment.

Column (2) compares the performance of our *Overhang* measure, which accounts for cross-country differences in the probability of renegotiation failure, to the performance of the traditional measure, previously used in U.S. studies only. The results are remarkable:

[9] In all tables, we report standard errors adjusted for heteroskedasticity and within country-industry clustering. Our inference is not affected by the more conservative approach of clustering at the country level.

the traditional measure has no significant effect on investment, whereas our measure has the predicted negative and statistically significant effect. Moreover, *Renegotiation failure* does not affect investment directly, but only via its interaction with the expected market value of debt recovered by creditors. This result validates the use of *Renegotiation failure* as a proxy for renegotiation frictions given that its effect seems to be precisely one of debt overhang.

To evaluate the economic significance of these estimates, we compute the implied difference between the expected investment rates of two firms that are otherwise identical but operate in two countries with different bankruptcy codes. We evaluate the statistic

$$\Delta E(\textit{Investment}) \equiv \hat{\beta}_O \times \overline{\textit{Leverage} \times DP \times \textit{Recovery rate}} \times \Delta f,$$

where Δf denotes the difference in the *Renegotiation failure* index between two selected countries, and $\overline{\textit{Leverage} \times DP \times \textit{Recovery rate}}$ denotes a given level of the normalized expected creditors' recovery on debt conditional on renegotiation failure. Table 4 reports this statistic evaluated at the average recovery for firms with a default probability larger than 0.5, and for the comparison between the same such firm in a country where debt renegotiation is very likely ($f = 0$, say Chile or China) vs. very unlikely ($f = 1$, say Australia or Singapore). For column (2), the difference corresponds to two percentage points in the investment ratio, or 19% of the average investment ratio among such firms. The difference increases to 25% in specification (3), where we focus only on the effect of our *Overhang* measure, and which we employ as our benchmark specification hereafter.

Becker and Stromberg (2012) estimate that a 1991 Delaware bankruptcy ruling, which established stronger managerial fiduciary duties towards creditors, increased investment for firms close to insolvency.[10] They interpret this finding as evidence that an earlier transfer of control rights from debtors to creditors mitigates debt overhang. Our results show that keeping shareholders in control, but *increasing* their expected recovery rate on the assets, also mitigate debt overhang. Together, these two sets of results show that the bankruptcy code can improve efficiency near insolvency by giving control to whoever (creditors or debtors) expects a higher recovery in bankruptcy.

The estimated economic effects of our measure of debt renegotiation frictions on investment are stronger than those that Becker and Stromberg (2012) find for Delaware firms

[10] *Credit Lyonnais v. Pathe Communications*, Delaware Civ A 12150. (Del. 1991).

following the 1991 ruling. The reason for the difference in magnitudes is partly due to sample differences. Additionally, our tests isolate the recovery channel by using a direct measure of debt renegotiation frictions, whereas their estimates may capture opposing incentive effects that the shift in fiduciary duties may have on creditors and debtors.

Columns (4) and (5) show the results of using industry-country and firm fixed effects estimators, respectively. These estimators account for the unobservable industry-country or firm-specific differences in investment rates. Hence, controlling for these effects makes it extremely unlikely that the estimated correlation between *Renegotiation failure* and investment is due to other unobservable country differences unrelated to debt overhang. We find that our results are even stronger: the economic significance of the effect of *Renegotiation failure* on investment increases up to 33%.

Finally, column (6) shows that our results are robust to correcting for measurement error in Tobin's Q. Using Erickson and Whited's (2002) fifth-order GMM estimator, we still identify a negative statistically and economically significant effect of debt renegotiation frictions on investment via the debt overhang channel.

Overall our results show that, controlling for Tobin's Q and cash flow, investment ratios among the relatively more distressed firms are significantly higher in countries where the bankruptcy code favors debt renegotiations over liquidations.

4.2. Asset sales

Given that the distribution of *Investment* is heavily skewed to the right, with a disproportionate amount of observations close to 0, it is remarkable that we are able to identify large differences in investment rates due to differences in *Overhang*. In our model, distressed firms in countries with high renegotiation frictions not only cut down investment but also have the option to sell assets. Given this additional flexibility, and the fact that the actual variable is a growth rate not bounded below by zero, we would expect to find larger differences in assets or PPE growth rates that are attributed to differences in *Renegotiation failure*.

This intuition is confirmed in Table 5, where the dependent variables are *PPE growth* (columns (1) through (5)) or *PPE sales* (column (6)). The results using total instead of fixed

assets only (*Assets growth* and *Assets sales*) are indentical and therefore not shown. Column (1) shows that, in the international cross-section, PPE growth is negatively correlated with debt overhang even without adjusting for differences in debt enforcement. Column (2), which includes our measure of *Overhang*, shows that, as predicted by the model, PPE growth is significantly lower for otherwise identical, distressed firms in countries where debt renegotiations are unlikely. As it is for investment, the fact that the coefficient of *Overhang* is relatively high shows that the differences across countries in PPE growth rates are largely driven by differences in debt renegotiation probabilities. Economically, the growth rate differences in PPE between identical firms in countries with likely vs. unlikely debt renegotiations can be as high as the average PPE growth rate across all countries.

Note too that *Renegotiation failure* does not affect *PPE growth* for firms where creditor recovery is expected to be low. Again, this result provides additional support to our claim that our measure of debt renegotiation frictions does not capture additional characteristics of bankruptcy law that may affect firms' decisions away from financial distress.

Insert Table 5 Here

Finally, column 6 Table 5 also shows that the less likely a debt renegotiation, the more likely the firm will be to sell assets as it becomes more distressed. As shown in the table, the difference in the probabilities of asset sales by the relatively more distressed average firms across countries with extremely different debt renegotiation procedures can reach up to 14 percentage points.

4.3. Risk-taking

Table 6 shows the estimates of our risk-taking specification in (8). Controlling for firm size, the country's economic development, the origins of the legal system, and either industry-country or firm fixed effects, we find that *Overhang* has a positive and significant effect on the volatility of EBITDA-to-assets (columns (2) to (6)). A comparison between columns (1), (2) and (3) shows that the differences in risk-taking explained by differences in *Overhang* are not merely due to differences in firm-specific leverage or industry-specific recovery, but in fact largely due to the differences in *Renegotiation failure*. Therefore, asset risk is higher

for firms in countries that block debt renegotiations in favor of liquidations. Moreover, the higher the expected creditors' recovery conditional on renegotiation failure, the larger the differences in risk across such countries.

Insert Table 6 Here

These results seem at odds with prior literature where stronger creditor rights are associated with lower risk-taking (Acharya, Amihud and Litov (2011)). As we argued above, our measure of debt renegotiation failure isolates the effect of a lower expected creditors' recovery so that the reduction in risk-taking is due to the reduction in the convexity of the shareholders' claim on the asset once the firm is sufficiently levered. The negative effect of stronger creditor rights on risk-taking showed by the prior literature is more likely to be reflecting the effects of increased creditor control of corporate policies. Section 5 includes additional tests that reconcile these seemingly different findings.

In terms of economic significance, the differences in *EBITDA-to-assets vol* between the average, relatively more distressed firms in the sample, in countries at the two extremes of *Renegotiation failure*, ranges between 0.8 and 1.5 percentage points per year. Relative to the average volatilities of the average distressed firm, these differences range between 14% and 26%.

Columns (4) to (6) show that our results are not affected by the inclusion of additional firm-specific controls used in previous literature. Column (6) shows that these results still obtain after controlling for firm fixed effects. This implies that there is evidence of risk-taking differences *within* the firm. That is, for a given firm in a given country with high renegotiation frictions, asset risk increases with the creditors expected recovery. Therefore, identification in our study is not only provided by the large variation in debt enforcement across countries, but also by the relatively long time series of our panel (18 years).

5. Robustness and other tests

5.1. Matching firms across countries

One possible weakness of our results so far is that the selection of firms into each country may not be random. In particular, creditors could anticipate future debt concessions in countries favoring debt renegotiations. Therefore, debt may be too expensive in such countries or credit may be rationed for riskier firms. As a result, the Worldscope sample may be biased towards safer and less financially constrained firms in countries where debt is easily renegotiable, which would bias β_O and γ_O downwards and ψ_O upwards. To address this concern, we re-estimate equations (4), (7), and (8) using a matching procedure. The aim is to identify firms that are similar on observable dimensions that likely affect investment and risk-taking decisions.

We define firms that operate in countries with strict debt enforcement procedures (i.e., with an index of renegotiation failure above the sample median) as 'treated' firms. From the set of non-treated firms, we construct a sample of 'matched' firms that are similar to the treated firms except for the fact they are in countries where the bankruptcy procedure is more debtor friendly. Prior work has documented that corporate risk-taking varies across industries and with firms' growth opportunities, cash flow, leverage and size (see, e.g., Eisdorfer (2008) or Becker and Stromberg (2012)). Accordingly, in each year, we match treated and non-treated firms that are close to each other on all these dimensions using the Mahalanobis metric, which weights the distance between two firms by the inverse covariance matrix of each matching dimension. This matching procedure ensures that we compare firms with statistically indistinguishable growth opportunities, cash flow, leverage, and firm size, even though they operate under different bankruptcy regimes.[11]

Insert Table 7 Here

Table 7 shows that our results are robust to the use of the matching estimator. In fact, the estimates remain virtually unchanged. Remarkably, the matching estimator, which is

[11] In a robustness test we also use a propensity score matching estimator and obtain very similar results.

based on a substantially smaller subsample of firms comparable across countries, provides even *quantitatively* similar results.[12]

5.2. Creditor rights and Renegotiation failure

Acharya, Amihud and Litov (2011) argue that risk-taking at the firm level is decreasing in the strength of creditor rights. We find that risk-taking *increases* with debt renegotiation frictions. Given that a higher probability of debt renegotiation failure could be interpreted as stronger creditor rights, the two sets of results seem to be contradictory. However, there are two important differences between the tests conducted in both studies. First, Acharya, Amihud and Litov (2011) estimate the *unconditional* effect of creditor rights whereas in this paper we estimate the effect of debt renegotiation frictions *conditional* on the distance to default and the expected creditors' recovery in default. Second, as our results so far show, our *Renegotiation failure* measure isolates the effects of debt enforcement via the creditors' expected recovery channel in default from the broader concept of creditor rights used in Acharya, Amihud and Litov (2011), which may also include the ability of creditors to influence management *away* from default.

To illustrate the difference between both studies, we re-estimate equations (4), (7), and (8) including also the creditor right index of Djankov, McLiesh and Shleifer (2007) (*Creditor rights*) and replacing our measure of *Overhang* with *Overhang_CR*, which itself replaces our *Renegotiation failure* index with the *Creditor rights* index.[13] This specification, whose

[12]While useful, our matching procedure may also have limitations. It only controls for selection based on observable characteristics. If unobservable differences among firms are correlated with the observable characteristics, the selection into treated and matched firms could be biased. However, the (unreported, available upon request) t-statistics for the difference of means of all matching variables in the treated and matched groups, both before and after matching, suggest that our matching procedure successfully homogenizes firm groups along the dimensions mentioned above.

[13]This index varies from 0 (weakest creditor rights) to 4 (strongest creditor rights) and aggregates four binary indicators of the powers of secured lenders to (*i*) approve a debtor's filing for reorganization; (*ii*) seize collateral after a reorganization petition is approved; (*iii*) be paid first out of the proceeds of liquidating a bankrupt firm; and (*iv*) replace the incumbent manager with an administrator who runs the business during the reorganization. The creditor right index of Djankov, McLiesh and Shleifer differs from our *Renegotiation failure* index because it is based on the written laws, rather than the bankruptcy process expected in practice

estimates are reported in Table 8, measures the conditional and unconditional effects of creditors rights.

Insert Table 8 Here

Table 8 shows that the creditor rights index has a positive, if not always statistically significant, effect on investment and PPE sales. As in Acharya, Amihud, and Litov (2011), the creditor rights index has a negative direct effect on risk-taking. However, the creditor rights index has a statistically significant *negative* effect on investment and PPE growth, and a *positive* effect on PPE sales and risk-taking via its interaction with the expected normalized creditors recovery in default. Thus, away from default, stronger creditor rights reduce risk-taking but do not appear to have significant effects on investment and asset sales. Closer to default, stronger creditor rights increase risk-taking and asset sales, but decrease investment and PPE growth. The likely cause of this reversal is that the creditor rights index summarizes not only the expected creditors recovery rate in bankruptcy, but also the creditors ability to influence corporate policies before insolvency. The latter effect is more powerful away from default, whereas the former becomes extremely relevant close to default.

5.3. Financing constraints

The possibility to renegotiate a debt contract ex post may constrain the firm's ability to raise debt in the first place. Creditors that anticipate low recovery rates in the event of default may limit ex ante credit to firms. As a result, renegotiation frictions may be correlated with the firm's ability to raise external financing. In this section, we address the concern that the effect of *Renegotiation failure* we identify may be due to variation in financing constraints across countries, instead of debt overhang.

It is important to point out first that if *Renegotiation failure* were indeed capturing a credit rationing effect, the estimates of β_O would be positive. That is, if lower values of *Renegotiation failure* implied a tighter debt constraint, then we would expect a positive

by the expert judges and attorneys. Acharya, Amihud and Litov (2011) use the creditor rights measure of La Porta, López de Silanes, Shleifer and Vishny (1997), which covers three fewer countries.

correlation between investment and renegotiation frictions. The results in Table 4 suggest that this conjecture is rejected by the data.

To further explore this issue, we estimate the sensitivity of investment, assets sales, and risk-taking to *Overhang*, conditional on the degree of financing constraints. To do so, we augment the regression models for each outcome variable (equations (4), (7), and (8)) by including the interaction between *Overhang* and several proxies of firm-specific financing constraints.

Insert Table 9 Here

We use three standard measures of financing constraints: firm size (as in Hadlock and Pierce (2010)), the Whited and Wu (2006) index (WW), and the Kaplan and Zingales (1997) index (KZ).[14] We then define three dummy variables $\mathbf{1}_{\{constrained?\}}$ that take the value of one if a firm belongs to the subsample of firms with size below the median in each country, or the firm has a WW or a KZ index above the median index in the same country, and zero otherwise. The interaction of these dummies with *Overhang* isolates the differential response of financially constrained firms. If our results were due to financing constraints, then the direct effect of *Overhang* on investment, asset sales and risk-taking would be zero, while the interaction between $Overhang \times \mathbf{1}_{\{constrained?\}}$ would be negative.

The results of these tests are reported in Table 9. For investment (Panel A), we find that the interaction term is negative and significant when firms are sorted by size or the WW index, suggesting that the investment response of credit constrained firms is indeed larger than of unconstrained firms.[15] However, the coefficient of *Overhang* remains negative and statistically significant in all specifications, regardless of the way we sort firms. Moreover, the differential investment response between constrained and unconstrained firms (reported in the lower part of Panel A) is small.

[14] Following Fazzari, Hubbard and Petersen (1998), and Almeida, Campello and Weisbach (2004), we have also sorted firms according to their payout ratio. The results are very similar to those using firm size or the Whited and Wu (2006) index and are therefore omitted for parsimony.

[15] The interaction term is never statistically significant for firms classified as credit constrained using the KZ index. This result alone cannot reject the financing constrains channel because the KZ index has been found to correlate poorly with many other measures of financing constraints (Almeida, Campello, and Weisbach(2004)).

Panels B and C confirm the same results for asset sales and risk-taking. Although credit constrained firms tend to sell more assets and take on more risk in countries with a higher index of renegotiation failure, so do unconstrained firms. These additional tests confirm that the effect of debt overhang on our main variables of interest is closely related to the debt enforcement procedure, regardless of the firms' capacity to raise external financing.

5.4. Alternative measures of risk

In this section, we verify that our results hold for alternative measures of asset risk. Table 10 estimates the relation between risk and our *Overhang* measure when we use volatility measures based on current equity prices as dependent variables. These measures are more likely to be forward-looking and reflect the changes in the shareholders' expectations about risk-taking. The two measures we use are the *Equity returns vol*, which equals the annualized standard deviation of weekly stock returns (Friday-to-Friday) and the *Implied assets vol*, which is the average of the annual equity and debt volatilities, weighted by the market equity and debt face values.

Insert Table 10 Here

The results for *Equity return vol* are identical to those for *EBITDA-to-assets vol* (columns (1), (2) and (3)). For *Implied assets vol* we obtain qualitatively similar, albeit economically weaker, results after controlling for industry-country and firm-fixed effects. A possible explanation for this quantitative difference is that the expected future changes in risk-taking are priced in and smoothed out well in advance into implied asset volatility, and are only identified via comparisons within, but not across, the firm. These effects show up more clearly on equity risk due to leverage.

5.5. Other tests

Table 11 shows the results of additional robustness tests. First, we ask whether firms from the U.S. and Japan, which represent a large fraction (30%) of the sampled firms, drive our results. Columns (1), (3) and (5) of Table 11 show the estimates of our benchmark

investment, PPE growth and risk-taking regressions, respectively, using a subsample that excludes U.S. and Japanese firms. We find that the results are not at all affected by such exclusion.

Insert Table 11 Here

Columns (2), (4) and (6) use *Overhang_Z*, which itself uses an alternative measure of creditors' expected recovery in default. Namely, it replaces the firm default probability based on Bharath and Shumway's (2008) approximation of the Merton distance-to-default model with a firm default probability based on Altman's z-score. We find that our results do not depend on the way we measure firms' default probabilities.

Our baseline measure *Overhang* is constructed using industry-specific recovery rates for the U.S. which are then imputed to other countries on the account that international differences in recovery rates within the same industry are only due to differences in the bankruptcy code. To check whether this assumption drives our results, we have re-estimate all benchmark specifications for investment, asset sales and risk-taking using a debt overhang measure that excludes the U.S. industry-specific recovery rates, and which therefore depends only on firm-specific leverage and default probability, and on country-specific debt renegotiation frictions. The (unreported) results remain the same, suggesting that our estimates are driven mostly by the cross-country variation in the *Renegotiation failure* index.

6. Conclusions

We have shown that the prospect of a successful debt renegotiation incentivizes shareholders to invest more, reallocate assets less intensively and take less risk. We have identified these effects via large exogeneous variation in the procedures of debt enforcement prescribed by the bankruptcy codes across 41 countries. The effects of debt renegotiation frictions are through their interactions with the expected creditors' recovery conditional on default. Therefore, we claim to have established that weaker debt enforcement actually decreases the underinvestment and asset substititions distortions caused by debt overhang.

Previous literature has shown that, on average, stronger creditor rights minimize debt overhang distortions. Here, these distortions are mitigated via a *weakening* of creditor rights,

i.e., allowing for the renegotiation of debt, when firms are sufficiently close to distress. The relative benefits and costs of these two approaches to bankruptcy regulation, and their effects on the ex ante efficiency of investment policy, should be studied in detail in future research.

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Appendix A. Data set

We start with all the countries in the paper by Djankov, Hart, McLiesh, and Shleifer (2008) that are also covered by Worldscope and Datastream. We drop some countries because of the low number of observations (Colombia, Czech Republic, Egypt, and Venezuela). We end up with a sample of firms from 41 countries, including all OECD, some Latin American, Middle Eastern, and Asian countries.

For every firm in each country, we download annual accounting variables, in USD, from Worldscope, and weekly and daily price data, in USD, from Datastream. For U.S. firms, we download price data from CRSP. We match the firm-level data with several country-specific institutional variables which come from Andrei Shleifer's web page and the World Bank. For every sampled country, we collect variables related to insolvency proceedings and the recovery rate. These variables are not available for India, Pakistan, and Zimbabwe. We end up with a sample of 19,466 firms from 41 countries.

Appendix B: *Renegotiation failure* index

The construction of the *Renegotiation failure* index follows the paper by Favara, Schroth, and Valta (2012) and is based on the survey data from Djankov, Hart, McLiesh, and Shleifer (2008). The individual data items are available on Andrei Shleifer's web page. The index measures the probability that shareholders fail to force a renegotiation of debt with creditors, and is based on 12 broad categories and 16 individual indicators. Specifically, the index is the average of the following non-missing binary (0 if no, 1 if yes) indicators (variable names in parentheses correspond to the names in the data set for the paper by DHMS (2008)):

1. secured creditors may seize and sell their collateral without court approval (ooc);
2. secured creditors may enforce their security either in or out of court (sumjud);
3. the entire business's assets can be pledged as collateral (floating);
4. an insolvency or liquidation order cannot be appealed at all (apporde, appsal);
5. an insolvency case is suspended until the resolution of the appeal (1-disclai);
6. the firm may enter liquidation without attempting reorganization ((1-attemreo), trigliq);
7. secured creditors may enforce their security upon commencement of the insolvency proceedings ((1-scstay), (1-lawsc));
8. a defaulting firm must cease operations upon commencement of insolvency proceedings (opceas);
9. management does not remain in control of decisions during insolvency proceedings (1-mancont);

10. secured creditors have the right to approve the appointment of the insolvency administrator (whoapp);

11. secured creditors may dismiss the insolvency administrator (dismiss);

12. secured creditors vote directly on the reorganization plan (scvotdir, proofreo).

Table 1
Definitions of variables

This table defines the variables used in the analysis. The data come from Thomson-Reuters' Worldscope and Datastream databases, and from the database of the paper 'Debt Enforcement around the World' by Djankov et al. (2008)

Variable name	Variable definition	Source
Investment	Capital expenditures in year t / Gross PPE in year $t-1$	Worldscope
Assets growth	Growth in total assets from year $t-1$ to year t	Worldscope
Assets sales	Equals 1 if *Assets growth* $< -15\%$, and 0 otherwise	Worldscope
PPE growth	Growth in net PPE from year $t-1$ to year t	Worldscope
PPE sales	Equals 1 if *PPE growth* $< -15\%$, and 0 otherwise	Worldscope
EBITDA-to-assets	Ratio of EBITDA to total assets	Worldscope
EBITDA-to-assets vol	Standard deviation of the ratio of EBITDA to assets between the years $t-7$ and t, as in John, Litov and Yeung (2008).	Worldscope
Leverage	Total debt / Total assets	Worldscope
LT-debt-to-assets	Total long-term debt / Total assets	Worldscope
Equity returns vol	Annualized standard deviation of weekly stock returns (Friday-to-Friday), as in Bartram, Brown and Stulz (2012).	Worldscope / Datastream
Implied asset vol	Average of equity and debt yearly volatilities (% per year) from weekly stock prices, weighted by debt face values and market equity values, as in Bharath and Shumway (2008)	Worldscope / Datastream
Default probability (DP)	Default probability estimate, using Bharath and Shumway's (2008) approximation of the Merton DD model	Worldscope / Datastream
Renegotiation failure (f)	Favara, Schroth, and Valta's (2012) estimate of the probability of debt renegotiation failure, using the survey data in Djankov et al. (2008)	Djankov et al. (2008)
Recovery rate	Industry average creditors' recovery rate, at the three-digit SIC code level	Altman & Kishore (1996)
Overhang	$Leverage_{t-1} \times DP_{t-1} \times$ *Recovery rate* $\times$ *Renegotiation failure*	All above
Market-to-book ratio	(Total assets + market cap - book equity) / Total assets	Worldscope
Cash flow-to-capital	(Net income + Depreciation & Amortization) / Gross PPE	Worldscope
Insiders' share	Numbers of shares held by officers, directors, their immediate families or in trust / Total shares outstanding	Worldscope
Intangibility	1 - (0.715×receivables + 0.547×inventories + 0.535×Net PPE + Cash) / Total assets	Worldscope
Creditor rights	Djankov et al.'s (2008) country-specific index of creditors' rights	Djankov et al. (2008)

Table 2: Descriptive statistics by country

This table presents a within-country summary (number of firms per country, N; mean; and standard deviation, sd) of *Investment*, *Implied asset vol*, *Renegotiation failure*, and *Overhang*. The sample includes all firm-year observations in the Worldscope data base between 1993-2010, for all countries surveyed by Djankov et al. (2008). Please refer to Table 1 for a definition of these variables.

	Renegotiation failure		*Overhang*		*Investment*		*PPE sales*		*EBITDA-to-assets vol*	
Country	N	mean	mean	sd	mean	sd	mean	sd	mean	sd
ARG	53	0.308	0.015	0.021	0.076	0.115	0.181	0.386	0.091	0.070
AUS	677	1.000	0.033	0.050	0.161	0.206	0.211	0.408	0.086	0.085
AUT	60	0.667	0.031	0.041	0.098	0.114	0.146	0.353	0.049	0.059
BEL	85	0.615	0.026	0.036	0.107	0.129	0.122	0.327	0.054	0.055
BRA	195	0.417	0.021	0.029	0.122	0.129	0.219	0.414	0.078	0.055
CAN	907	0.667	0.026	0.038	0.150	0.182	0.165	0.371	0.081	0.070
CHE	151	0.538	0.022	0.030	0.089	0.102	0.128	0.335	0.048	0.047
CHL	91	0.000	0.000	0.000	0.109	0.144	0.071	0.256	0.047	0.043
CHN	1,428	0.000	0.000	0.000	0.155	0.188	0.078	0.269	0.048	0.045
DEU	612	0.455	0.019	0.028	0.126	0.179	0.178	0.383	0.075	0.070
DNK	90	0.500	0.021	0.030	0.113	0.120	0.148	0.356	0.057	0.054
ESP	84	0.462	0.021	0.029	0.085	0.096	0.121	0.326	0.056	0.053
FIN	108	0.692	0.027	0.041	0.131	0.155	0.157	0.364	0.059	0.048
FRA	609	0.231	0.008	0.012	0.168	0.223	0.151	0.358	0.056	0.054
GBR	1,023	1.000	0.030	0.049	0.130	0.154	0.203	0.402	0.077	0.071
GRC	205	0.417	0.023	0.029	0.124	0.214	0.087	0.282	0.049	0.035
HKG	681	1.000	0.041	0.056	0.125	0.180	0.208	0.406	0.083	0.076
HUN	26	0.667	0.022	0.030	0.169	0.225	0.181	0.386	0.052	0.030
IDN	182	0.500	0.033	0.039	0.136	0.153	0.176	0.381	0.066	0.046
IRL	50	0.615	0.027	0.041	0.134	0.126	0.122	0.327	0.067	0.067
ISR	309	0.556	0.028	0.040	0.099	0.132	0.160	0.367	0.074	0.065
ITA	182	0.231	0.012	0.014	0.105	0.144	0.150	0.357	0.048	0.041
JPN	2,248	0.538	0.030	0.036	0.073	0.113	0.116	0.320	0.037	0.041
KOR	1,261	0.538	0.033	0.040	0.125	0.173	0.150	0.358	0.066	0.059
MEX	83	0.273	0.012	0.015	0.076	0.075	0.100	0.300	0.050	0.032
MYS	698	0.583	0.025	0.035	0.095	0.146	0.152	0.359	0.058	0.055
NLD	115	0.250	0.011	0.015	0.117	0.120	0.169	0.375	0.058	0.061
NOR	109	0.385	0.019	0.025	0.189	0.215	0.168	0.374	0.078	0.072

(Continues)

Table 2: continued

	Renegotiation failure		*Overhang*		*Investment*		*PPE sales*		*EBITDA-to-assets vol*	
Country	N	mean	mean	sd	mean	sd	mean	sd	mean	sd
NZL	77	1.000	0.037	0.056	0.133	0.147	0.166	0.373	0.062	0.052
PER	71	0.538	0.020	0.033	0.089	0.128	0.073	0.261	0.081	0.077
PHL	102	0.538	0.026	0.033	0.102	0.144	0.186	0.389	0.070	0.065
POL	231	0.417	0.013	0.021	0.158	0.212	0.159	0.366	0.073	0.061
PRT	45	0.538	0.034	0.038	0.090	0.136	0.124	0.330	0.058	0.062
RUS	129	0.250	0.014	0.021	0.108	0.101	0.106	0.308	0.075	0.041
SGP	488	1.000	0.040	0.057	0.126	0.193	0.175	0.380	0.065	0.061
SWE	282	0.667	0.022	0.034	0.121	0.155	0.218	0.413	0.080	0.069
THA	364	0.692	0.041	0.060	0.096	0.133	0.135	0.341	0.060	0.041
TUR	214	0.692	0.030	0.046	0.101	0.171	0.198	0.398	0.097	0.054
TWN	1,147	0.538	0.027	0.033	0.117	0.157	0.095	0.294	0.055	0.045
USA	3,779	0.538	0.026	0.033	0.135	0.146	0.131	0.338	0.074	0.066
ZAF	215	0.455	0.014	0.022	0.181	0.157	0.179	0.383	0.075	0.070
Total	19,466	0.557	0.025	0.038	0.121	0.160	0.143	0.350	0.062	0.060

Table 3
Firm characteristics

This table presents descriptive statistics (number of firm-year observations, N; mean; standard deviation, decomposed into between-firm, sd_b, and within-firm, sd_w, variation; and the three quatiles: p25, p50 and p75) of the variables used in the analysis. The sample includes all firm-year observations in the Worldscope data base between 1993-2010, for all countries surveyed by Djankov et al. (2008). Please refer to Table 1 for a definition of these variables.

			Standard deviation					
	N	mean	Total	sd_b	sd_w	p25	p50	p75
Investment	141,256	0.123	0.164	0.147	0.125	0.036	0.076	0.145
Assets growth	150,757	0.088	0.259	0.180	0.230	−0.053	0.059	0.182
Assets sales	150,757	0.118	0.322	0.218	0.286	0.000	0.000	0.000
PPE growth	150,497	0.093	0.388	0.266	0.349	−0.074	0.035	0.171
PPE sales	150,497	0.143	0.350	0.243	0.307	0.000	0.000	0.000
EBITDA-to-assets vol	116,648	0.062	0.060	0.068	0.028	0.025	0.042	0.076
Overhang	150,757	0.025	0.038	0.029	0.029	0.000	0.008	0.037
Leverage	150,757	0.253	0.180	0.168	0.097	0.107	0.234	0.368
Default probability (DP)	150,757	0.360	0.344	0.228	0.297	0.009	0.271	0.681
Recovery rate	150,757	42.327	9.792	9.705	0.000	33.160	44.000	48.740
Equity returns vol	150,014	0.520	0.318	0.300	0.220	0.313	0.439	0.627
Implied asset vol	149,808	0.407	0.244	0.240	0.163	0.249	0.342	0.489
Market-to-book ratio	150,755	1.474	1.045	1.020	0.658	0.927	1.172	1.628
Cash flow-to-assets ratio	139,842	0.181	0.777	0.922	0.516	0.049	0.125	0.262
log(*Total assets*)	150,757	5.416	1.808	1.766	0.458	4.169	5.279	6.547
Insiders' shares	108,584	0.410	0.243	0.223	0.116	0.215	0.405	0.593
Intangibility	149,550	0.471	0.120	0.120	0.065	0.400	0.455	0.527
GDP growth	150,693	3.422	3.862	3.288	2.533	1.514	2.996	5.044
log(*GDP per capita*)	150,282	9.814	1.072	1.051	0.244	9.360	10.318	10.516

Table 4
Debt overhang, renegotiation failure, and capital investment

This table presents OLS, industry-country (IC) fixed effects, firm fixed effects and higher-order GMM estimates of investment regressions using a sample of all firm-year observations in the Worldscope data base between 1993-2010, for all countries surveyed by Djankov et al. (2008). The dependent variable is yearly $Investment_{t+1}$. *Overhang* for firm i in industry j, and country c, is defined as $Leverage_{it} \times DP_{it} \times Recovery\ rate_j \times f_c$, where DP_{it} is the default probability, and f_c is the country's *Renegotiation failure* index. The specification in column 6 is estimated using a 5th-order GMM estimator (GMM5), which corrects for measurement error in Tobin's average Q (*Market-to-Book ratio*). All specifications include year fixed effects. Standard errors (in brackets under each estimate) are adjusted for heteroskedasticity and within industry-country clustering. Estimates followed by the symbols ***, ** or * are statistically significant at the 1%, 5%, or 10% levels, respectively. Please refer to Table 1 for a definition of all the variables.

	OLS	OLS	OLS	Fixed effects		GMM5
				IC	Firm	
	(1)	(2)	(3)	(4)	(5)	(6)
Market-to-book ratio	0.032***	0.032***	0.032***	0.027***	0.028***	0.069***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
Cash flow-to-capital	0.036***	0.036***	0.036***	0.032***	0.029***	0.029***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
$Leverage_t \times DP_t \times$	−0.135***	−0.045				
Recovery rate	(0.011)	(0.030)				
Overhang		−0.177***	−0.242***	−0.249***	−0.319***	−0.044**
		(0.049)	(0.018)	(0.015)	(0.016)	(0.019)
Renegotiation failure (f)		0.000				
		(0.007)				
Constant	0.086***	0.087***	0.087***	0.105***	0.124***	0.006
	(0.004)	(0.006)	(0.004)	(0.004)	(0.004)	(0.004)
Observations	134,954	134,954	134,954	134,954	134,954	134,954
Adjusted R^2	0.09	0.09	0.09	0.19	0.38	
	Economic significance : $\Delta E(y) \equiv E(y\|f=0,.) - E(y\|f=1,.)$					
$\Delta E(Investment)$		0.019***	0.026***	0.027***	0.034***	0.005**
Standard error		(0.005)	(0.002)	(0.002)	(0.002)	(0.002)
$\frac{\Delta E(Investment)}{\text{mean } Investment}$		0.186	0.250	0.257	0.330	0.045

Table 5
Debt overhang, renegotiation failure, and fixed assets sales

This table presents OLS, industry-country (IC) fixed effects and firm fixed effects estimates of PPE growth regressions using a sample of all firm-year observations in the Worldscope data base between 1993-2010, for all countries surveyed by Djankov et al. (2008). The dependent variables are either *PPE growth*$_{t+1}$ (columns 1 through 5) or *PPE sales*$_{t+1}$ (column 6). *Overhang* for firm i in industry j, and country c, is defined as $Leverage_{it} \times DP_{it} \times Recovery\ rate_j \times f_c$, where DP_{it} is the default probability, and f_c is the country's *Renegotiation failure* index. All specifications include year fixed effects. Standard errors (in brackets under each estimate) are adjusted for heteroskedasticity and within industry-country clustering. Estimates followed by the symbols ***, ** or * are statistically significant at the 1%, 5%, or 10% levels, respectively. Please refer to Table 1 for a definition of all the variables.

	OLS	OLS	OLS	Fixed effects		Probit
				IC	Firm	
	(1)	(2)	(3)	(4)	(5)	(6)
Market-to-book ratio	0.041***	0.040***	0.040***	0.046***	0.059***	−0.069***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.007)
Cash flow-to-capital	0.068***	0.068***	0.068***	0.069***	0.069***	−0.215***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.006)	(0.016)
$Leverage_t \times DP_t \times$	−0.282***	−0.094**				
Recovery rate	(0.021)	(0.045)				
Overhang		−0.377***	−0.525***	−0.602***	−0.720***	2.037***
		(0.076)	(0.033)	(0.037)	(0.048)	(0.177)
Renegotiation failure (f)		−0.009				
		(0.009)				
Constant	0.089***	0.096***	0.090***	0.035***	0.003	−1.184***
	(0.007)	(0.009)	(0.007)	(0.005)	(0.006)	(0.028)
Observations	139,785	139,785	139,785	139,785	139,785	139,785
Adjusted R^2	0.05	0.05	0.05	0.07	0.12	
Pseudo R^2						0.04
	Economic significance : $\Delta E(y) \equiv E(y\|f=0,.) - E(y\|f=1,.)$ or $\Delta Pr(y) \equiv Pr(y\|f=1,.) - Pr(y\|f=0,.)$					
$\Delta E(PPE\ growth)$		0.049***	0.056***	0.064***	0.077***	
Standard error		(0.008)	(0.004)	(0.004)	(0.005)	
$\frac{\Delta E(PPE\ growth)}{\text{mean } PPE\ growth}$		0.736	0.841	0.964	1.153	
$\Delta Pr(PPE\ sales)$						0.141***
						(0.004)

Table 6
Debt overhang, renegotiation failure, and asset risk

This table presents OLS, industry-country (IC) fixed effects and firm fixed effects estimates of risk-taking regressions using a sample of all firm-year observations in the Worldscope data base between 1993-2010, for all countries surveyed by Djankov et al. (2008). The dependent variable is *EBITDA-to-assets vol*$_{t+1}$. *Overhang* for firm i in industry j, and country c, is defined as $Leverage_{it} \times DP_{it} \times$ *Recovery rate*$_j \times f_c$, where DP_{it} is the default probability, and f_c is the country's *Renegotiation failure* index. Additional firm-specific controls include *Market-to-book ratio*, *EBITDA-to-assets*, and *LT-debt-to-assets*. All specifications include year fixed effects. Standard errors (in brackets under each estimate) are adjusted for heteroskedasticity and within industry-country clustering. Estimates followed by the symbols ***, ** or * are statistically significant at the 1%, 5%, or 10% levels, respectively. Please refer to Table 1 for a definition of all the variables.

	OLS	OLS	OLS	OLS	Fixed effects	
					IC	Firm
	(1)	(2)	(3)	(4)	(5)	(6)
log(*Total assets*)	−0.011***	−0.011***	−0.011***	−0.010***	−0.010***	−0.019***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
GDP growth	0.000**	0.000**	0.000***	0.000	0.000	−0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
log(*GDP per capita*)	0.005***	0.005***	0.004***	0.003***	0.000	0.009***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
$Leverage_t \times DP_t \times$	0.090***	0.059***				
Recovery rate	(0.006)	(0.012)				
Overhang		0.059***	0.143***	0.141***	0.141***	0.075***
		(0.022)	(0.011)	(0.01)	(0.008)	(0.006)
Renegotiation failure		−0.004				
		(0.005)				
Legal origin controls	Yes	No	No	Yes	No	No
Additional firm-specific controls	No	No	No	Yes	Yes	Yes
Constant	0.063***	0.066***	0.067***	0.071***	0.120***	0.085***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.016)	(0.018)
Observations	116,378	116,378	116,378	116,329	116,329	116,329
Adjusted R^2	0.16	0.16	0.16	0.26	0.45	0.77
	Economic significance : $\Delta E(y) \equiv E(y\|f=0,.) - E(y\|f=1,.)$					
ΔE(*EBITDA-to-assets vol*)		−0.002	−0.015***	−0.015***	−0.015***	−0.008***
Standard error		(0.005)	(0.001)	(0.001)	(0.001)	(0.001)
$\frac{\Delta E(\textit{EBITDA-to-assets vol})}{\text{mean } \textit{EBITDA-to-assets vol}}$		−0.042	−0.256	−0.254	−0.253	−0.135

Table 7
Robustness check: matched sample estimates

This table presents OLS, industry-country (IC) fixed effects and firm fixed effects estimates of investment, PPE growth, and risk-taking regressions using a matched sample of all firm-year observations in the Worldscope data base between 1993-2010, for all countries surveyed by Djankov et al. (2008). Firms are matched across countries by *Market-to-book ratio*, *Cash flow-to-capital*, *Leverage*, and *log(Total assets)* using the Mahalanobis distance metric. The dependent variable in columns 1 and 2 is $Investment_{t+1}$, in column 3 is $PPE\ growth_{t+1}$, and in column 4 $PPE\ sales_{t+1}$. These 4 columns include *Market-to-book ratio* and *Cash flow-to-capital* as control variables. The dependent variable in columns 5 and 6 is $EBITDA\text{-}to\text{-}assets\ vol_{t+1}$. These 2 columns include *Market-to-book ratio*, log(*Total assets*), *EBITDA-to-assets*, *LT-debt-to-assets*, *GDP growth*, log(*GDP per capita*), and the legal origin as control variables. *Overhang* for firm i in industry j, and country c, is defined as $Leverage_{it} \times DP_{it} \times Recovery\ rate_j \times f_c$, where DP_{it} is the default probability, and f_c is the country's *Renegotiation failure* index. All specifications include year fixed effects. Standard errors (in brackets under each estimate) are adjusted for heteroskedasticity and within industry-country clustering. Estimates followed by the symbols ***, ** or * are statistically significant at the 1%, 5%, or 10% levels, respectively. Please refer to Table 1 for a definition of all the variables.

	Investment		Fixed assets sales		Risk-taking	
	OLS	IC FE	IC FE	Probit	OLS	IC FE
	(1)	(2)	(3)	(4)	(5)	(6)
Overhang	−0.252***	−0.282***	−0.713***	2.136***	0.147***	0.143***
	(0.02)	(0.02)	(0.089)	(0.250)	(0.012)	(0.01)
Observations	65,810	65,810	67,427	67,427	53,252	53,252
Adjusted R^2	0.07	0.16	0.06		0.28	0.46
Pseudo R^2				0.04		
	Economic significance : $\Delta E(y) \equiv E(y\|f=0,.) - E(y\|f=1,.)$ or $\Delta Pr(y) \equiv Pr(y\|f=1,.) - Pr(y\|f=0,.)$					
$\Delta E(Dependent\ variable)$	0.026***	0.029***	0.073***		−0.015***	−0.015***
Standard error	(0.002)	(0.002)	(0.009)		(0.001)	(0.001)
$\frac{\Delta E(Dependent\ variable)}{\text{mean } Dependent\ variable}$	0.251	0.280	1.097		−0.254	−0.247
$\Delta Pr(PPE\ sales)$				0.163***		
				(0.006)		

Table 8
Robustness check: creditor rights index

This table presents OLS, industry-country (IC) fixed effects and firm fixed effects estimates of investment, PPE growth, and risk-taking regressions using a sample of all firm-year observations in the Worldscope data base between 1993-2010, for all countries surveyed by Djankov et al. (2008). The dependent variable in columns 1 and 2 is $Investment_{t+1}$, in column 3 is $PPE\ growth_{t+1}$, and in column is 4 $PPE\ sales_{t+1}$. These 4 columns include *Market-to-book ratio* and *Cash flow-to-capital* as control variables. The dependent variable in columns 5 and 6 is *EBITDA-to-assets vol.* These 2 columns include *Market-to-book ratio*, log(*Total assets*), *EBITDA-to-assets*, *LT-debt-to-assets*, *GDP growth*, log(*GDP per capita*), and the legal origin as control variables. *Overhang_CR* for firm i in industry j, and country c, is defined as $Leverage_{it} \times DP_{it} \times Recovery\ rate_j \times Creditor\ rights_c$, where DP_{it} is the default probability, and $Creditor\ rights_c$ is the Djankov et al.'s (2008) creditors' rights index for country c. All specifications include year fixed effects. Standard errors (in brackets under each estimate) are adjusted for heteroskedasticity and within industry-country clustering. Estimates followed by the symbols ***, ** or * are statistically significant at the 1%, 5%, or 10% levels, respectively. Please refer to Table 1 for a definition of all the variables.

	Investment		Fixed assets sales		Risk-taking	
	OLS	IC FE	IC FE	Probit	OLS	IC FE
	(1)	(2)	(3)	(4)	(5)	(6)
Creditor rights	−0.002	0.024***	−0.001	0.029**	−0.002***	−0.003**
	(0.002)	(0.003)	(0.007)	(0.014)	(0.001)	(0.001)
Overhang_CR	−0.048***	−0.053***	−0.112***	0.226***	0.028***	0.031***
	(0.004)	(0.004)	(0.01)	(0.044)	(0.002)	(0.002)
Observations	134,954	134,954	139,785	139,785	116,329	116,329
Adjusted R^2	0.09	0.19	0.07		0.26	0.44
Pseudo R^2				0.04		
	Economic significance : $\Delta E(y) \equiv E(y\|f=0,.) - E(y\|f=1,.)$ or $\Delta Pr(y) \equiv Pr(y\|f=1,.) - Pr(y\|f=0,.)$					
$\Delta E(Dependent\ variable)$	0.020***	0.023***	0.048***		−0.012***	−0.013***
Standard error	(0.002)	(0.002)	(0.004)		(0.001)	(0.001)
$\frac{\Delta E(Dependent\ variable)}{\text{mean } Dependent\ variable}$	0.197	0.218	0.715		−0.204	−0.225
$\Delta Pr(PPE\ sales)$				0.113***		
				(0.004)		

Table 9
Debt overhang, renegotiation failure, and financing constraints

This table presents industry-country or firm fixed effects (FE) estimates of investment (Panel A), assets sales (Panel B) and risk-taking (Panel C) regressions using a sample of all firm-year observations in the Worldscope data base between 1993-2010, for all countries surveyed by Djankov et al. (2008). Each regression includes the product between *Overhang* and a dummy variable, $\mathbf{1}_{\{constrained?\}}$, which equals one if the firm belongs to the subsample of firms in each country that are relatively more financially constrained. The three criteria for financing constraints are median size (log(*Total assets*)), median Whited and Wu (2006) index (*WW index*) and the median Kaplan and Zingales (2000) index (*KZ index*). *Overhang* for firm i in industry j, and country c, is defined as $Leverage_{it} \times DP_{it} \times Recovery\ rate_j \times f_c$, where DP_{it} is the default probability, and f_c is the country's *Renegotiation failure* index. The regressions in Panels A and B include *Market-to-book ratio* and *Cash flow-to-capital* as control variables. The regressions in Panel C include *Market-to-book ratio*, log(*Total assets*), *EBITDA-to-assets*, *LT-debt-to-assets*, *GDP growth*, and log(*GDP per capita*) as control variables. All specifications include year fixed effects. Standard errors (in brackets under each estimate) are adjusted for heteroskedasticity and within industry-country clustering. Estimates followed by the symbols ***, ** or * are statistically significant at the 1%, 5%, or 10% levels, respectively. Please refer to Table 1 for a definition of all the variables.

Panel A: Investment

	Industry-country FE			Firm FE		
	Sorted by			Sorted by		
	Size	*WW index*	*KZ index*	Size	*WW index*	*KZ index*
Overhang	−0.232***	−0.187***	−0.339***	−0.267***	−0.242***	−0.291***
	(0.018)	(0.019)	(0.034)	(0.017)	(0.018)	(0.029)
Overhang ×	−0.050*	−0.112***	0.044	−0.127***	−0.127***	−0.038
$\mathbf{1}_{\{constrained?\}}$	(0.028)	(0.024)	(0.035)	(0.029)	(0.027)	(0.031)
Observations	134,954	128,263	127,527	134,954	128,263	127,527
Adjusted R^2	0.19	0.20	0.20	0.39	0.39	0.39
	Economic significance : $\Delta E(y) \equiv E(y\|f=0,.) - E(y\|f=1,.)$ $\Delta^2 E(y) \equiv \Delta E(y\|\mathbf{1}_{\{constrained?\}}=1,.) - \Delta E(y\|\mathbf{1}_{\{constrained?\}}=0,.)$					
$\Delta^2 E(Investment)$	0.005*	0.012***	−0.005	0.014***	0.013***	0.004
Standard error	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)
$\frac{\Delta^2 E(Investment)}{\Delta E(Investment)}$	0.177**	0.375***	−0.148	0.322***	0.344***	0.115
Standard error	(0.089)	(0.067)	(0.120)	(0.058)	(0.060)	(0.093)

(Continues)

Table 9: continued

Panel B: Asset sales

	Firm Fixed Effects *PPE growth* Sorted by			Probit *PPE sales* Sorted by		
	Size	*WW index*	*KZ index*	Size	*WW index*	*KZ index*
Overhang	-0.595^{***}	-0.551^{***}	-0.803^{***}	2.736^{***}	2.265^{***}	1.252^{***}
	(0.048)	(0.05)	(0.082)	(0.213)	(0.23)	(0.415)
Overhang $\times$	-0.326^{***}	-0.268^{***}	0.051	-0.135	-0.061	0.194
$\mathbf{1}_{\{constrained?\}}$	(0.077)	(0.074)	(0.088)	(0.252)	(0.256)	(0.387)
Observations	139,785	132,394	131,044	139,785	132,394	131,044
Adjusted R^2	0.24	0.25	0.25			
Pseudo R^2				0.12	0.13	0.12
	Economic significance : $\Delta E(y) \equiv E(y\|f=0,.) - E(y\|f=1,.)$ $\Delta^2 E(y) \equiv \Delta E(y\|\mathbf{1}_{\{constrained?\}}=1,.) - \Delta E(y\|\mathbf{1}_{\{constrained?\}}=0,.)$ or $\Delta Pr(y) \equiv Pr(y\|f=1,.) - Pr(y\|f=0,.)$ $\Delta^2 Pr(y) \equiv \Delta Pr(y\|\mathbf{1}_{\{constrained?\}}=1,.) - \Delta Pr(y\|\mathbf{1}_{\{constrained?\}}=0,.)$						
$\Delta^2 E(PPE\ growth)$	0.035^{***}	0.028^{***}	-0.005			
Standard error	(0.008)	(0.008)	(0.009)			
$\frac{\Delta^2 E(PPE\ sales)}{\Delta E(PPE\ sales)}$	0.354^{***}	0.327^{***}	-0.068			
Standard error	(0.066)	(0.074)	(0.118)			
$\Delta^2 Pr(PPE\ sales)$				-0.024^{***}	-0.028^{***}	-0.008
				(0.331)	(0.218)	(0.645)

Table 9: continued

Panel C: risk-taking

	Industry-country FE			Firm FE		
	Sorted by			Sorted by		
	Size	*WW index*	*KZ index*	Size	*WW index*	*KZ index*
Overhang	0.100***	0.095***	0.168***	0.053***	0.048***	0.064***
	(0.008)	(0.008)	(0.016)	(0.006)	(0.006)	(0.010)
Overhang ×	0.088***	0.077***	−0.030*	0.050***	0.049***	0.013
$\mathbf{1}_{\{constrained?\}}$	(0.015)	(0.014)	(0.016)	(0.010)	(0.009)	(0.011)
Observations	115,603	109,562	107,354	115,603	109,562	107,354
Adjusted R^2	0.45	0.45	0.45	0.77	0.77	0.77
	Economic significance : $\Delta E(y) \equiv E(y\|f=0,.) - E(y\|f=1,.)$ $\Delta^2 E(y) \equiv \Delta E(y\|\mathbf{1}_{\{constrained?\}}=1,.) - \Delta E(y\|\mathbf{1}_{\{constrained?\}}=0,.)$					
$\Delta^2 E(EBITDA\text{-}to\text{-}assets\ vol)$	−0.009***	−0.008***	0.003*	−0.005***	−0.005***	−0.001
Standard error	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
$\frac{\Delta^2 E(EBITDA\text{-}to\text{-}assets\ vol)}{\Delta E(EBITDA\text{-}to\text{-}assets\ vol)}$	0.469***	0.449***	−0.219*	0.486***	0.508***	0.169
Standard error	(0.055)	(0.058)	(0.125)	(0.068)	(0.068)	(0.141)

Table 10
Robustness analysis: alternative measures of asset risk

This table presents OLS, industry-country (IC) fixed effects and firm fixed effects estimates of risk-taking regressions using alternative measures of asset risk. The dependent variables are either *Equity return vol* (columns 1 through 3) or *Implied assets vol* (columns 4 through 6). *Overhang* for firm i in industry j, and country c, is defined as $Leverage_{it} \times DP_{it} \times Recovery\ rate_j \times f_c$, where DP_{it} is the default probability, and f_c is the country's *Renegotiation failure* index. Additional firm-specific controls include *Market-to-book ratio*, *EBITDA-to-assets*, and *LT-debt-to-assets*. Additional macro controls include log(*GDP per capita*) and *GDP growth*. All specifications include year fixed effects. Standard errors (in brackets under each estimate) are adjusted for heteroskedasticity and within industry-country clustering. Estimates followed by the symbols ***, ** or * are statistically significant at the 1%, 5%, or 10% levels, respectively. Please refer to Table 1 for a definition of all the variables.

	Equity return vol			*Implied assets vol*		
	OLS	Fixed effects		OLS	Fixed effects	
		IC	Firm		IC	Firm
	(1)	(2)	(3)	(4)	(5)	(6)
Overhang	1.466***	1.397***	0.922***	0.291***	0.314***	0.263***
	(0.057)	(0.047)	(0.038)	(0.033)	(0.027)	(0.025)
log(*Total assets*)	−0.048***	−0.052***	−0.048***	−0.037***	−0.042***	−0.055***
	(0.001)	(0.002)	(0.003)	(0.001)	(0.001)	(0.003)
Legal origin controls	Yes	No	No	Yes	No	No
Additional firm-specific controls	Yes	Yes	Yes	Yes	Yes	Yes
Additional macro controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	146,180	146,180	146,180	145,943	145,943	145,943
Adjusted R^2	0.27	0.41	0.54	0.26	0.40	0.55
	Economic significance : $\Delta E(y) \equiv E(y\|f=0,.) - E(y\|f=1,.)$					
$\Delta E(risk\ measure)$	−0.157***	−0.150***	−0.099***	−0.031***	−0.034***	−0.028***
Standard error	(0.006)	(0.005)	(0.004)	(0.004)	(0.003)	(0.003)
$\frac{\Delta E(risk\ measure)}{\text{mean } risk\ measure}$	−0.281	−0.268	−0.177	−0.079	−0.085	−0.072

Table 11
Robustness: alternative subsamples and distance-to-default measures

This table shows the robustness of the results to different subsamples and definitions of the overhang variable. The table presents industry-country fixed effects estimates of investment, PPE growth, and risk-taking regressions using a sample of all firm-year observations in the Worldscope data base between 1993-2010, for all countries surveyed by Djankov et al. (2008). The dependent variable in columns 1 and 2 is $Investment_{t+1}$, in column 3 is $PPE\ growth_{t+1}$, and in column is 4 $PPE\ sales_{t+1}$. These 4 columns include *Market-to-book ratio* and *Cash flow-to-capital* as control variables. The dependent variable in columns 5 and 6 is *EBITDA-to-assets vol.* These 2 columns include *Market-to-book ratio*, log(*Total assets*), *EBITDA-to-assets*, *LT-debt-to-assets*, *GDP growth*, log(*GDP per capita*), and the legal origin as control variables. *Overhang* for firm i in industry j, and country c, is defined as $Leverage_{it} \times DP_{it} \times Recovery\ rate_j \times f_c$, where DP_{it} is the default probability, and f_c is the country's *Renegotiation failure* index. In columns 1, 3, and 5, all firm-year observations belonging to the US or Japan are excluded. In columns 2, 4, and 6 *Overhang_Z* replaces DP for Altman's z-score. Standard errors (in brackets under each estimate) are adjusted for heteroskedasticity and within industry-country clustering, except for column 6, where they are clustered at the firm level. Estimates followed by the symbols ***, ** or * are statistically significant at the 1%, 5%, or 10% levels, respectively.

	Investment		Fixed assets sales		Risk-taking	
	(1)	(2)	(3)	(4)	(5)	(6)
Overhang	−0.284***		−0.713***		0.146***	
	(0.019)		(0.046)		(0.009)	
Overhang_Z		−0.008***		−0.017***		0.004***
		(0.000)		(0.001)		(0.000)
Observations	86,633	193,275	88,299	202,211	73,465	151,379
Adjusted R^2	0.17	0.19	0.06	0.08	0.46	0.44
	Economic significance : $\Delta E(y) \equiv E(y\|f=0,.) - E(y\|f=1,.)$					
ΔE(*Dependent variable*)	0.031***	0.025***	0.077***	0.055***	−0.016***	−0.012***
Standard error	(0.002)	(0.001)	(0.005)	(0.003)	(0.001)	(0.001)
$\frac{\Delta E(Dependent\ variable)}{\text{mean } Dependent\ variable}$	0.297	0.238	1.156	0.828	−0.267	−0.120