Bankruptcy System and Corporate Tax Policy*

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Abstract

We jointly analyze government choice of bankruptcy system and corporate tax rate in the economy where firms with investment projects select their capital structures and make liquidation/continuation decisions. The model predicts, for example, that for developped countries, a low tax rate can be combined with any bankruptcy system, intermediate tax rate - with creditors-friendly bankruptcy system and high tax rate - with shareholders-friendly system. The model also generates predictions for developing countries. Most of our predictions have not been tested sofar but are consistent woth some empirical evidence.

1 Introduction

There has been literature comparing the efficiency of different bankruptcy rules but the discussion is far from over as countries are still having radical bankruptcy reforms, i.e. the Dodd-Frank Act in the US in 2011 and the European reform in 2019, the reform in Italy in 2005 (Aghion et al (1994), Cornelli and Felli (1996), Davydenko and Franks (2008), McGowan and Andrews (2016)). One of the major difficulties in establishing an optimal bankruptcy procedure is the multitude of factors affecting firm bankruptcy outcomes (McCormack, Keay, Brown and Dahlgreen (2016)). An important factor that has not been extensively studied in conjunction with bankruptcy laws is corporate taxation. Meantime bankruptcy system and corporate tax policy are closely related from businessses point of view. For example one of the major thoeries of capital structure (the trade-off theory (Kraus and Litzenberger (1973)) predicts that firms' choice of capital structure represents a trade-off between expected bankruptcy costs and tax shield. The government choice of its bankruptcy system affects the former and the government choice of corporate tax rate affects the latter. So an uncoordinated choice of bankruptcy system and corporate tax rate can lead to extreme capital structrue biases by businesses such as extermely high or

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extermely low debt for example. Even if the extreme capital structrue choice is not the case, the government might want to benefit from providing incnetives for firms in selecting investment and capital strcutrue policy that will maximize the government objective function.

Acharya, John and Suburmanyan (2011) investigate the impact of bankruptcy codes on firms' capital-structure choices in the presence of croporate taxes. They develop a theoretical model to identify how firm characteristics may interact with the bankruptcy code in determining optimal capital structures. The authors argue that the difference in leverage choices under a relatively equity-friendly bankruptcy code (such as the US's) and one that is relatively more debt-friendly (such as the UK's) should be a decreasing function of the anticipated liquidation value of the firm's assets.In contrast to this ppaer, in pur paper the choice of corporate tax is endogenous. Also we include more bankruptcy system into consideration and model the government choice more expliciitely by intriducing the government objective function in the spirit of public finance lietrature. We also include renegotiation.

Our paper also contrbutes to the public finance debate about corporate income tax. Traditional "folk" opinion is that corporate tax is the price corporations pay for the right of limited liability (Meade (1978)). However, the quantitvative determination of these benefits is a different issue. Musgrave and Musgrave (1980) and Rosen (2004) noticed that it is hard to link the real amount of benefits corporations receive from limited liability and the magnitude of corporate taxation. A quantitate determination of optimal tax should then quantify sharheodlers advantage of limited liabilityy that in turn depends on other benfits costs which sharheolders of cropoartions face. A part of these costs are costs endured duting bankruptcy. So when quantifying benfits of corporate tax it is logical to balance them against potential bankruptcy costs.[1]

There are several prominent bankruptcy systems used around the world: instant liquidation (eg. Sweden), creditor friendly (eg. UK), debtor friendly (eg. US) and neutral (where control goes to a third party under bankruptcy). I want to see how each system, when coupled with a corporate taxation law, impacts firm investment, capital structrue choice and liquidation/continuationd ecsion. Bankruptcy literature has traditionally gravitated toward studying the interplay of bankruptcy systems with market imperfections ((Giammarino (1989), White (1994), Mooradian (1994), Bernhardt and Nosal (2005), Gennaioli and Rossi (2011)). This include both ex-ante ineefciencies and ex-post inefcciencies of bankruptcy. We contribute to this literature by considering the role of free cash flow (it is the main comonent of ex-ante inefciencies in our model) and incomplete contract /behavioural finance elemnts more specifically reference points and shading activities which is the main component of ex-post bankruptcy ineffciency in our model.

Grossman and Hart (1982) and Jensen (1986) argue that the usage of debt financing can be used to mitigate the tendency for "empire-building". Jensen

[1] Also see Miglo (2007, 2010a and b, 2020) for discussions related to different justifications of corporate taxes related to firm capital structure policies.

(1986, 1989) argued that debt financing is an effective way to resolve agency problems between managers and investors: It would limit managerial discretion by minimizing the "free cash-flow" available to managers and thus provide protection to investors. Sometimes in literature this idea is referred to as "debt and discipline" theory.[2] As we know, using debt as a major source of financing incurs substantial costs of financial distress. Firms may face direct bankruptcy costs or indirect costs in the form of debt-overhang or asset substitution. To reduce the risk of financial distress, it may be desirable to have the firm rely partly on equity financing. DeMarzo and Fishman (2007) consider a dynamic model where a firm's manager can divert the firm's cash flow. It is shown that an optimal mechanism can be implemented by combining equity, long-term debt and a line of credit.[3] Our paper adds the bankruptcy system and taxes....and aslo ...check....and the debt overhang problem as well as behavioural financ eelments to a typical free cash flow model. In such an environment firms can select between debt as a disciplinary device to mitigate the free cash flow problem as in traditional literature and another policy that includes zero debt.

Shading is related to incomplete contracts ideas (contracts as a reference point, Hart and Moore (2008)). In our model the parties may engage in some shading activities to damage the firm unhappy with the renegotiation. Examples include: entrepreneur may not share all information about the firm with new team if he is not satisfied with negotiation results; creditors are opposing the approval of some decisions etc. (see Cuwenberg and Luven (2015), Lipson (2010), janger and Levitin (2018) for more examples).

We consider a model where the government selects its bankruptcy system and the corporate tax rate. The government objective function is a sum of buisness output plus the governemnt surplus that is equal to the amount of tax minus bankruptcy costs which is in this case are not business related bankrutpocyc osts that are counted in firm's objective function but rather social costs and processing fees). Also the parts of the objective function are weighted and their weights depend on several factors including the productivity of public investments (see eg Muthov and Khan , (2017), Chattarji et al (2015), Auerbach (1989) etc.). The government faces a representitative firm. A very rough skeleton of our model can be the following. Initially the government will select its bankruptcy system out of the 4 choices above as well as its corporate tax rate. The firm has an investment project. In the first period the firm may raise funds (debt and equity) and invest into the project with some positive return. If the project succeeds, all is well and any loan the firm has is repaid. Also the owner can use the remaining cash at his discretion by invetsing in potentially ineefcient "prsonal" projects. So issuing too much equity may not be feasible for this reason. If the project fails and the firm issued equity then the shareholders lose. If it was financed with debt then the firm and the creditors can sit down to

[2] A related result is the costly state-verification theory (see Townsend, 1979, and Gale and Hellwig, 1985). It considers an environment where a firm's earnings are unobservable by investors, the verification of earnings is costly and managers can report earnings at their discretion (ex-post moral hazard).

[3] Other notable papers include Zheng (2009) and Edmans (2011).

renegotiate the loans privately. Then if no agreement is reached the firm must file for bankruptcy. After renegotiation the partues can be engaged in shading activities.

Some intuitions are as follows. In the absence of free cash problem or shading problem, the main problem for firms is underinvestment in potentially profitable stage 2 projects. To avoid underinvestment, firms will use equity. The government tax rate depends on the weight of government surplus component in the objective function but in most reasonable cases (i.e. when the weight of government component does not exceed the business component) the optimal tax rate is zero. It also minimizes the amount of ressources diverted from businesses by the government after stage 1 that reduces the amount of funds available for stage 2 investments. In the presence of free cash flow problem but in the absence of shading, two things happen. First firms need to issue debt to discipline the owner from diverting firm cash. Secodnly the government might want to use some positive tax in this case since using debt by firms increases the probabilty of bankruptcy and therefore increases poentially government bankruptcy related costs that must be covered by taxes. In most case the system that leads to lower face values of debt (and respectively lower taxes and lower probability of bankruptcy) will be selected (in fact it is system 4) since it increases investment efficiency of businesses in stage 2. More trade-offs are added when shading is a part of the model. In this case several things can happen. If shading costs are very high then in some cases system 1 can be optimal where firms are automatically liquidated in default. In most cases however there is usually a choice between System 3 and 4 and depending on the magnitude of damage from shading (that depends on the quality of corporate governnace system) and free cash flow etc. system 3 may be chosen.

The paper generates some predictions and policy recommendations about bankruptcy systems and taxation policy. In addition, it is tied to capital structure literature and helps resolve some of the controversy surrounding it.

Miglo (2024) analyzes the trade-off theory[4] of capital structure with endogenous tax rates. In the model, the government first selects tax rates and then firms with investment projects select their capital structures driven by the trade-off between expected bankruptcy costs and the effective debt tax rate advantage. The model predicts, for example, that an equlibrium often emerges where the effective tax rate debt advantage equals 0. This is consistent with recent reduction in the corporate tax rate in the US and with low/zero effective rate of debt tax advantage mentioned in recent literature.[5]

The rest of the paper is organized as follows. Section 2 introduces the model and describes some preliminaries. Section 3 analyzes the main case and provides the main results. Section 4 analyzes the model implications. The model extensions and robustness are discussed in Section 5 and Section 6 provides the conclusion.

[4] For a review of trade-off theory of capital structrue see eg. Miglo (2011) or Miglo (2016).

[5] Miglo (2021) considers a new capital structure theory that is based on 4 different factors including tax rate and bankruptcy costs.

2 The Model and Basic Results

2.1 Model description.

The government selects its bankruptcy system and the corporate tax rate. The government faces an infinite number of identical firms. A firm in this economy can be described as follows. The firm exists for two periods $T = 1, 2$ and owns an investment project. The project requires an amount of investment I. Stage 1 of the project generates earnings C_1, that can be reinvested with a rate of return g at Stage 2.[6] I is known while C_1 is risky. It is uniformly distributed between 0 and 1. We also assume that $I < \frac{1}{2}$ and $g > 0$, which implies that the project has a positive net present value at both stages. The firm belongs to the shareholders who we will call the entrepreneur. The entrepreneur is responsible for making capital structure and liquidation decisions. To finance the initial investment I, the firm can either issue debt (D) or equity (E), $I = D + E$.

Debt should be paid back at $T = 1$. Let F be the face value of debt (including principal and interest). A high amount of debt limits the firm's investment capacity. If $F > C_1$, the firm will not be able to make any investments at stage 2 (without renegotiation) and if $F < C_1$, the firm can make a full or partial investment in the second stage of the project. Financing from third parties in stage 2 is not considered. We will discuss an extension with stage 2 capital markets available in Section 5 (roughly speaking an opportunity to externally finance stage 2 helps the firm mitigate ex-post inefficiencies of default and bankruptcy by issuing senior debt, for example, but it will incease the initial cost of capital for investors in stage 1 who can rationally anticipate stage 2 scenario. So qualitaively most our conclusions are nor affected by this assumption). Under equity financing the firm sells a fraction α of firm's equity to outside investors.

The bankruptcy system design is as follows. The government should make two decsions. First in case $C_1 < F$, the firm can either be liquidated automatically (we will denote this as System 1: note that the liquidation value equals C_1) or it can be allowed to continue. If the latter is the case, 3 choices are available for the government. It can delegate control to special agency (eg bankruptcy court) (System 2), or delegate it directly to shareholders (System 3) or creditors (System 4).[7] The party in control decides whether the firm should be liquidated or continue (reorganized). If necessary it can also make a take-it-or-leave offer to another party.

The government objective function is $G = V + S$, where V is the firm value (entrepreneur's expected earnings), S is the government surplus (taxes T minus costs K related to bankruptcy -we do not include here traditional banklrutpcy costs which will affect firm value but rather government related costs such as bankruptcy court costs and social costs) subject to government budget constraint which is $T \geq K$ (we assume that each case of bankruptcy costs for the government k are lower under system 1; most cmplication arise

[6] We discuss the model assumptions and its robustness in Section 5.

[7] As was discussed in Sections 1 and 2, System 1 is similar to the bankruptcy system in Sweden, System 2 to France, System 3 to the US and System 4 to the UK.

from resolving complicated cases with renegotiation between parties involved whihc is not apart of system 1). (in the spirit of Giammarino, Lewis and Sappington (1993) etc.).

In addition the firm is facing a free cash flow problem. Free cash flow theory (Jensen, 1986) suggests that firm insiders have a tendency to overinvest if the threat of bankruptcy is not high enough (empire-building). This moral hazard problem can be mitigated if the firm uses debt as a disciplinary device. More spedcifically we assume that the parties can be involved in inefficient usage of firm ressources. These activities are non-contractible -in the spirit of moral hazard literature. More formally we model this as follows. Party(-ies) that is in control can "steel" and the firm cash flow in period 1 is $C_1 - b$, $b \leq C_1 - F$. The party who steels increases his profit by the same amount b. Since $g > 0$, "steeling" is socially ineffcient since it can be instead reinvested in a positive NPV stage 2.

In addition if the firm is operating in stage 2 after restructuring, the entrepreneur can be involved in "shading" activities under system 2 or 4 (i.e. when the entreprneur lost ful control of the frim). Shading is an activity (non-contractible -in the spirit of Hart and Moore (2008) and Hart (2017)) that makes a damage to the company and is costless for the party involved in it. Examples include: entrepreneur may not share all information about the firm with new team if he is not satisfied with negotiation results; creditors are opposing the approval of some decisions etc. (see Cuwenberg and Luven (2015), Lipson (2010), Janger and Levitin (2018) for more examples). More formally we model this as follows. The firm value in period 2 after shading is $C_1(1+g)(1-0.5\theta)$ under system 2 and $C_1(1+g)(1-\theta)$under System 4, where θ reflects the extent of shading.

Finally, firms have to pay a corporate income tax. Let t be the corporate tax rate. Payments on debt reduce the firm taxable income (Modigliani-Miller (1963), Kraus and Litzenberger (1973), Acharya et al (2011) among others). For simplicity we assume that the tax is only paid at stage 1.[8]

When choosing its capital structure, the firm faces a trade-off between the flexibility, free cash flow and shading problems and the debt tax shield. When selecting the tax rate, the government faces a trade-off between direct costs and benefits including reduced firms output and an increase in its own output as well indirect effects on firms' output through firms capital structure/steeling decisions. When selecting its bankruptcy system the government faces a trade-off between shareholders and creditors control in bankruptcy, that indirectly affects the outcome of renegotiations in case firms are in default after stage 1 that in turn affects all decisions made by firms. Everybody is risk-neutral and the risk-free interest rate is zero. The timing of events is present in Figure 1.

[8] Similar to Acharya et al (2011). We dsicuss ane xtension with stage 2 taxes in section 7. Roughtly, stage 2 tax do not have strong incentoves on parties so they do nto have a significant qualittaive implications in the model. Formally they are irrleevnt since we model second period claims after reorganization as eqyuity. Theoretically taxes could affect the outcome of renegotiation if debt cliaams would be used instead. But in general it is known that in uncoslvnecy cases taxes do not play a significant role (see, eg..).

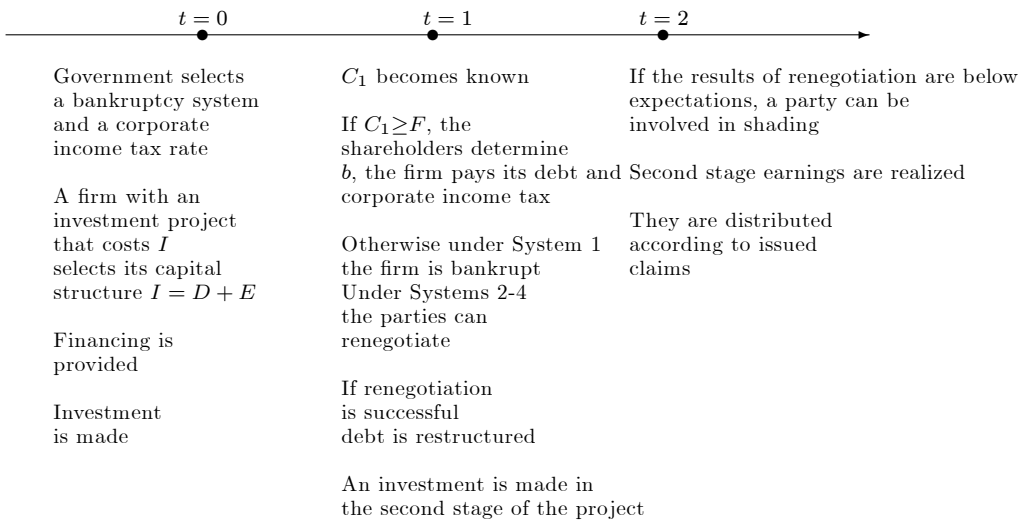

Figure 1. The sequence of events.

2.2 Perfect market.

Let us first consider a perfect market case when $t = 0$ and $k = 0$ and the firm does not face a free cash flow or shading problem. So the government maximizes V. The intuition here is that the only problem the frim faces here is potential underinvestment in a positive NPV stage 2 project. Therefore equity finanicng is optimal because it does not reduce cash after stage 1.

Lemma 1. *1) In a perfect market, the government is indifferent between different bankruptcy systems. 2) Firms optimally select equity finanincg.*

Proof. Consider first a case when the government decided to implement System 1, i.e if $C_1 < F$ the firm is automatically liquidated for the value C_1. Equity is optimal since it elliminates a debt overhang problem. The investors will be happy to provide equity financing with a fraction of equity required α such that

$$\alpha = \frac{2I}{1+g} \tag{1}$$

Indeed, the expected payment to the shareholders (recall that C_1 is uniformly distributed) equals

$$\alpha \frac{1+g}{2} \tag{2}$$

Here $\frac{1+g}{2}$ is the average amount of firm second-period profit (since $g > 0$, no dividends will be paid at the end of stage 1 and all profits will be reinvested)

so the second-period profit is uniformily distributed between 0 and $1+g$. The entrepreneur's expected profit (and the government objective function) is

$$G = V = (1-\alpha)\frac{1+g}{2} \tag{3}$$

Using (1), we can write (3) as

$$\frac{1+g}{2} - I \tag{4}$$

If instead the firm uses debt finanicng or a mix of debt and equity, then not all cash will be reinvested in stage 2 so the maximal expected profit over two stages will be less than $\frac{1+g}{2}$. The payoff to investors should be still be equal at least I so equity finanicng is optimal.

The calculations are similar for other systems (omitted for brevity).

Lemma 1 is intuitive. Under any system equity finaicing is optimal since the firm can reinvest all profit with a rate of return $g > 0$.

2.3 Corporate Income Tax.

Now consider the case when the markets are still perfect (no free cash flow or shading problem exist) but $k \geq 0$ and the government introduces a corporate income tax. The intuition here is that when there is no other imperfections, for businesses the main problem is potential underinvestment in stage 2 project. So similarly to previous section, equity financing is optimal.

Proposition 1. *In a market with corporate taxes and no free cash flow or shading problem: 1) bankruptcy system is irrelevant; optimal tax rate is sufficiently low (see Table 1); firms optimally select equity financing.*

Proof. We will proceed as follows. We will first identify the optimal tax rate for each bankruptcy system and then compare the objective function of the government under different systems. Start again with System 1. The creditors expected payoff should be equal D:

$$F(1-F) + F\frac{F}{2} = D \tag{5}$$

Here $1-F$ is the probability that $C_1 \geq F$ (recall that C_1 is uniformly distributed between 0 and 1) and F is the face value of debt that creditors recieve when $C_1 \geq F$. Respectively, F is the probaility that $C_1 < F$ and in that case the creditors get the average cash flow in that case that is equal $F/2$. The outside shareholders' payoff should be equal E:

$$(1-F)\alpha\frac{(1-F)(1+g)(1-t)}{2} = E \tag{6}$$

When $C_1 \geq F$ shareholders recieve when $(C_1 - F)(1-t)$ that is reinvested with the rate of return g in second stage project so the total payoff is $(C_1 - F)(1-t)(1+g)$. The average value of $C_1 - F$ equals $\frac{F+1}{2} - F = \frac{1-F}{2}$. When $C_1 < F$ shareholders get nothing under System 1. The entrepreneur's expected profit

equals $V = (1-F)(1-\alpha)\frac{(1-F)(1+g)(1-t)}{2}$. Taking into account (5) and (6), this equals:

$$V = \frac{(1+g)(1-t)}{2} - I + (\frac{F^2}{2} - F)((1+g)(1-t) - 1) \tag{7}$$

(7) implies $V'(F) = (F-1)((1+g)(1-t)-1)$. Since $F < 1$, two cases exist: if

$$(1+g)(1-t) \geq 1 \tag{8}$$

$V'(F) \leq 0$ and optimal $F = D = 0$.[9] In this case the firm value equals (substituting $D = 0$ into (7)):

$$\frac{(1+g)(1-t)}{2} - I \tag{9}$$

The government objective function equals:

$$G = \frac{(1+g)(1-t)}{2} - I + x\frac{1}{2}t$$

subject

$$\frac{1}{2}t \geq 0 \tag{10}$$

$G'(t) = -\frac{1+g}{2} + \frac{x}{2}$. $G'(t) = 0$ because $x = 1+g$, tax is irrelevant (i.e any tax can be used as long as (8) holds) and government objective finction is $\frac{1+g}{2} - I$.

If (8) does not hold i.e.

$$(1+g)(1-t) < 1 \tag{11}$$

firms will maximize F. According to (5) maximal F (when $D = I$) equals $F = 1 - \sqrt{1-2I}$. Then the firm value equals

$$\frac{(1+g)(1-t)}{2} - I(1+g)(1-t) \tag{12}$$

Fig.2 illustartes the firm choice of capital structrue. If tax is low (i.e condition (8) holds) firm optimally select $D = F = 0$. otherwise, a high debt is optimal.

[9] Technically when () holds as an equality, the firm is indifferent between debt levels but we assume that it selects $F = 0$ in this case. This assumption is natural in the context of ourmodel since as we saw in previous section and simplifies calculations. One can consider the case when (8) holds as equality separately. It will make calculations longer without bringing new intuions.

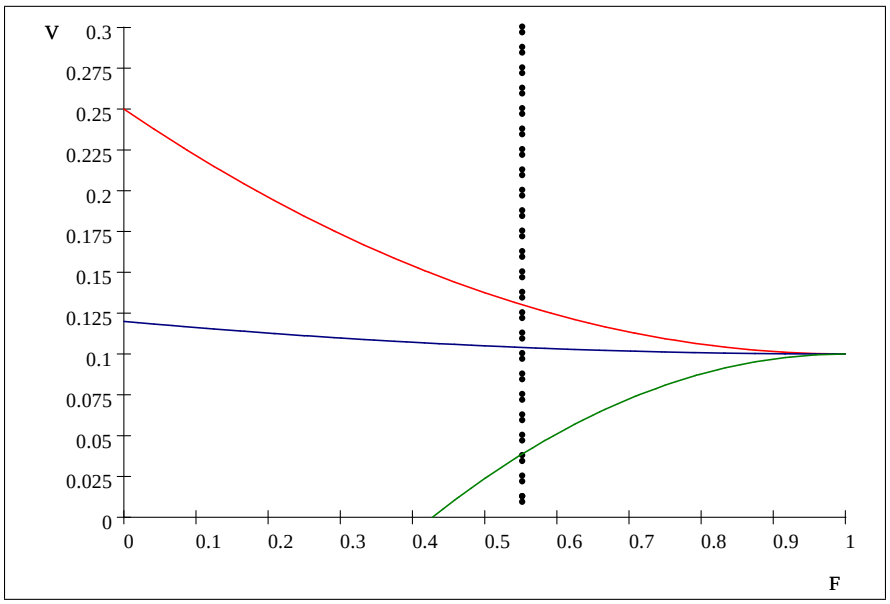

Figure 2. $g = 0.3$, $I = 0.4$. **Bold line (blue): t = 0.2. Bold line (green): t = 0.7. Bold line (red): t = 0. Dot-line (black): constraint for** F.

The government problem is to maximize:

$$G = \frac{(1+g)(1-t)}{2} - I(1+g)(1-t) + \frac{(1-F)^2 t}{2} - kF =$$

$$= \frac{(1+g)(1-t)}{2} - I(1+g)(1-t) + \frac{(1-2I)t}{2} - k(1-\sqrt{1-2I})$$

subject

$$\frac{(1-F)^2 t}{2} \geq kF$$

or

$$\frac{(1-2I)t}{2} \geq k(1-\sqrt{1-2I}) \tag{13}$$

In this problem note that in the government objective function last two terms are T and K respectively. This is because the expected amount of tax equals $\frac{(1-F)^2 t}{2}$. $1-F$ is the probability of firm success in the first period, $\frac{1-F}{2}$ is the average first-period profit conditional on firm's success in the first period and finally the total expected tax equals $\frac{(1-F)^2 t}{2}$. kF is the cost related to bankruptcy because F is the probbaility of default.

$G'(t) = -\frac{1+g}{2} + I(1+g) + \frac{x(1-2I)}{2}$. It equals zero because $x = 1+g$. The government objective function (take for example $t = 1$) equals

$$x(\frac{(1-2I)}{2} - k(1-\sqrt{1-2I})) = \frac{(1+g)(1-2I)}{2} - (1+g)k(1-\sqrt{1-2I})$$

This is less than $\frac{1+g}{2} - I$. So optimal $t < \frac{g}{1+g}$. Firms optimally select equity finanicng.

Consider system 2. Since the firm has a positive NPV investment opportunity at stage 2, the parties can renegotiate if $C_1 < F$.[10] If negotiation fails, creditors get C_1 and entrepreneur gets 0. If negotiation is successful, creditors get

$$\alpha_c C_1(1+g) \tag{14}$$

and the shareholders get

$$(1-\alpha_c)C_1(1+g) \tag{15}$$

, where α_c is the fraction of equity that belongs to creditors in exchange for their previous debt claim. The negotaion is successful: it brings a positive surplus because $g > 0$. The creditors' payoff after negotiation is $C_1 + 0.5S$, where S is the surplus from renegotiation and it equals $C_1(1+g) - C_1 = C_1 g$ and this should be equal to (14) and for shareholders it is $0.5C_1 g$ and this should be equal to (15). So $\alpha_c C_1(1+g) = C_1 + 0.5C_1 g$ and $\alpha_c = \frac{1+0.5g}{1+g}$.

Now consider the firm's capital structure choice. The creditors expected payoff should be equal D:

$$F(1-F) + F\frac{1+0.5g}{1+g}\frac{F(1+g)}{2} = D \tag{16}$$

The outside sharehodlers' payoff should be equal E:

$$(1-F)\alpha\frac{(1-F)(1+g)(1-t)}{2} + F\alpha(1 - \frac{1+0.5g}{1+g})\frac{F(1+g)}{2} = E \tag{17}$$

The entrepreneur's profit is $(1-F)(1-\alpha)\frac{(1-F)(1+g)(1-t)}{2} + F(1-\alpha)(1-\frac{1+0.5g}{1+g})\frac{F(1+g)}{2}$. Taking into acocunt (16) and (17), this equals $(1-F)\frac{(1-F)(1+g)(1-t)}{2} + F(1 - \frac{1+0.5g}{1+g})\frac{F(1+g)}{2} - E = (1-F)\frac{(1-F)(1+g)(1-t)}{2} + F\frac{F(1+g)}{2} - F\frac{1+0.5g}{1+g}\frac{F(1+g)}{2} - E = (1-F)\frac{(1-F)(1+g)(1-t)}{2} + F\frac{F(1+g)}{2} - (D - F(1-F)) - E =$

$= \frac{(1+g)(1-t)}{2} - I - F(1+g)(1-t) + \frac{F^2(1+g)(1-t)}{2} + F\frac{F(1+g)}{2} + F(1-F) = \frac{(1+g)(1-t)}{2} - I + F(1-(1+g)(1-t)) + \frac{F^2((1+g)(2-t)-2)}{2}$.

Two cases are possible.

1) $(1+g)(2-t) > 2$. Then $V(F)$ is a convex function (the second derivative in F is positive) so the optimal F is either $F = 0$ or the maximal possible F (i.e when $D = I$) (see red line in Fig. 3). In the former case the firm value equals $\frac{(1+g)(1-t)}{2} - I$ and in the latter case it is $\frac{(1+g)(1-t)}{2} - I + F_2(1-(1+g)(1-t)) + \frac{F_2^2((1+g)(2-t)-2)}{2}$, where F_2 is the maximal possible F (i.e when $D = I$) that is $F_2 = \frac{1-\sqrt{1-2I+gI}}{1-0.5g}$ (follows from cond (16)). It means that optimal $F = 0$ if $t < t_2$ and $F = F_2$ if $t > t_2$, where $t_2 = \frac{2g(1-F_2)}{(1+g)(2-F_2)} = \frac{2g(\sqrt{1-2I+gI}-0.5g)}{(1+g)(1-g+\sqrt{1-2I+gI})}$.

[10] Although theoretically it is possble to consider renegotiation when $C_1 > F$ but we assume that in a good state it is a large corporateions with many debts so in a good state payments are made an no negotiation takes place.

Intuitively a higher tax rate provides more incentive to issue debt and use the tax shield.

2) $(1+g)(2-t) < 2$. Then $V(F)$ is concave. Then we have $1-g > (1+g)(1-t)$. Then also $1 > (1+g)(1-t)$ that means that the extremum of $V(F)$ is $F = \frac{1-(1+g)(1-t)}{1-g-(1+g)(1-t)} > 1$ so optimal F for the firm is the maximal possible F (i.e when $D = I$) that is $F_2 = \frac{1-\sqrt{1-2I+gI}}{1-0.5g}$.

In Fig. 3 horizonal axes represents debt face values and on y-axis is the firm's value. Vertical doted lines correspond to debtholders budget constraints for System 2. Fig. 3 demonstrates that firm incentive changes with t. Hiher t provides more incentive for selecting high debt (debt tax shield). Also note that when $t = 0$, optimal $D = F = 0$.

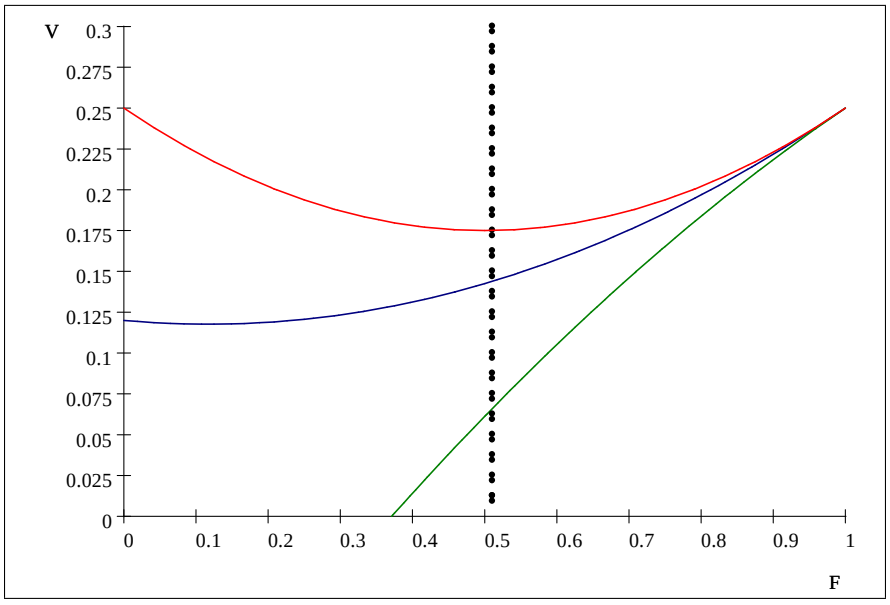

Figure 3. $g = 0.3$, $I = 0.4$. **Bold line (blue): t = 0.2. Bold line (green): t = 0.7. Bold line (red): t = 0. Dot-line (black): constraint for** F.

In fact it can be shown that the firm value under system 2,3 and 4 are identical (in the absence of moral hazard, surplus from renegotiation is ideantically positive regardless who has the power so the negotiation is always successful and firm overall values are identical).[11] However investors' budget constraints are different. Debt face value is highest under system 3 and lowest under system 4.

Note that condition $(1+g)(2-t) < 2$ above can be rewritten as $t > t_2' = \frac{2g}{1+g}$. Also note that $t_2 < t_2'$ (because $g < 2$). Therefore under System 2 the government problem becomes to maximize its objective function that equals (when firms select high debt):

$$G_H = \frac{(1+g)(1-t)}{2} - I + F(1-(1+g)(1-t)) + \frac{F^2((1+g)(2-t)-2)}{2} + \frac{(1-F)^2 t}{2} - kF =$$

[11] The calculations are omitted for brevity.

$$= \frac{(1+g)(1-t)}{2} - I + \frac{1-\sqrt{1-2I+gI}}{1-0.5g}(1-(1+g)(1-t)) + \frac{(\frac{1-\sqrt{1-2I+gI}}{1-0.5g})^2((1+g)(2-t)-2)}{2} +$$

$$+ \frac{(1-\frac{1-\sqrt{1-2I+gI}}{1-0.5g})^2 t}{2} - k\frac{1-\sqrt{1-2I+gI}}{1-0.5g}$$

subject to

$$\frac{(1-\frac{1-\sqrt{1-2I+gI}}{1-0.5g})^2 t}{2} \geq k\frac{1-\sqrt{1-2I+gI}}{1-0.5g}$$

and condition $t > t_2$ or

$$t \geq \frac{2g(\sqrt{1-2I+gI}-0.5g)}{(1+g)(1-g+\sqrt{1-2I+gI})}$$

The government objective function equals (when firms select no debt ($D = 0$)):

$$G_L = \frac{(1+g)(1-t)}{2} - I + x\frac{t}{2}$$

subject to

$$\frac{t}{2} \geq 0$$

and condition $t < t_2$ or

$$t \leq \frac{2g(\sqrt{1-2I+gI}-0.5g)}{(1+g)(1-g+\sqrt{1-2I+gI})}$$

In the latter case $G'_L(t) = -\frac{1+g}{2} + \frac{x}{2}$. If $x < 1+g$, $G'_L(t) < 0$ and optimal $t = 0$ and the government objective function equals $\frac{1+g}{2} - I$. In the fomer case $G'_H(t) = -\frac{1+g}{2} + \frac{1-\sqrt{1-2I+gI}}{1-0.5g}(1+g) - \frac{(\frac{1-\sqrt{1-2I+gI}}{1-0.5g})^2(1+g)}{2} + x\frac{(1-\frac{1-\sqrt{1-2I+gI}}{1-0.5g})^2}{2}$. In the latter case $G'_L(t) = 0$ and optimal $t \leq \frac{2g(\sqrt{1-2I+gI}-0.5g)}{(1+g)(1-g+\sqrt{1-2I+gI})}$ and the government objective function equals $\frac{1+g}{2} - I$. In the fomer case $G'_H(t) = 0$ as well and optimal $t \geq \frac{2g(\sqrt{1-2I+gI}-0.5g)}{(1+g)(1-g+\sqrt{1-2I+gI})}$ and the government objective function equals $-I + \frac{1-\sqrt{1-2I+gI}}{1-0.5g} - \frac{(\frac{1-\sqrt{1-2I+gI}}{1-0.5g})^2}{2} + (1+g)(\frac{(1-\frac{1-\sqrt{1-2I+gI}}{1-0.5g})^2}{2} - k\frac{1-\sqrt{1-2I+gI}}{1-0.5g})$. This is less than $\frac{1+g}{2} - I$. So optimal $t = 0$. In this case firms optimally select equity finanicng and the government objective function equals $\frac{1+g}{2} - I$.

As was previously mentioned, calculations for sytem 3 and 4 are similar so they are omitted for breovity (results are summarized in the table below.).

Finally we have to cpmpare different systems. The above analyis leads to the folowing.

Table 1. Firms optimal tax rate and fiirm capital structure when $x = 1+g$.

System	Optimal tax rate	Firms capital structure	Government objective function
1	$t < \frac{g}{1+g}$	equity	$\frac{1+g}{2} - I$
2	$t < \frac{2g(\sqrt{1-2I+gI}-0.5g)}{(1+g)(1-g+\sqrt{1-2I+gI})}$	equity	$\frac{1+g}{2} - I$
3	$t < \frac{2g\sqrt{1-2I}}{(1+g)(1+\sqrt{1-2I})}$	equity	$\frac{1+g}{2} - I$
4	$t < \frac{2g\sqrt{1-2I(1-g)}}{(1+g)(1-g+\sqrt{1-2I(1-g)})}$	equity	$\frac{1+g}{2} - I$

As folows from Table 1 bankruptcy system is irrelevant. Taxes should sufficiently small.

2.4 Free Cash Flow.

Now consider the case without tax (and also $k = 0$) or shading problems but with a free cash flow problem.[12]

Proposition 2. *1) In a market with a free cash flow problem and no taxes and no shading problem, the government selects bankruptcy system 4. 2) Firms optimally select a mix of debt and equity financing; 3)* $\alpha = g/(1+g)$.

Proof. Consider system 1. Consider cash diversion by the entrepreneur. Let b be the amount of diverted cash. 1. $C_1 \geq F$. Then the entrepreneur's payoff is: $V = b + (1-\alpha)(C_1 - b - F)(1+g)$. $V'(b) = 1 - (1-\alpha)(1+g)$. Two cases are possible.

$$(1-\alpha)(1+g) \geq 1 \tag{18}$$

Then optimal $b = 0$ and the entrepreneur's payoff is $V = (1-\alpha)(C_1 - F)(1+g)$. 2) (18) does not hold. Then optimal $b = C_1 - F$ and the entrepreneur's payoff is $V = C_1 - F$.

2. $C_1 < F$. Then the entrepreneur's payoff is 0.

Now consider the capital structrue choice.

The creditors expected payoff should be equal D:

$$F(1-F) + F\frac{F}{2} = D \tag{19}$$

The outside shareholders' payoff (If $C_1 \geq F$ then outside shareholders' payoff equals $V_0 = \alpha(C_1 - F - b)$; if $C_1 < F$ then outside shareholders' payoff equals 0 under System 1) should be equal E. If $(1-\alpha)(1+g) < 1$ (i.e. $\alpha > \frac{g}{1+g}$) then their payoff is zero because $b = C_1 - F$. So this case is not feasible.

If $\alpha < \frac{g}{1+g}$ then the outside shareholders' payoff

$$(1-F)\alpha\frac{(1-F)(1+g)}{2} = E \tag{20}$$

[12] Steeling is not the same as dividends since the firm does not pay taxes on stolen funds. We keep dividends outside of thos rrsearch (more dicussion is provided later). Free cash flow problem is more intersting with regard to analyzing government incentive snce it is related to taxes (see eg...) etc.

The entrepreneur's expected profit equals $V = (1-F)(1-\alpha)\frac{(1-F)(1+g)}{2}$. Taking into account (19) and (20), this equals:

$$V = \frac{1+g}{2} - I + g(\frac{F^2}{2} - F) \tag{21}$$

(21) implies $V'(F) = g(F-1)$. Since $F < 1$ and $g > 0$, $V'(F) < 0$ and so F should be minimized as much as possible. It means optimal $\alpha = \frac{g}{1+g}$ and $F = 1 - \sqrt{\frac{2E}{g}} = 1 - \sqrt{\frac{2(I-D)}{g}}$. In this case (using (20)) we find that

$$F = 1 - \sqrt{\frac{1-2I}{1-g}}$$

and the firm value equals:

$$\frac{1+g}{2} - I + g(\frac{F^2}{2} - F) = \frac{1+g}{2} - I + g(1 - \sqrt{\frac{1-2I}{1-g}})(\frac{1 - \sqrt{\frac{1-2I}{1-g}}}{2} - 1) \tag{22}$$

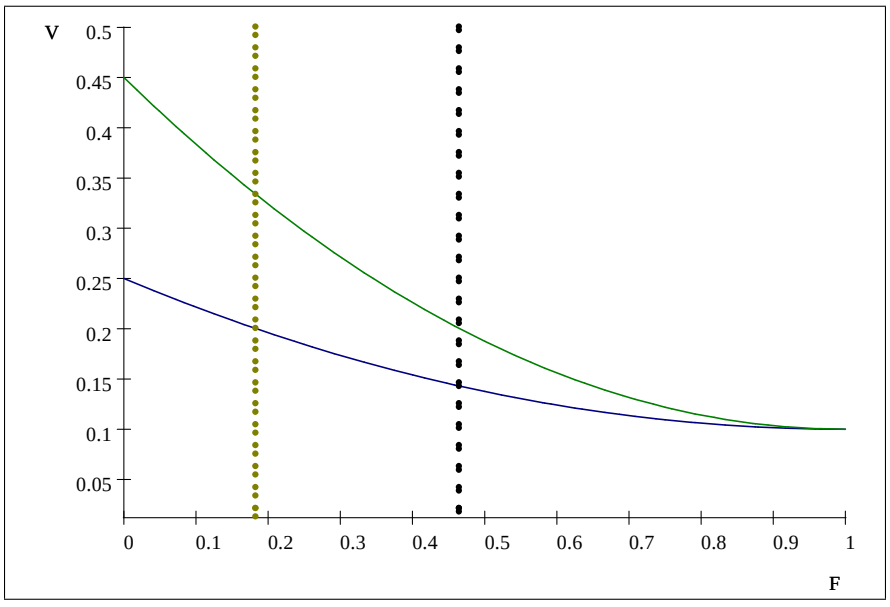

Figure 4. $I = 0.4$. **Bold line (blue):** V_1 **when** $g = 0.3$**. Bold line (green):** V_1 **when** $g = 0.7$**. Dot-line (brown): constraint for** F **when** $g = 0.3$**. Dot-line (black): constraint for** F **when** $g = 0.7$**.**

Fig. 3 illustrates firms capital structrue choice. V(F) is decreasng howver, there is constarint (disctated by free cahs problem) (), so F should be suffiecntly high (vertical lines denote the minimal threshold). As one can see, optimal $F = 1 - \sqrt{\frac{1-2I}{1-g}}$.

The government objective function equals:

$$G_2 = \frac{1+g}{2} - I + g(1 - \sqrt{\frac{1-2I}{1-g}})(\frac{1-\sqrt{\frac{1-2I}{1-g}}}{2} - 1)$$

Consider system 2. Consider steeling decision by the entrepreneur. 1. $C_1 > F$. Similarly to previous sytem, if (18) does not hold then optimal $b = C_1 - F$ and the entrepreneur's payoff is $V = C_1 - F$. otherwise optimal $b = 0$ and the entrepreneur's payoff is $V = (1-\alpha)(C_1 - F)(1+g)$. 2. $C_1 < F$. First consider the renegotiation. Since the firm has positve NPV investment opportunity at stage 2 and the parties can renegotiate. Then if negotiation fails, creditors get C_1 and entrepreneur gets 0. If negotiation is successful, creditors get

$$\alpha_c C_1(1+g) \tag{23}$$

and the shareholders get

$$(1-\alpha_c)C_1(1+g) \tag{24}$$

, where α_c is the fraction of equity that belongs to creditors in exchange for their previous debt claim. The negotaion is successful: it brings a positive surplus because $g > 0$. The creditors' payoff after negotiation is $C_1 + 0.5C_1 g$ and this should be equal to (14) and for shareholders it is $0.5C_1 g$ and this should be equal to (15). So $\alpha_c C_1(1+g) = C_1 + 0.5C_1 g$ and $\alpha_c = \frac{1+0.5g}{1+g}$.

Now consider capital strcutrue choice. Two cases are possible.

1. $(1-\alpha)(1+g) \geq 1$. The creditors total payoff should be equal D:

$$F(1-F) + F\frac{1+0.5g}{1+g}\frac{F(1+g)}{2} = D \tag{25}$$

The outside sharehodlers' payoff should be equal E:

$$(1-F)\alpha\frac{(1-F)(1+g)}{2} + F\alpha(1 - \frac{1+0.5g}{1+g})\frac{F(1+g)}{2} = E \tag{26}$$

The entrepreneur's profit is

$$(1-F)(1-\alpha)\frac{(1-F)(1+g)}{2} + F(1-\alpha)(1 - \frac{1+0.5g}{1+g})\frac{F(1+g)}{2}$$

Taking into acocunt (25) and (26), this equals $(1-F)\frac{(1-F)(1+g)}{2} + F(1 - \frac{1+0.5g}{1+g})\frac{F(1+g)}{2} - E = (1-F)\frac{(1-F)(1+g)}{2} + F\frac{F(1+g)}{2} - F\frac{1+0.5g}{1+g}\frac{F(1+g)}{2} - E =$

$= (1-F)\frac{(1-F)(1+g)}{2} + F\frac{F(1+g)}{2} - (D - F(1-F)) - E = (1-F)\frac{(1-F)(1+g)}{2} + F\frac{F(1+g)}{2} + F(1-F) - I$.

This is a convex function. Optimal F is either the minimal one or the maximal one. The fromer can be found as follows. Because of (26) F is minimized when $\alpha = \frac{g}{1+g}$. In this case (using (25)) we find that

$$(1-F)\alpha\frac{(1-F)(1+g)}{2} + F\alpha(1 - \frac{1+0.5g}{1+g})\frac{F(1+g)}{2} = E = I - D$$

or

$$(1-F)^2\frac{g}{2}+F^2\frac{g^2}{4(1+g)}=I-F(1-F)-F^2\frac{1+0.5g}{2} \tag{27}$$

The maximal value of debt (similar to..) is $F_2=\frac{1-\sqrt{1-2I+gI}}{1-0.5g}$. Firm value is

$$V_{21}=\frac{1+g}{2}-I+g(F^2-F) \tag{28}$$

The government objective function equals:

$$G=\frac{1+g}{2}-I+g(F^2-F)$$

2. $(1-\alpha)(1+g)<1$
The creditors total payoff should be equal D:

$$F(1-F)+F\frac{1+0.5g}{1+g}\frac{F(1+g)}{2}=D \tag{29}$$

The outside sharehodlers' payoff should be equal E:

$$F\alpha(1-\frac{1+0.5g}{1+g})\frac{F(1+g)}{2}=E \tag{30}$$

The entrepreneur's profit is

$$(1-F)\frac{(1-F)}{2}+F(1-\alpha)(1-\frac{1+0.5g}{1+g})\frac{F(1+g)}{2}$$

Taking into acocunt (29) and (30), this equals $(1-F)\frac{(1-F)}{2}+F(1-\frac{1+0.5g}{1+g})\frac{F(1+g)}{2}-E=(1-F)\frac{(1-F)}{2}+F\frac{F(1+g)}{2}-F\frac{1+0.5g}{1+g}\frac{F(1+g)}{2}-E=$

$=(1-F)\frac{(1-F)}{2}+F\frac{F(1+g)}{2}-(D-F(1-F))-E=(1-F)\frac{(1-F)}{2}+F\frac{F(1+g)}{2}+F(1-F)-I$.

$V'(F)>0$ so F should be maximized as much as possible. It means optimal $\alpha=\frac{g}{1+g}$ and $F=\frac{2}{g}\sqrt{E(1+g)}=\frac{2}{g}\sqrt{(I-D)(1+g)}$. In this case (using ()) we find that

$$F=1-\sqrt{1-2I}$$

. and the firm value equals:

$$V_{22}=\frac{1}{2}-I+\frac{gF^2}{2}=\frac{1}{2}-I+\frac{g(1-\sqrt{1-2I})^2}{2} \tag{31}$$

This is less compared to the case with a=g/1+g.

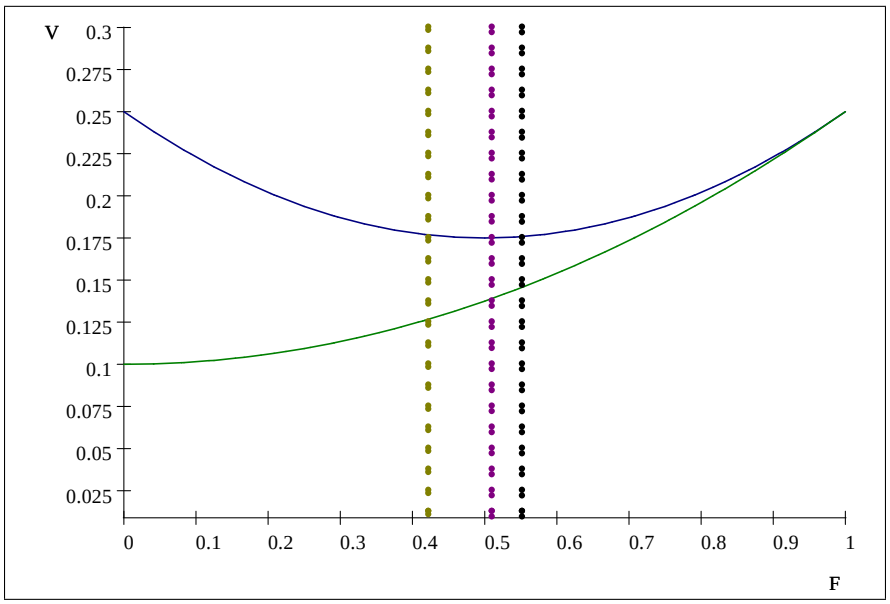

Figure 10. $g = 0.3$, $I = 0.4$. **Bold line (blue): V_{21}. Bold line (green): V_{22}. Dot-line (brown): minimal constraint for F when V_{21}. Dot-line (purple): maximal constraint for F when V_{21}. Dot-line (black): constraint for F when V_{22}.**

Optimal solution for the firm will be $\alpha = \frac{g}{1+g}$ and F==.. so V21 (no steeling).

The government objective function equals:

$$G = \frac{1+g}{2} - I + g(F^2 - F)$$

and F is the solution of (27).

It can be shown similalry (calculations are omitted fro brevity) that in the case of System 3, $\alpha_c = \frac{1}{1+g}$ and the condition (16) becomes $F(1-F) + F\frac{1}{1+g}\frac{F(1+g)}{2} = D$. And for syetm 4,..It can be shown similalry (calculations are omitted fro brevity) that in the case of System 4, $\alpha_c = 1$ and the condition (16) becomes $F(1-F) + F\frac{F(1+g)}{2} = D$.(detailed calculations are oniited for brevity).

Now we need to comapre different systems.

Table 2. Firms optimal tax rate and fiirm capital structure.

System	Firms capital structure	Government objective function
1	$\alpha = \frac{g}{1+g}$; $F = 1 - \sqrt{\frac{1-2I}{1-g}}$	$\frac{1+g}{2} - I + g(1 - \sqrt{\frac{1-2I}{1-g}})(\frac{1-\sqrt{\frac{1-2I}{1-g}}}{2} - 1)$
2	$\alpha = \frac{g}{1+g}$; $F = F_2$	$\frac{1+g}{2} - I + g(F_2^2 - F_2)$
3	$\alpha = \frac{g}{1+g}$; $F = F_3$	$\frac{1+g}{2} - I + g(F_3^2 - F_3)$
4	$\alpha = \frac{g}{1+g}$; $F = F_4$	$\frac{1+g}{2} - I + g(F_4^2 - F_4)$

F_2 is the solution of the following equation: $(1-F)^2\frac{g}{2} + F^2\frac{g^2}{4(1+g)} = I - F(1-F) - F^2\frac{1+0.5g}{2}$.

F_3 is the solution of the following equation: $(1-F)^2\frac{g}{2} + F^2\frac{g^2}{2(1+g)} = I - F(1-F) - F^2\frac{1}{2}$.

F_4 is the solution of the following equation: $(1-F)^2\frac{g}{2} = I - F(1-F) - F\frac{F(1+g)}{2}$.

So to sumarize. Under any system there are two possible scenario: one where the entrepreneur steels in equilibrium and one where he does not. In the latter case, the firm value is a convex function and there are potnetially two scenarios one with a relatively low debt (when $\alpha = g/(1+g)$) and one with high debt (when $\alpha = 0$). The first scenario is better since in the absence of taxes the problem for sharehodlers (as long as long free cash flow problem is solved) is to maximize the amount of funds reinvetsed in stage 2. Lower debt leaves more resosurces available for reinvestment. So the scenario withoth lower debt is prefeerd. Noew the former case with steleing is not optimal. Investors rationally anticipate steeling an dthere fore with ask for higher debt face value exa-nte or highe fraction of equity etc. This reduces ressources available for stage 2 investments. So for each system the best scenario is $\alpha = g/(1+g)$. Which system is better for the government? The firm value is maximized under system 4. The reason again is that under system 4 the face value of debt is lower so more ressources remains for stage 2 investments.

2.5 Shading

Now consider the case with a shading problem but without taxes and free cash flow problem.

Proposition 3. *1) In a market with shading, no taxes and no free cash flow problem, the government is indifferent between different bankruptcy systems. 2) Firms optimally select equity financing.*

Proof. Under any system, there is no shading, if equity financing is selected. It is optimal since there is no tax and so debt does not provide any tax benefits for businesses. Furthermore equity does not limit the firm ability ro invest in Stage 2.

3 Main case: a market with taxes, free cash flow and shading problems.

Now consider the main case when firms are facing a free cash flow problem and the government uses a corporate income tax. We first consider the case where only three systems are available for the government (System 1, 3 and 4-System 2 will be discussed later) and that only entrepreneur can be involved in "steeling" firm ressources, i.e $\theta_2 = 0$.

Proposition 4. *Let $g_1 = \frac{\theta}{1+\theta}$. If $g > g_1$ then: 1) there exists k_1 such that If $k > k_1$ then System 1 is optimal and $t = t_1$; firms select a mixture of*

debt and equity finanicng; 2) if $k < k_1$ then there exist θ_1 and θ_2 such that if $\theta < \theta_1$, System 4 is optimal and $t = t_1$; if $\theta_1 < \theta < \theta_2$, System 2 is optimal and $t = t_2$; if $\theta > \theta_2$, System 3 is optimal and $t = t_3$ and $t_1 < t_2 < t_3$. Firms select a mixture of debt and equity financing.

Proof. Sketch of proof. If k is very large, System 1 is optimal because it has smaller bankruptcy costs. Otherwise, it depends on θ. If θ is relatively small, then shading is relatively unimportant compared to free cash flow and underinvestment problem and then similalry to section 2.4. System 4 is optimal since under this sytem the face value of debt is smallest so the bankruotcyc osts are minimized and underinvestment extent is minimized. If θ is large then System 3 is optimal since it minimizes shading extent.

For our analysis two conditions are crucial namely the condition (8) and the following condition that is crucial for the likelihood of negotiation success: $(1+g)(1-\theta) > 1$ as we will see further. Let $g_1 : (1+g_1)(1-\theta) = 1$ and $t_1 : (1+g_1)(1-t_1) = 1$. So we have:

$$g_1 = \frac{\theta}{1-\theta} \tag{32}$$

$$t_1 = g_1 \tag{33}$$

Consider $g > g_1$. Then we have $(1+g)(1-\theta) > 1$.

Consider System 1. Consider cash flow diversion decision by the entrepreneur. Let b be the amount stolen. 1. $C_1 \geq F$. Then the entrepreneur's payoff is: $V = b + (1-\alpha)(C_1 - b - F)(1+g)(1-t)$. $V'(b) = 1 - (1-\alpha)(1+g)(1-t)$. Two cases are possible. If

$$(1-\alpha)(1+g)(1-t) \geq 1 \tag{34}$$

Then optimal $b = 0$ and the entrepreneur's payoff is $V = (1-\alpha)(C_1 - F)(1+g)(1-t)$. If (34) does not hold, optimal $b = C_1 - F$ and the entrepreneur's payoff is $V = C_1 - F$. 2) $(1-\alpha)(1+g)(1-t) \geq 1.2$. $C_1 < F$. Then the entrepreneur's payoff is 0.

Now consider firm capital structrue choice.

The creditors expected payoff should be equal D:

$$F(1-F) + F\frac{F}{2} = D \tag{35}$$

The outside shareholders' payoff should be equal E. If (34) does not hold, i.e. $\alpha > 1 - \frac{1}{(1+g)(1-t)}$ then the outside shareholders' payoff is zero so this case is not feasible under system 1. If (34) holds and $\alpha < 1 - \frac{1}{(1+g)(1-t)}$ then the outside shareholders' payoff

$$(1-F)\alpha\frac{(1-F)(1+g)(1-t)}{2} = E \tag{36}$$

The entrepreneur's expected profit equals $V = (1-F)(1-\alpha)\frac{(1-F)(1+g)(1-t)}{2}$. Taking into account (35) and (36), this equals: $(1-F)\frac{(1-F)(1+g)(1-t)}{2} - E =$

$(1-F)\frac{(1-F)(1+g)(1-t)}{2}+F(1-F)+F\frac{F}{2}-D-E=(1-F)\frac{(1-F)(1+g)(1-t)}{2}+F(1-F)+F\frac{F}{2}-I=\frac{(1+g)(1-t)}{2}-F(1+g)(1-t)+\frac{F^2(1+g)(1-t)}{2}+F(1-F)+F\frac{F}{2}-I$

$$V=\frac{(1+g)(1-t)}{2}-I+\frac{F^2((1+g)(1-t)-1)}{2}+F(1-(1+g)(1-t)) \quad (37)$$

(37) implies $V'(F)=((1+g)(1-t)-1)(F-1)$. (34) implies $(1+g)(1-t)>1$ because $0\leq\alpha<1$. Since $F<1$, $V'(F)<0$ and so F should be minimized as much as possible. It means optimal $\alpha=1-\frac{1}{(1+g)(1-t)}$ and $F=1-\sqrt{\frac{2E}{(1+g)(1-t)-1}}=1-\sqrt{\frac{2(I-D)}{(1+g)(1-t)-1}}$. In this case (using (35)) we find that

$$1-2F+F^2=\frac{2(I-F+\frac{F^2}{2})}{(1+g)(1-t)-1}$$

The government objective function (low debt) equals:

$$G_L=\frac{(1+g)(1-t)}{2}-I+\frac{F^2((1+g)(1-t)-1)}{2}+F(1-(1+g)(1-t))+\frac{(1-F)^2t}{2}-kF$$

subject to

$$\frac{(1-F)^2t}{2}\geq kF$$

Consider system 3. Calculations are similar. Furthermore the firm value function is determined by () same as with system 2 but the budget constarint for creditos is different, i.e

$$F(1-F)+F\frac{1}{1+g}\frac{F(1+g)}{2}=D \quad (38)$$

and respectively equation determining optimal debt is different

$$(1-\frac{1}{(1+g)(1-t)})\frac{(1-F)^2(1+g)(1-t)}{2}+(1-\frac{1}{(1+g)(1-t)})\frac{F^2g}{2}=I-F(1-F)-\frac{F^2}{2} \quad (39)$$

although in this case too optimal $\alpha=1-\frac{1}{(1+g)(1-t)}$.

The government objective function equals:

$$G=\frac{(1+g)(1-t)}{2}+\frac{F^2((1+g)(2-t)-2)}{2}+F(1-(1+g)(1-t))-I+\frac{(1-F)^2t}{2}-kF$$

Consider system 4. Calculations are similar. Furthermore the firm value function is determined by () same as with system 2 but the budget constarint for creditos is different, i.e

$$F(1-F)+F\frac{F(1+g)(1-\theta)}{2}=D \quad (40)$$

and respectively equation determining optimal debt is different

$$\frac{(1-F)^2((1+g)(1-t)-1)}{2}=I-F(1-F)-\frac{F^2(1+g)(1-\theta)}{2}$$

although in this case too optimal $\alpha = 1 - \frac{1}{(1+g)(1-t)}$.

The government objective function equals:

$$G = (1-F)\frac{(1-F)(1+g)(1-t)}{2} + F\frac{F(1+g)(1-\theta)}{2} + F(1-F) - I + \frac{(1-F)^2 t}{2} - kF$$

We first argue that when θ is relatively small, System 4 is the best. Indeed consider an extreme case $\theta = 0$. The firm value function can be writtemn (for any system 2-4) as

$$(1-F)\frac{(1-F)(1+g)(1-t)}{2} + F\frac{F(1+g)}{2} + F(1-F) - I \tag{41}$$

and the government objective function equals

$$G = (1-F)\frac{(1-F)(1+g)(1-t)}{2} + F\frac{F(1+g)}{2} + F(1-F) - I + \frac{(1-F)^2 t}{2} - kF \tag{42}$$

(42) can be written as $\frac{1+g}{2} - \frac{gt}{2} + \frac{F^2 g(1-t)}{2} - Fg(1-t) - \frac{t}{2} + Ft - \frac{F^2 t}{2} + \frac{(1-F)^2 t}{2} - kF$. Here the amount of tax is value neutral since it reduces the firm value by elevating the government function at the same time. Next we have a loss form underinvestment ($\frac{F^2 g(1-t)}{2} - Fg(1-t)$). This part decreases with F and also a part related to governemnt related bankrutpyc ossts $-kF$ that also decreases with F. So the best situation is the one under which F is minimal. This is sytem 4 since it goves the creditors highest riggths in renegotiation and there they do not require as high face value of debt as under othe systems.

Now when θ increases governemt function with system 4 remains the same (it does not depend on θ) but it decreases with θ for sytem 2 and 3. Highest rate of decrase is for system 3 because the extent of shadong is highest under this system. So graphically we have this.

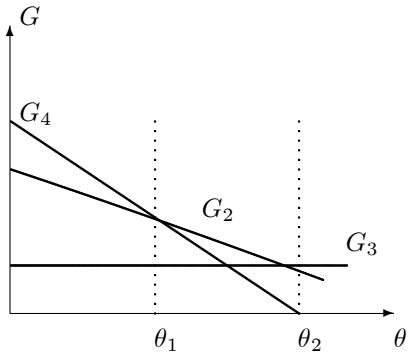

Figure 1. θ and government objective functions.

4 The Model Implications.

The model predicts the following. First consider developed countries, i.e when $g \geq x - 1$ (so the weight of governemnt role is relatively low compared to the rates of growth). It can be related to the quality of corporate governance/bureacracy/market development etc. In this case we have that if tax rate is very low it can be combined with any bankruptcy system since firms will optimally select equity finanicng. When tax rate is low the benefits from tax shield are smaller than potential loss from debt overhand. Intermediate level of taxes should be combined with creditors-friendly system. In fact this is smth. we observe in the UK. Under high level of taxes, shareholders friendly system prevail (smth like US). Although this prediction has not been directly tested it seems to be consistent with observed eveidence.

Secondly for developing countries, the model predicts that it is rarely shareholders' friendly system.

Table 2. Optimal bankruptcy system and tax rate choice for $g \geq x - 1$

Cases	Optimal bankruptcy system	Optimal tax rate
Case 1: $k \geq k_1$	System 1	
Case 2: $k \leq k_1$ Subcases:		
$\theta < \theta_1$	System 4	low
$\theta_1 < \theta < \theta_2$	System 2	medium
$\theta > \theta_2$	System 3	high

Our model also generates some predictions about capital structure choice. Given that in many cases in our model, firm value is convex, it contrasts traditional trade-off theory where the value of the firm is usually a concave function of leverage. This provides an explanation for a zero-leverage puzzle discovered relatively recently (see, for example, Strebulaev and Yang (2013)).

Our results are consistent with some recent empirical evidence. For example, the model predicts that a system with automatic liquidation (System 1) is not necessailty optimal and that System 3 and 4 can be benefitial for the economy. Rodano, Serrano-Velarde and Tarantino (2015) exploit the the 2005–2006 Italian bankruptcy law reforms. A 2005 reform introduces reorganization procedures facilitating loan renegotiation.

Also in our model, creditors-friendly system leads to lower interest rates compared to System 3 and often leads to a better outcome. Rodano et al (2015) show that the 2006 reform subsequently strengthens creditor rights in liquidation. They find that the first reform increases interest rates and reduces investment. The second reform reduces interest rates and spurs investment. Also Davydenko and Franks (2008) find that large differences in creditors' rights across countries lead banks to adjust their lending and reorganization practices to mitigate costly aspects of the bankruptcy law. In particular, in response to weak legal protection, French banks demand higher levels of collateral per dollar of debt at loan origination. However, the adjustments by creditors do not

eliminate the effect of bankruptcy codes on outcomes of default. Davydenko and Franks find that the creditor recovery rate is still the highest in the UK (92%) and the lowest in France (56%). Claessens and Klapper (2005) also find that bankruptcy filings, which indicate the usage of the bankruptcy system, are more frequent in countries with stronger legal protection of creditor rights.

McGowan and Anrews (2016) suggest that creditors-friendly system can be required in developing countries where corporate governance system is weak. This is consistent with our findings that when θ_1 is high, system 3 is never optimal while system 4 is more often optimal. As long as the quality of governance improves, system 3 can become optimal. It is the case in our model too when θ_1 becomes relatively low.

Blazy, Petey and Weill (2017) do not confirm any superiority of one family of insolvency system over another, but rather stress the importance of an appropriate design of the procedures, especially regarding the incentives they create before and after insolvency filing. This is consustent with the spirit of findings in our paper where different system emerge as optimal ones.

Favara, Morellec, Schroth and Valta (2016) argue that the prospect of an imperfect enforcement of debt contracts in default reduces shareholder-debtholder conflicts and induces leveraged firms to invest more and take on less risk as they approach financial distress. In our case, the model with less creditor rights (can be interpreted as a system with weak creditors rights enforcement) is System 3. This system can be optimal in some cases. On the other hand note that Favara et al (2016) do not specifically analyze the government choice of differnet systems but rather focus on firm choice analysis that depend on existing system in the country.

Jiang, Li, and Wang (2012) examine the role of hedge funds in Chapter 11 bankruptcies. They show that hedge fund presence has an important impact on the outcome of the distress resolution. On the one hand, the presence of hedge funds helps to reduce the debtor-friendly bias in Chapter 11 because it is associated with higher probabilities of the debtors' loss of exclusive rights to file a reorganization plan, CEO turnover, and adoptions of a key employee retention plan. To some extent this paper supports creditors freindly system and is consistent to some extent with the spirit of findings in our paper because we find that creditors friendly system is often optimal.

5 Firther directions and robustness.

Asymmetric information and different types of firms. In our basic model the government faces a representative firm....etc.

Tax at stage 2. In our basic model there is no tax in period 2 (same as in Acharya et al (2011)). Intuitively it should not be important since the parties receive different claims and in most tax systems taxation of post default firms will not be significantly different. The difference comes mostly from first period (before bankruptcy): firms with more debt have more tax shield etc. However, in Acharya et al (2011) they do not model epxlicitly renegotuation. They just

assume an exogenous cost of continuation/liquidation. In our model we have reorgnisation. So the presence of tax in stage 2 can affect the conditions when rengotiation is successful and this can bring new qualitative insights in the model.

Liquidation value. In our model, the firm liquidation value is C_1 i.e there is not cost in selling firm asets. One can assume that if liquidated the firm is sold for some value L. One can futher investaigate the influence of L on firm decision as well as government choices. Intuitively though it seems like it should not have a lot of effect qulitatively although quantitatively calculations may be different. If L is higher, it should reduce debt face value (and overall debt) consistent with findings in Acharya et al (2011).

Creditors behavioural bias towards liquidation. One can model creditors bias towards liquidation. Acharya et al (2009) argue that when bankruptcy code is creditor friendly, excessive liquidations cause levered firms to shun innovation, whereas by promoting continuation upon failure, a debtor-friendly code induces greater innovation. They provide empirical support for this claim by employing patents as a proxy for innovation. Using time-series changes within a country and cross-country variation in creditor rights, Acharya et al (2009) confirm that a creditor-friendly code leads to a lower absolute level of innovation by firms, as well as relatively lower innovation by firms in technologically innovative industries. When creditor rights are stronger, technologically innovative industries employ relatively less leverage and grow disproportionately slower.

6 Conclusions.

We argue that banruptcy system choice and corporate tax policy should be connected. Uncoordinated choice may lead to damage for the economy: either too much debt in the economy or eleimination of too many good companies etc. The model generates some predictions about optimal bankruptcy system and corporate tax rate choice depending on the situation in the economy, total investments etc. Most of our predictions have not been tested sofar. In particular the model predicts that if tax rate is very low it can be combined with any bankruptcy system since firms will optimally select equity finanicng. When tax rate is low the benefits from tax shield are smaller than potential loss from debt overhand. Intermediate level of taxes should be combined with creditors-friendly system. In fact this is smth. we observe in the UK. Under high level of taxes, shareholders friendly system prevail (smth like US). Although this prediction has not been directly tested it seems to be consistent with observed eveidence.

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