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Abstract

This paper is about using speci…c investments and secured debt to shield a …rm from exploitation by a regulatory authority. It is shown that speci…c investments and secured debt constrain the regulatory authority in its choice of regime, by providing a credible threat of bankruptcy.

Keywords: Regulation, Financial Structure, Hold–up problem

JEL classi…cation: D21, G38, L50

1 Regulatory constraints

It is a common presumption in the literature on regulation that the Regulator or regulatory agency has limited powers. Looking at the world around us, this assumption appears to be justi…ed. If the Regulator really was omniscient, her preferred outcome would always obtain. In reality outcomes of the regulatory process often are highly imperfect, even taking into account the sometimes di¤use objectives of regulatory agencies. In fact, even in cases where the Regulator's mandate is quite clear, examples of ine¤ective regulation abound.[1]

Limits to regulation have been modelled in a number of ways in the theoretical literature. In the older literature on regulation, bounds on regulatory discretion were often imposed exogeneously. A common form of this was restrictions to linear schemes such as uniform per–unit taxes. Linear schemes or piecewise linear schemes with only a few kinks are appealing due to their simplicity. Furthermore, these types of schemes are frequently observed in the real world. In situations with perfect information there is often no loss involved in using linear schemes. However, allowing some form of non-linearity, eg. not imposing the restriction of linearity, should theoretically improve matters for the Regulator. How big a loss is incurred by employing a linear form obviously depends on the setting.[2]

Another problem for the regulatory authority, on which a large literature has emerged, is asymmetric information. Here the limits to regulatory powers lie in the information available to the Regulator. If the regulated parties possess considerably more information about themselves than does the Regulator, very likely they are able to use this to their advantage. One of the earliest contributions to this literature is Baron and Myerson (1982). A large number of later works (in particular by Jean Jacques La¤ont and Jean Tirole) are synthesized in La¤ont and Tirole (1993).

Holmström and Milgrom (1987), Gjesdal (1988), and La¤ont and Tirole (1993) all identify cases in which simple linear or "one–kinked" piecewise linear functions are no less e¢cient than fully general schemes under asymmetric information. They also discuss the feasibility of approximating the fully optimal scheme with piecewise linear functions. Jebjerg and Lando (1997) extend the analysis of La¤ont and Tirole to include settings typical for environmental problems, and take a slightly more negative view on linearity.

The incomplete contracting framework of Grossman and Hart (1986),

[1] Just open a newspaper for examples. The point is illustrated by the fact that a number of countries have nationalized (and, for di¤erent reasons, privatized) key industries at one time or another, implying that "ownership" is associated with more extensive controlrights than "regulation".

[2] It also depends on the number of kinks allowed in the piecewise linear functional form. Any continous function can be approximated closely by some piecewise linear function.

Hart and Moore (1988), and others also has some relevance for this paper. These authors explain imperfections by assuming that certain key actions, while observable, are not contractible in the sense of not being veri…able to a court, or any other third party. The noncontractability creates a role for a holder of residual rights of control, much like in the present paper.

Finally, an explaination that is very di¤erent from the one presented here is given by political theories, including the political economy literature. This approach focuses on the Firm's stakeholders and their ability to in‡uence the regulatory process through in‡uence activities. A prime example is Grossman and Helpman (1994).

In this paper we o¤er an alternative explanation of regulatory imperfections, in the spirit of the incomplete contracting models, by showing that the Firm's …nancial structure matters. Speci…cally, sunk investments and debt can be a restraining device vis â vis the Regulator, assuming the Regulator has a preference for the Firm staying in business. This preference may exist if the Firm generates bene…ts, such as jobs or tax revenue, that would be lost were the Firm to shut down. Presumably, the Regulator also wants to impose a regulatory regime (taxation, environmental regulation, etc.) on the Firm. The Regulator's preferences may lead to the following time–inconsistency problem: When …rst approached by the Firm, the Regulator may well promise to run a lenient regulatory regime, possibly even to give current and future subsidies, in exchange for the Firm setting up an operation in the Regulator's domain. Once the Firm's sunk investments are in place, however, it is locked into a relationship with the Regulator. Now, given its typical powers of enforcement, the Regulator is able to renege on his promises, and even extract concessions from the Firm. He can do so up to the point where regulation is so burdensome, it becomes pro…table for the Firm to write o¤ its investment and discontinue operations. Of course, a clever Firm would try to …nd ways to protect itself, or abstain from investing altogether.

What I show in this paper, is that the possibilities for hold-up by the regulatory authority can be partially o¤set by the Firm's capital (ownership) structure. The Firm can counter the Regulator's threat of exploitation by taking on secured debt, which embeds a promise to hand the Firm's assets over to its Creditors if the Firm cannot service its debt obligations. Thus, the possibility of regulatory hold–up leads the Firm to favour debt when …nancing a project. By highlighting an example of non–neutrality of …rms' performance to …nancial structure, this paper can be seen as part of the large literature challenging the assumptions of the Modligiani–Miller theorem.

The main assumption is that …rms are not necessarily fully compensated for costs imposed by regulation. This view is supported by many authors. To quote from a book on law and economics by Thomas Miceli, "In contrast to physical acquisitions or intrusions, government regulation of private

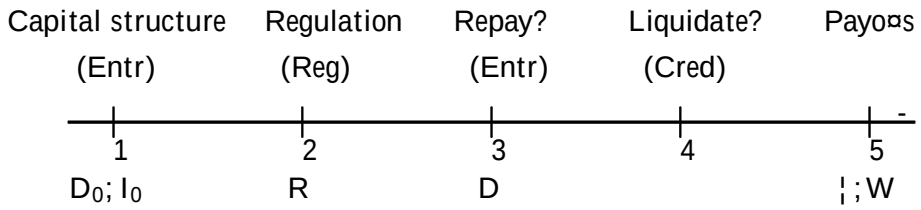

Figure 1: Timing

property generally does not require compensation. Instead it is viewed as a legitimate exercise of the government's police power." (Miceli 1997, p. 137) Miceli then goes on to argue that even in cases where government regulation is so burdensome so as to be considered a "regulatory taking" for which compensation is due, the regulated parties are generally undercompensated.

A court case referred by Miceli (p. 146) shows that taking on debt may actually have a favourable e¤ect on the outcome of the legal process. Investment backed expectations is quoted as one of three key factors in the 1978 U.S. Supreme Court ruling Penn Central Transportation Co. v. City of New York. The ruling establishes that "In particular, compensation is more likely, all else equal, if regulation interferes with development plans that are investment-backed". So the regulated parties may get a more favourable treatment if regulation interferes with plans involving third–party investors.

A second case where …rms' investments in place clearly matter for the regulatory treatment is the stranded assets problem common to privatized utilities. The term "stranded assets" refers to sunk investments made before politically imposed structural changes, such as liberalization of the market. These investments may be huge for …rms such as utilities. The changing nature of contracts, and supplier–/customer relationships following liberalization, often mean that a substantial part of the …rm's assets in place become inappropriate in the new environment ("stranded" in the jargon). Providing some form of compensation to owners of stranded assets, perhaps through a more lenient regulatory treatment (pass through of costs to consumers), is an essential feature of the regulation of newly liberalized industries.

In this paper we show that debt, by creating a credible threat of bankrupcy, can e¤ectively limit the Regulator's freedom to exploit the regulated Firm.

2 The model

The structure of the model is shown in …gure 1. A single project with an initial capital requirement of one unit is considered. During the lifetime of

the project a number of decisions need to be taken by the Entrepreneur. These will in‡uence his …nal payo¤. However, the Regulator also cares about these decisions and will try to in‡uence the Entrepreneur. Ultimately, payo¤s from the project are realized and the project is liquidated.

The project can be …nanced by the Entrepreneur's own money I_0 and/or a loan D_0, as long as I_0 and D_0 are non–negative and sum to one. Any debt taken on initially must be repaid when the project has been completed.

The choice of …nancial structure is the focus of this paper. To make matters interesting, we need at least three agents. The Entrepreneur implements and owns the project.[3] The Regulator wants to in‡uence the Entrepreneur's actual implementation of the project and has the authority to do so. An example is the case of an Entrepreneur setting up a small plant. Once the plant has been set–up, the local authority has a stake in inducing the Entrepreneur to take on more labour, buy inputs locally, etc., even though these may not be good business decisions from the Entrepreneur's point of view. Realizing these opportunities for hold–up exists, the Entrepreneur will seek ways to protect himself. In this paper, I argue that taking on secured debt prior to undertaking the project will, to some degree, shield the Entrepreneur from being expropriated by the Regulator. In order to introduce debt we need a third party; the …rm's Creditors.

The timing is as follows: First the Entrepreneur decides whether or not to undertake the project. If he decides to go ahead with the project, he must invest one unit of capital. He can choose to invest any combination of own or borrowed funds as long as it sums to one ($I_0 + D_0 = 1$). The Regulator then makes a binding announcement of the regulatory regime, R.[4] Given this announcement the Entrepreneur decides whether to Continue or Stop the project. If the project is continued, it generates a bene…cial externality, valued at $S_0 > 0$ by the Regulator,[5] and the Entrepreneur must abide by the regulatory regime (implement R). Before pro…ts are paid out, the Entrepreneur must repay any debt with interest. Denote the principal D_0 2 [0; 1], and the value of debt with interest ¿ D_0.[6] A repayment of $D <$ ¿ D_0 means that the Entrepreneur defaults on his obligations. In case of default the Creditors get to decide whether to liquidate the project or not. Under the assumption that the Creditors never opt to renegotiate the …rm's debt, they will always liquidate and get the …rm's assets (up to the value of outstanding debt).[7] The Entrepreneur's liability is limited to the

[3] Ownership in this context is identi…ed with residual controlrights.

[4] R could be an index of net taxes levied on the …rm.

[5] The externality could be in the form of tax–revenue, employment etc. The bene…ts are only needed to ensure that $R + S_0$ is strictly positive and amounts to a normalization of R.

[6] All amounts can be thought of as denominated in date one currency.

[7] The assumption of no renegotiation can be given a number of justi…cations. One is

liquidation value of the project's assets A or the value of outstanding debt ¿ D_0 ¡ D, whichever is less.

More formally, the Entrepreneur manages the project and cares about net pro…ts. The pro…t is in‡uenced by the Regulatory regime as well as the period 1 …nancing decision. Let R 2 [0; 1] be an index of the stringency of the regulatory regime (interpreting R = 0 as "very loose", R = 1 as "very stringent"). If the project is undertaken the Entrepreneur must adhere to the regulatory regime, ie. implement R. Let A > 0 be the ex-post value of the project's assets[8] and B(R) be net project revenue as a function of the costs induced by regulation. Finally, let D be the amount of debt actually repaid, and º be the opportunity cost of own funds. Net pro…ts if the project is not liquidated is:

$$\Pi \equiv B(R) + A - D - \rho I_0 \tag{1}$$

The last term is non–zero only if the project is not fully debt–…nanced. Note that as the initial investment I_0 is sunk in period 1, the last term only matters for the initial investment decision.

If the Entrepreneur repays only D < ¿ D_0 (ie. defaults) and the Creditors subsequently exercise their option to liquidate the project, the Creditors get a payo¤ of:

$$\min(A; ¿ D_0 - D) \tag{2}$$

The Entrepreneur's net pro…t in liquidation, using (1) and (2) and the fact that B(R) is not paid out when the project is liquidated, is:

$$\Pi^L \equiv \max(-D; A - ¿ D_0) - \rho I_0 \tag{3}$$

It is easily seen that given the project will be liquidated it is optimal to repay nothing, ie. set D = 0.

The Regulator cares about the amount of surplus she is able to squeeze out of the …rm, measured by R. The Regulator cannot set R directly but can specify a regulatory regime R 2 [0; 1] by which the Entrepreneur must abide if the project is to be undertaken. Also, the Regulator gains some exogeneous bene…t S_0 > 0 from the realization of the project. Think of S_0 as a positive externality (jobs, taxes, etc.) generated by the project and R 2 [0; 1] as the

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that this particular project is small relative to the creditors' other engagements. Then not renegotiating entails only a small loss, relative to the the gain from "playing tough" and deterring other debtors from defaulting strategically.

The main results will go through with su¢ciently high cost of bankruptcy, even when renegotiation is allowed. See the appendix for more details.

[8] The value of the assets should be thought of as contingent on the ex–ante expected regulatory regime (which may very well matter for the investment decision). It is plausible that the actual regulatory regime does not a¤ect asset values, as the Regulator always has the option of changing the rules. This will of course not hold true if the next regime is thought to be very much like the current.

"intensity" of regulation. For simplicity S_0 is assumed to be independent of R. The important assumption is that the Regulator's and the Entrepreneur's objectives are not perfectly corrolated, hence more "regulation" lowers the …rm's pro…ts. Also it is important that the Regulator gains something from not to shutting the …rm down. The Regulator's objective function is

$$W = S_0 + R \tag{4}$$

If debt repayments are not made, Creditors gain the right to force the project into bankruptcy. As the present value of debt with interest is ¿ D_0, a repayment of $D < ¿ D_0$ means the Entrepreneur defaults on his obligations. In case of default Creditors have the option to seize control of the project's assets, valued at A. Below we will assume depreciation/asset speci…city, $0 < A < ¿$. The asset could be machines, buildings, and/or human capital, necessary for production but not possible to install and remove at zero cost. Creditors are assumed to operate on a competitive market, thus they have no ex–ante bargaining power vis â vis the Entrepreneur.

A number of assumptions are needed to more formally capture the structure presented above:

Assumption I (Regulatory Powers): The Regulator has the power to announce any regulatory regime R 2 [0; 1] when the capital structure of the project has been choosen. She cannot commit herself to any further actions, including the payment of monetary transfers.

The regulatory authority is thus endowed with coercive powers vis â vis the regulated parties. As argued in the introduction this is often the case in North American common law (and most other countries' law as well). The lack of commitment is a serious constraint on compensatory transfers (these are essentially ruled out). Note that if the Regulator could credibly commit to the regulatory regime before the Entrepreneur makes his investment decision, there would be no role in the model for debt …nancing under Assumption IV (a,d) below.

Assumption II (Outside options): The Entrepreneur and the Regulator get payo¤s ¦ = W = 0 if the project is not undertaken or the asset is removed from the Entrepreneur (by forced liquidation).

Assumption III (Asset speci…city): If an investment of one unit is undertaken in period 1, the Entrepreneur obtains a productive asset A with a post–period 1 value of: $0 < A < º$.[9]

[9] Recall º ¸ 1 is the opportunity cost of investing own funds (which is less than the cost of borrowing, see Assumption IV).

Thus, the asset is not a good passive investment object; buying it without using it yields less than putting money in the bank. The realization of the project generates a positive externality S_0, captured by the Regulator. A possibility is $A + S_0 = º$ which gives a nice interpretation of the investment. Also note that, even though the Regulator in some cases would like to promise to compensate the Entrepreneur for investing, this is not credible under assumption I.

Assumption IV (Financing and Debt):

(a) Debt …nancing is (weakly) more expensive than investing own savings: ¿ ¸ º ¸ 1.

(b) Debt repayments cannot be negative, $D \geq 0$.

(c) Limited liability: In case of default ($D < ¿D_0$), creditors can seize at most $\min(A; ¿D_0 ¡ D)$

(d) The Entrepreneur is not wealth–constrained, $I_0 \geq 1$.

Part (a) assures that debt …nancing would not be an optimal strategy if the Regulator could commit before the initial investment decision is made not to expropriate the Entrepreneur's surplus. If capital markets are perfect, ¿ = º. Assumptions III and IV implies $A < ¿$. Part (c) says that Creditors are not entitled to more than the value of outstanding debt $¿D_0 ¡ D$ or the …rm's assets A, whichever is worth less. Regarding part (d) we need the assumption $I_0 > 0$ (the Entrepreneur has some personal wealth) to make matters non–trivial. Having $I_0 \geq 1$ simpli…es the analysis.

Finally, to make matters interesting we need an assumption stating that the consequenses of regulation are su¢ciently important to the project. This is an assumption on the range of the function $B : [0; 1] \to R$ (measuring attainable pro…ts as a function of the regulatory environment). By varying this, we would in e¤ect be able to incorporate costly e¤ort in the model.

Assumption V (Regulation Matters): The function B(¢) is strictly decreasing and continuous. Furthermore,

(a) $9\hat{R} \in]0; 1[: B(\hat{R}) = ¿ ¡ A$.

(b) $B(1) = 0$.

Part (a) says that a fully debt …nanced project breaks even for some intermediate value of R. This implies that under a "no regulation" regime ($R = 0$), the project is pro…table regardless of …nancing method. It also

implies $B(1) < \neg\, ¡\, A$, ie. a fully debt …nanced project is not pro…table with intensive regulation. Part (b) is stronger than needed and implies: $B(1) < º\, ¡\, A$. Hence $¦ = B(1) + A ¡ \neg D_0 ¡ º I_0 < 0$ for any combination $(I_0; D_0)$ 2 ¢, where $¢ \acute{} f(x; y) ¸ 0 j x + y = 1g$. That is, a very demanding regulatory regime always makes the project unpro…table, no matter what method of …nancing is choosen. If the Regulator could (in violation of Assumption I) commit to compensate the Entrepreneur for any regulatory costs incurred, $B(¢)$ would be a "‡at" schedule and regulation would not matter in the model.

3 Debt as a shield

The basic trade-o¤ when the initial investment has been sunk is as follows: The Entrepreneur will optimally default on his obligations by repaying nothing if net revenue, excluding the initial sunk investment, $¼ \acute{} ¦ + º I_0 = B(R) + A ¡ \neg D_0$, is negative. By doing this he loses the asset A, pro…ts ¦, and the ex-post value $º I_0$ of his investment. On the other hand, he limits his liability to the minimum of $(A; \neg D_0)$.

The model is solved by backwards induction (cf. …gure 1).

Stage 4: If the Entrepreneur defaults on his obligations $(D < \neg D_0)$, the Creditors (…gure 2) have the right to force the project into bankruptcy and seize control of the asset A. It is apparent that the Creditors will always choose to liquidate the project as $A > 0$.[10]

Stage 3: The Entrepreneur (…gure 3) has the choice of stopping or continuing the project. If the project is …nanced by his own money, he will always continue (even under the strictest regulatory regime, $R = 1$, stopping is no worse than continuing by assumption V (b)).

For a debt …nanced project, continuing is equivalent to repaying the debt in full $(D = \neg D_0)$. Stopping means paying nothing at all $(D = 0)$.[11] If the Entrepreneur opts to continue, the project yields pro…t $¦^{cont} = B(R) + A ¡ \neg D_0 ¡ º I_0$. If the project is stopped (by the Entrepreneur repaying nothing and the Creditors subsequently liquidating the project) the pro…t is $¦^{stop} = \max(0; A ¡ \neg D_0) ¡ º I_0 \quad 0$ for $(I_0; D_0)$ 2 ¢ under assumptions III and IV. Continuation and repayment is optimal i¤

$$¼ = \begin{cases} B(R) ¸ 0 & \text{for } D_0 \quad A=\neg \\ B(R) + A ¡ \neg D_0 ¸ 0 & \text{for } D_0 > A=\neg \end{cases} \tag{5}$$

[10] Under the maintained assumption of no renegotiation in bankruptcy.

[11] It is easily seen that any other level of debt repayment is suboptimal given the creditors' behaviour: For $D_0 > 0$, choosing $0 < D < \neg D_0$ resp. $D > \neg D_0$ is more costly than $D = 0$ respectively $D = \neg D_0$ and doesn't change the outcome.

For low levels of debt (D_0 A=¬) it is optimal to repay the Creditors and stop the project (selling o¤ the asset), if $B(R) < 0$. This is ruled out by assumption V.

Call this the continuation constraint. It is always ful…lled for low levels of debt ($D_0 \quad A=¿$), but may not be ful…lled for high levels of debt. The intuition is that, under limited liability with a high level of debt, it is sometimes better for the Entrepreneur to give up on his sunk investment than to implement the current regulatory regime and repay the Creditors.

Stage 2: The Regulator can induce the Entrepreneur to Continue or Stop the project by the choice of R (see …gure 4). As $W^{cont} = S_0 + R > 0 = W^{stop}$ for all R, the Regulator prefers to induce "Continue". Hence, she must solve:

$$R^{¤} = \arg \max_{R \in [0;1]} R \quad \text{st. } ¼ \, ¸ \, 0$$

This yields $R^{¤} = B^{¡1}(¿D_0 ¡ A)$ st. $R^{¤} \in [0;1]$. Parameterizing $R^{¤}$ by D_0, we get our …rst result:

Lemma 1 The optimal regulatory regime is given by:

$$R^{¤} = \begin{cases} \overline{R} & \text{for } D_0 = 1 \\ B^{¡1}(¿D_0 ¡ A) & \text{for } D_0 \in [\frac{A}{¿};1[\\ 1 & \text{for } D_0 \in [0;\frac{A}{¿}[\end{cases} \tag{6}$$

It is optimal to regulate a …rm with debt more lenient than a …rm with no debt so as not to force it into liquidation. We are able to conclude that the Regulator optimally sets a more lenient regime for a Firm with a high level of debt. This is formalized in lemma 2:

Lemma 2 The optimal regulatory regime is weakly decreasing in D_0. For any level of debt $D_0 \in \left[\frac{A}{¿};1\right]$, the optimal regulatory regime R is monotonically decreasing in D_0.

Proof: For $D_0 \in \left[\frac{A}{¿};1\right]$, the optimality condition (6) has an interior solution by assumption V. Again by assumption V, this solution is monotonically decreasing in the argument of $B^{¡1}(¢)$. The …rst statement follows directly from inspection of condition (6) ¤

Stage 1: The Entrepreneur decides whether or not to undertake the project. If he is to invest, he must be able to ensure for himself at least his outside option value of zero. His participation constraint is:

$$9(I_0; D_0) \in ¢ : B(R^{¤}) + A ¡ °I_0 ¡ ¿D_0 \, ¸ \, 0$$

Where $R^{¤}$ is given by (6). Under Assumption IV (a), satisfaction of the continuation constraint (5) for $D_0 = 1$ implies satisfaction of the participation constraint. It is easy to show that the participation constraint is never satis…ed for $D_0 < 1$:

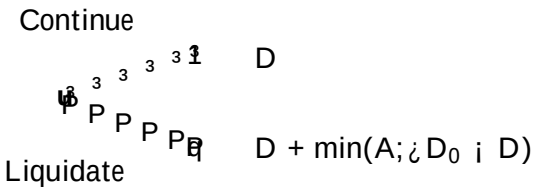

Figure 2: Creditors' decision when $D < ¿ D_0$ (default).

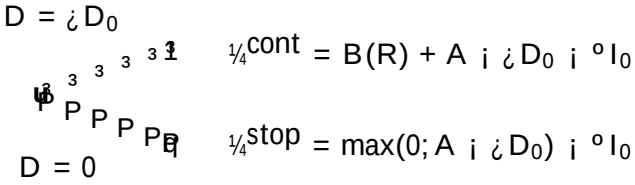

Figure 3: The Entrepreneur's decision.

Proposition 3 The Entrepreneur will never undertake the project if he must invest his own funds. The project will be undertaken if the Entrepreneur can borrow.

Proof: The condition for participation with $1 ¸ I_0 ¸ 0; D_0 = 1 ¡ I_0$ is $B(R^¤) + A ¡ ºI_0 ¡ ¿ D_0 ¸ B(R^¤_{jD_0=1}) + A ¡ ¿ = 0 ¸ B(R^¤_{jD_0=1}) ¡ B(R^¤)$ $(1 ¡ D_0)¿ ¡ ºI_0 = (¿ ¡ º)I_0$. By substituting the optimal $R^¤$ from (6), one can verify that this is satis…ed for $I_0 = 0$, but not for $I_0 > 0$ ¤

Thus, we have established that the Entrepreneur will never risk his own funds as they will always be expropriated by the Regulator. By inspecting proposition 3, one may notice that the Entrepreneur is indi¤erent between undertaking the project and not when it is debt–…nanced. Of course the Regulator would be willing to leave a small amount of surplus to the Entrepreneur to induce him to continue the project. A somewhat stronger result can be obtained by introducing a non–appropriable bene…t of running the project, which also breaks the indi¤erence.

One important question remains unresolved: Why is debt used at all? We have seen that the Entrepreneur desires to take on debt even though

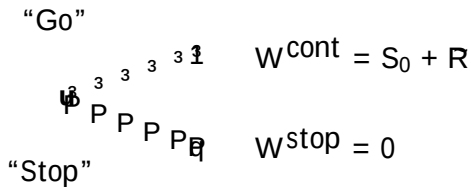

Figure 4: The Regulator's decision.

this may be a more expensive way of …nancing the project. What is less clear at this stage is why the Regulator must allow the …rm to do so.

Suppose as before that the Entrepreneur can …nance the project with his own money or debt. As the Entrepreneur have no credible leverage over the Regulator once the project is underway, any sunk investment …nanced with the Entrepreneur's own money will be appropriated by the Regulator, yielding $I_0 > 1 \Rightarrow \Pi < 0$ (by the analysis above). Realizing this, the project will not be undertaken. If the Entrepreneur is allowed to take on debt, he will optimally set $D_0 = 1$, thus getting a payo¤ of $\Pi = 0$ and (just) be willing to undertake the project.

As the Regulator gets $W = S_0 + R^{\alpha} > 0$ when the project is undertaken and $W = 0$ when it is not, it is not an equilibrium strategy for the Regulator to preclude the Entrepreneur from taking on debt.

In equilibrium Creditors get ρD_0. The yield on their investment is $\rho D_0 / D_0 = \rho \geq 1$, which is the market rate if the market for credit is competitive.

4 Discussion

We have seen that debt can act as a device to constrain the discretion of the Regulator. Actually this improves matters for the Regulator as well by acting as a commitment device in the sense of Kydland and Prescott (1977). The special feature of the debt instrument is that it relates transfers of control to …nancial performance. In case of default, the Creditors gain the right to assume control of the project's assets. By providing a credible mechanism for removing the assets from the Entrepreneur, and hence from the in‡uence of the Regulator, when the project performs badly, the secured debt contract e¤ectively provides a restraining- or commitment device for the Regulator. It is a common result that the presence of such a device can raise welfare. Observe that equity cannot perform this role, precisely because it doesn't provide a credible way of liquidating the project when performance is bad. In this model equity–…nance works in exactly the same way as the Entrepreneur's investment I_0.

Of course there are a number of other reasons for using debt in a …rm's

…nancial structure, most of which are not featured in this simple model. Therefore the present model should not be interpreted as an explanation of the optimal debt/equity mix, but rather as an example of a regulatory constraint. In this context it is important to note that even though the typical real world debt/assets ratio is signi…cantly lower than 1 (the prediction of this model), debt can still act as an e¤ective restraining mechanism.

The somewhat dramatic result that the project will never be undertaken unless fully debt–…nanced is an artefact of the simple structure of the model. The general result that debt o¤ers the Entrepreneur some protection will carry through under more plausible assumptions. The important features are that the Entrepreneur will choose to scale back the project when regulated heavily, and that the Regulator dislikes this su¢ciently much.

It is possible to empirically validate or falsify the conclusions of this paper. A test could run along the lines of whether capital–intensive industries (such as utilities, airlines, etc.), where …rms in general have large external debts, are subject to more burdersome regulation than less capital intensive industries (services, say). Casual observation seem to con…rm this a priori. It is important to do such a test by comparing di¤erent industries. A …rm–to–…rm intra–industry comparision will not in general be satisfactory, as regulation is typical done on an industrywide basis. To do a proper test, one must be able to control for features, such as market structure, that make some industries more likely targets for regulation than others.

An application of the model, somewhat di¤erent from the set–up in this paper, is to procurement. A buyer entering into a long–term project (eg. the construction of a bridge or a tunnel) with a seller may want the seller to take on debt. This, coupled with an appropriately structured payments contract, commits the seller to keep making progress on the project in order to get funds from the buyer to repay the Creditors. If he doesn't, the seller runs the danger of loosing control of the project's assets. Of course, as recent experience shows, one would have to be very careful about the possibilities of renegotiation in such a case.

A Appendix: Default and renegotiation

The purpose of this appendix is to evaluate the e¤ects of introducing renegotiation in the model. Allowing for renegotiation adds the possibility of strategic default on the part of the Entrepreneur. Strategic default is a situation where the Entrepreneur could in fact repay his debt, but chooses not to, in order to obtain a more favourable outcome through the renegotiation process.

Assume that the Entrepreneur has borrowed one unit of capital ($D_0 = 1$) and that there is a …xed cost $K > 0$ of renegotiation. If the Entrepreneur

chooses to default rather than repay his debt, he might as well repay nothing ($D = 0$) as was shown in the main text.

If the Entrepreneur defaults ($D = 0$), the Creditors face the choice of stopping the project, or renegotiating the terms of the contract. The aim of renegotiation is to hand control of the asset back to the Entrepreneur who can use it most productively (obtain a surplus that is larger that the liquidation value A of the asset). Liquidating the project yields a payo¤ of A. Renegotiating with Nash–bargaining gives

$$A + (1 ¡ ®)[B(R^{¤}) ¡ K]$$

where $(1 ¡ ®)$ 2]0; 1[is the relative bargaining power of the Creditors, $B(R^{¤})$ is the value of the asset when it is controlled by the Entrepreneur under the current regulatory regime, $K > 0$ is the …xed cost of renegotiating the contract. The Creditors will choose to renegotiate rather than to liquidate i¤

$$A + (1 ¡ ®)[B(R^{¤}) ¡ K] ¸ A \quad ( ) \quad B(R^{¤}) ¸ K \tag{7}$$

The Entrepreneur will choose to default rather than repay the full amount owed (¿) i¤

$$®[B(R^{¤}) ¡ K] > B(R^{¤}) + A ¡ ¿ \quad ( ) \quad (1 ¡ ®)B(R^{¤}) + A + ®K < ¿ \tag{8}$$

where ® is the Entrepreneur's relative bargaining power. That is, the Entrepreneur will renegotiate if the loss from defaulting and renegotiating – a fraction of the output ($(1 ¡ ®)B(R^{¤})$), plus the liquidation value of the asset (A), and a share of the cost of renegotiating ($®K$) is less than the savings (¿) from not repaying the initial debt.

The Regulator maximizes R in one of two possible cases, each with a di¤erent set of constraints.

Case I — The Entrepreneur chooses to repay rather than to liquidate, and has to break even: $B(R) + A ¡ ¿ ¸ 0$. This case prevails when bankruptcy costs are high ($K ¸ ¿ ¡ A$). The solution is exactly as in the main text (lemma 1).

Case II — the Entrepreneur defaults but the Creditors choose to renegotiate. This case prevails when ($K < ¿ ¡ A$). The set of constraints are: $(1 ¡ ®)B(R^{¤}) + A + ®K < ¿$ and $B(R^{¤}) ¡ K ¸ 0$. The optimal strategy for the Regulator is to choose $R^{¤}$ such that $B(R^{¤}) = K$, $R^{¤} > \overline{R}$.[12] In this case, the project will not be undertaken because the Creditors cannot guarantee themselves an adequate return on their investment of $D_0 = 1$. In equilibrium they get a repayment of only $A + (1 ¡ ®)[B(R^{¤}) ¡ K] = A$ (substitute $B(R^{¤}) = K$), which is less than the market rate ¿. This holds

[12] Choose $R = 1 > \overline{R}$, if $K > 1$.

regardless of their bargaining power (1 ¡ ®). Hence they are not willing to …nance the project.

The facts about renegotiation that emerge from this analysis are: For su¢ciently high bankruptcy costs (K ¸ A ¡ ¿), the solution is exactly the same as with no renegotiation. For smaller bankruptcy costs, the market breaks down and the project will not be undertaken. In the latter case, the Regulator exploits his "…rst mover advantage" (100% bargaining power in the jargon of contract theory) to capture all the ex–post gains from renegotiation. Renegotiation costs should be at least as high as the combined investment costs — the cost of borrowing funds, and depreciation of assets, for the conclusions of the model to be valid.

It is straightforward to verify that the renegotiation game is robust to asymmetric costs of renegotiation, with $K_C \neq K_E$. A reason for the asymmetry of costs could be that Creditors lose more than the direct costs of bargaining if they come to be known as "weak" players that allow debtors to renegotiate their commitments.

Whether bankruptcy costs in fact are high or low is an unsettled question. Giammarino (1989) argues in a theoretical framework that it is rational for players on the credit market to incur signi…cant bankruptcy costs in the presence of asymmetric information, even when the possibility of costless renegotiation exists. Of course, asymmetry of information is not an issue in the present model. On the other hand, Warner (1977) in a much cited study estimates US bankruptcy costs to be less than 1% of …rms' pre–bankruptcy valuations.

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