A New Capital Structure Theory: The Four-Factor Model

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Abstract

This article presents a new capital structure model based on four factors well documented in literature: asymmetric information, taxes, bankruptcy costs and decision-makers' overconfidence. The model can simultaneously explain several facts about capital structure including those that remain puzzling from existing theories point of view eg. negative correlation between debt and profitability; why firms issue equity etc. Unlike many advanced research on capital structure, a closed-form solution is obtained for most results.

JEL codes: D82, D89, D90, G32, H21, H32, L26, L29

Key words: capital structure; asymmetric information; overconfidence; debt tax shield; bankruptcy costs

1 Introduction

The modern theory of capital structure began with the famous proposition of Modigliani and Miller (1958) that described the conditions of capital structure irrelevance. Since then, many financial economists have altered these conditions to explain the factors driving capital structure decisions.[1]

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[1]For a review of major capital structure theories see, among others, Harris and Raviv (1991) and Miglo (2011, 2016).

Pecking-order theory (POT) suggests that there is pecking order where firms issue equity only as last resort (Myers and Majluf (1984)). The main drawback of this theory is that despite suggested pecking order, many firms issue equity even when they have other options available (Frank and Goyal (2003), Leary and Roberts (2010)). Another asymmetric information based theory is signalling theory. It suggests that good quality firms should use debt as a signal of quality. The major shortcoming of this theory is that it is not consistent with negative correlation between debt and profitability well documented in literature (Titman and Wessles (1988), Frank and Goyal (2008)).

Trade-off theory of capital structure (TOT) focuses on two factors. Corporate income tax creates a tax shiled for companies that use debt. Secondly, firms that use debt are facing some probability of bankruptcy which is costly. Optimal capital structure is based on the trade-off between the benefits of tax shield and expected bankruptcy costs (Kraus and Litzenberger (1973)). The major shortcoming of this theory is that it is not consistent with mentioned previously negative correlation between debt and profitability.

Behavioral finance theory of capital structure assumes that managers overestimate the value of their projects and as such they would rather issue debt than equity because the latter is more sensitive to earnings uncertainty and estimation biases (Fairchild (2005)). In most cases these conclusions are similar to mentioned above pecking-order theory.

In last 20 years dynamic versions of TOT and POT have been created (eg Morellec (2004), Miglo (2012)). Dynamic extensions of TOT do not often have a closed-form solution. Dynamic extensions of POT often lack empirical support to the best of our knowledge.

Finally note that Graham and Harvey (2001) report a large gap between capital structure theory and practice.

In this article we suggest a new model of capital structure which combines elements of all mentioned above approaches. Unlike many modern advanced studies on capital structure it generates a closed-form solution for most results. These results are consistent with most well-known results about capital structure.

In our model a firm owned by an entrepreneur has an investment project and decides whether to use debt or equity to finance the project. The firm is subject to corporate income tax. In the case of default there are bankruptcy costs. Entrepreneur has private information about project quality. Finally entrepreneur can be biased in estimating project results. We first consider cases where only one factor is present (eg asymmetric information) and other factors are ignored. These variations of the model can produce some results regarding capital structure choice which are consistent with empirical evidence but at the same time in most cases they have some major drawbacks. For example, when considering separately the effect of asymmetric infromation, the model predicts that equilibrium is either pooling woth debt or separating where high-quality firms issue debt and low-quality firms issue equity which is generally consistent with traditional asymmetric information theories and which have problems discussed above.

We next analyze a model where all factors are present simultaneously. In this case the model generates a large number of predictions regarding capital structure largely consistent with observed evidence. Among model results note the following: debt/equity ratio is positively correlated with firm size and tax rate; it is negativley correlated with firm profitability and bankruptcy costs; good firms may issue equity in equilibrium; overconfidence is positively correlated with debt etc.

The rest of the paper is organized as follows. Section 2 provides a literature review. Section 3 presents the basic model and its main results. Section 4 considers the main case where all factors are present simultaneously. Section 5 discusses the model's implications and its consistency with empirical evidence. Section 6 discusses model assumptions and possible extensions and Section 7 concludes.

2 Literature Review.

2.1 Capital Structure Under Asymmetric Information

Myers and Majluf (1984) set forth POT. The key element of this theory is asymmetric information between firm's insiders and outsiders. POT predicts that equity should only be used as a last resort. Firms issuing equity will be undervalued. Consequently only firms with low expected performance may issue equity. Equity is dominated by internal funds and debt in this model. Debt suffers from misvaluation less than equity. The empirical evidence on pecking order theory is mixed. Shyam-Sunder and Myers (1999), Lemmon and Zender (2010), and a survey of New York Stock Exchange firms by Kamath (1997) find support for pecking order while Chirinko and Singha (2000), Frank and Goyal (2003) and Leary and Roberts (2010) do not.

Similarly signaling theory (Leland and Pyle (1977), Ross (1977)) usually suggests that high-quality firms issue debt and low-quality firms issue equity. The empirical prediction is that firm value (or profitability) and the debt-to-equity ratio is positively related. The evidence, however, is ambiguous. Most empirical studies report a negative relationship between leverage and profitability as discussed earlier. In a similar spirit, some studies document the superior absolute performance of equity-issuing firms before and immediately after the issue (Jain and Kini (1994), Loughran and Ritter (1997)). Finally the evidence on the announcement of debt issues does not support signaling theories. Eckbo (1986) as well as Antweiler and Frank (2006) find insignificant changes in stock prices in response to straight corporate debt issues.

Some asymmetric information-based ideas exist as to why managers of high-quality firms may use leverage-decreasing transactions as a signal. These include issuing equity to signal low variance of earnings (Brick, Frierman, and Kim (1998)), retiring existing debt to signal earnings quality (Brennan and Kraus (1987)), signaling based on a model that combines asymmetric information with agency problems (Noe and Rebello (1996)) and issuing equity to signal a high level of expected short-term earnings as compared to long-term earnings (Miglo (2007, 2017). Empirical support for these ideas is limited. A challenge for researchers today is to find a model that can explain several major empirical phenomena simultaneously.

2.2 Taxes and Bankruptcy Costs

In contrast to dividends, interest paid on debt reduces the firm's taxable income. Debt also increases the probability of bankruptcy. TOT suggests that capital structure reflects a trade-off between the tax benefits of debt and the expected costs of bankruptcy (Kraus and Litzenberger (1973)). TOT also suggests that if profitability increases, debt should also increase. Therefore more profitable firms should have more debt. Expected bankruptcy costs are lower and interest tax shields are more valuable for profitable firms. Empirical evidence on TOT is mixed. Rajan and Zingales (1995), Barclay, Morellec, and Smith (2006), and Frank and Goyal (2009) generally support some of its prediction. However, the major shortcoming is that empirical studies typically find a negative relationship between profitability and leverage (Titman and Wessels (1988), Rajan and Zingales (1995), Fama and French (2002), Frank and Goyal (2009)).

Dynamic versions of TOT suggest several ideas that can improve the drawbacks of traditional theory (Hennessy and Whited (2005), Ju, Parrino, Poteshman, and Weisbach (2005), Strebulaev (2007), Tserlukevich's (2008), Morellec (2004), Titman and Tsyplakov (2007), Cook and Kieschnick (2009)). Dynamic trade-off models are likely to provide an important contribution to TOT. Empirical results and simulated results apparently dominate theoretical results. New theoretical results are expected.

2.3 Behavioural Finance and Capital Structure

Fairchild (2005) examines the combined effects of managerial overconfidence, asymmetric information and moral hazard problems on the manager's debt/equity choice. In particular it argues that firms issue too much debt and firm profits are reduced. Although it provides some intersting results, in terms of capital structure choice, the results are mostly consistent with traditional asymmetric information based theories where equity is not issued. Unlike in Fairchild (2005), managers are not equally overconfident in our model. No other existing paper seems to be able to explain why firms may be interested in issuing equity and do not compare performance of firms issuing debt and equity.

3 Basic Model.

Consider a firm with an investment project. The project costs B. In the case of success it generates earnings X. Earnings equal 0 in the case of failure.[2] The probability of success is p. The firm belongs to an entrepreneur who owns 100% of the firm's equity. The entrepreneur can undertake the project by issuing debt or equity. Everybody is risk-neutral and risk-free interest rate is normalized to zero. The investors provide funds as long as the expected earnings cover their cost and the entrepreneur maximizes his expected profits. Also, the entrepreneur has private information about project quality. More specifically, there are two types of firms, high (h) and low quality (l). For a high-quality firm the project generates an amount of earnings X_h in the case success and for low-quality firm it generates X_l with $X_l < X_h$. The fraction of high-quality firms is $\mu \in (0;1)$. In addition, entrepreneur can be

[2] In Section 6, we discuss the model's robustness with reagrd to different assumptions made.

overconfident, i.e. he thinks that the amount of earnings from the project equals $X_i + \varepsilon_i$ where ε_i reflects the degree of the entrepreneur's bias, $i = l, h$. $\varepsilon_i > 0$ means that the entrepreneur is overconfident, $\varepsilon_i = 0$ means that the entrepreneur is unbiased (rational). Also the firm is subject to corporate income tax. The corporate income tax rate is denoted by t. In the case of bankruptcy there are bankruptcy costs C.

The timing of events is present in Figure 1.

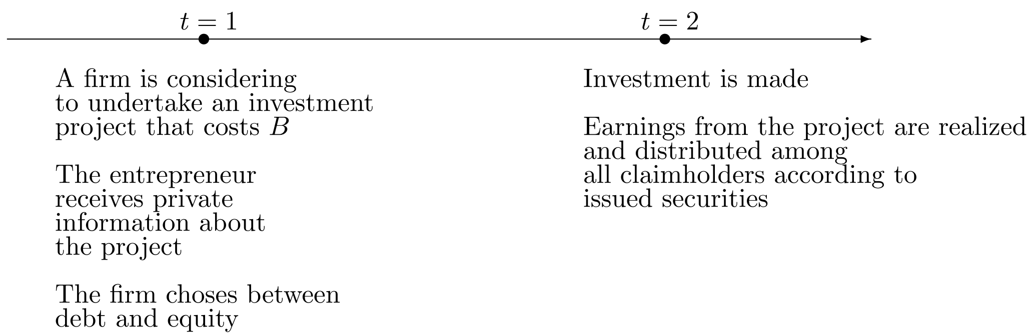

Figure 1. The sequence of events.

We start by considering the case without taxes ($t = 0$) and bankruptcy costs ($C = 0$) as well as with rational entrepreneurs ($\varepsilon_h = \varepsilon_l = 0$) and symmetric information ($X_h = X_l = X$), i.e. all parties share the same information and all variables are public knowledge.

If debt is selected (we will denote this decision/strategy by d for shortness), the entrepreneur's expected profit equals

$$p(X - F) \tag{1}$$

where F is the face value of debt. The entrepreneur's expected profit from the project equals the probability of success multiplied by the difference between earnings from the project in a good scenario and face value of the debt.

If equity is selected (this strategy is denoted by e), the entrepreneur's profit is

$$(1-\alpha)pX \tag{2}$$

where α is the fraction of equity sold to new shareholders.

Lemma 1. *If information is symmetric and entrepreneurs are rational then in the absence of taxes and bankruptcy costs: 1) if $pX \leq B$, the project is worthless for the firm; 2) otherwise the firm is indifferent between debt and equity financing.*

Proof. Under strategy e, the fraction of shares that has to be sold is determined by the following condition:

$$\alpha pX = B \tag{3}$$

Substituting α from (3) into (2) leads to the following:

$$(1-\frac{B}{pX})pX = pX - B \tag{4}$$

Under strategy d, the face value of debt is determined by the following condition:

$$X \geq F \tag{5}$$

$$F = \frac{B}{p} \tag{6}$$

The first condition means that the face value of debt should not be greater than the amount of earnings the firm earns if the projects succeeds and the second condition means that the expected earnings that the bank is going to receive covers their investment/loan. They can hold simultaneously if the project has positive net present value or:

$$pX > B \tag{7}$$

Substituting (6) into (1) leads to the following:

$$p(X-\frac{B}{p}) = pX - B \tag{8}$$

(4) and (8) are equal.

This result (see also Table 1) is not surprising. It is conisistent with the spirit of classical literature on firm financial decision-making in a perfect market (Modigliani and Miller (1958)). Finally note that if (7) does not hold, project is worthless for the firm under any type of financing.

Table 1. The model predictions

Conditions	Prediction
no tax no bankruptcy costs no asymmetric information entrepreneurs are fully rational	Capital structure is irrelevant

3.1 Taxes and Bankruptcy Costs

Now suppose that entrepreneurs are still rational and information is still symmetric but the firm pays corporate income tax and there are bankruptcy costs. If e is selected, the entrepreneur's profit is

$$(1-\alpha)pX(1-t) \tag{9}$$

The fraction of shares that has to be sold is determined by the following condition:

$$\alpha pX(1-t) = B \tag{10}$$

Substituting α from (10) into (9) leads to the following:

$$(1-\frac{B}{pX(1-t)})pX(1-t) = pX(1-t) - B \tag{11}$$

If d is selected, the entrepreneur's expected profit equals

$$p(X-F)(1-t) - C(1-p) \tag{12}$$

Here $C(1-p)$ are the expcted bankruptcy costs. Also $F = B/p$. Substituting this into (12) leads to the following:

$$p(X-\frac{B}{p})(1-t) - C(1-p) = (pX-B)(1-t) - C(1-p)$$

Comparing with (11) we find that e is optimal if

$$C > \frac{tB}{1-p}$$

and vice versa.

Lemma 2. *If $C > \frac{tB}{1-p}$, the entrepreneur prefers e to d and vice versa. If $C = \frac{tB}{1-p}$, the entrepreneur is indifferent between e and d.*

Proof. Follows from above.

Lemma 2 (see also Table 2) is conisistent with the spirit of traditional literature related to trade-off theory of capital structure (Kraus and Litzenberger (1973), Titman and Wessles (1988), Frank and Goyal (2009) etc.). It implies that debt is positively correlated with firm size (B) and tax rate (t); it is negatively correlated with firm profitability (p) and bankruptcy costs (C). The shortcoming of this theory is the negative correlation between debt and profitability well documented in existing literature as we discussed previously.

Table 2. The model predictions

Conditions	Result	Predictions
tax bankruptcy costs no asymmetric information entrepreneurs are fully rational	*If* $C > \frac{tB}{1-p}$ e is better than d *If* $C < \frac{tB}{1-p}$ d is better than e	debt is positively correlated: - with tax rate - with profitability - with firm size debt is negatively correlated with bankruptcy costs

3.2 Asymmetric information

Now assume that firm does not pay any tax and there is no bankruptcy cost but asymmetric information exists between entrepreneurs and investors regarding the value of X. An equilibrium is defined as a situation where no firm type has an incentive to deviate. In the case of separating equilibrium firms select different strategies and in the case of pooling equilibria both types of firms select the same strategy. We will also check that the off-equilibrium beliefs of market participants survive the intuitive criterion by Cho-Kreps (1987). This condition means that the market off-equilibrium beliefs are reasonable in the sense that if for any firm type its maximal payoff from deviation is not greater than its equilibrium payoff then the market should place the probability 0 on possible deviations of this type. The definitions above are consistent with the standard perfect bayesian equilibrium definition (see, for instance, Fudenberg and Tirole, 1991) with the addition of an intuitive criterion that is quite common in these types of games (see, for instance, Nachman and Noe, 1994). Under asymmetric information, some good quality projects may sustain losses compared to perfect information case because of unfavorable market conditions (adverse selection). So if multiple equilibria exist we will use the mispricing criterion to indicate the one that is most likely to exist. We use the standard concept of mispricing that can be found, for example, in Nachman and Noe (1994). The magnitude of mispricing in a given equilibrium is equal to that of undervalued type(s). The overvaluation of overvalued type(s) does not matter.

4 possible equilbria should be considered: pooling where both types of firm select d; pooling where both types select e; separating equilibrium where h selects d and l selects e and separating where h selects e and l selects d.

Consider pooling with d. For this to be an equilibrium entrepreneurs with high-quality firms should not be interested in deviating to e, that is

$$p(X_h - \frac{B}{p}) \geq (1 - \frac{B}{\mu_e^{off} pX_h + (1 - \mu_e^{off})pX_l})pX_h \tag{13}$$

where μ_e^{off} denote the market off-equilibrium belief about the probability for the firm to be type h when observing strategy e. Similarly for entrepreneurs with low-quality projects

$$p(X_l - \frac{B}{p}) \geq (1 - \frac{B}{\mu_e^{off} pX_h + (1 - \mu_e^{off})pX_l})pX_l \tag{14}$$

Off-equilibrium market beliefs that support this equilibrium are as follows:

$$\mu_e^{off} = 0 \tag{15}$$

If $\mu_e^{off} > 0$, (14) does not hold, i.e. low-quality firm would deviate to strategy e. Such beliefs are generally consistent with singalling literature (Brennan and Kraus (1987)) and they also satisfy the intuitive criterion.[3] In this case (13) and (14) become:

$$p(X_h - \frac{B}{p}) \geq (1 - \frac{B}{pX_l})pX_h \tag{16}$$

[3]Indeed, if $\mu_e^{off} > 0$, type l payoff would be higher than its equilibrium payoff because $X_h > X_l$ so $\mu_e^{off} = 0$ are considered as reasonable beliefs from intuitive criterion point of view (Cho and Kreps (1987)). The same will be used in other pooling equilibria (we will omit formal discussions of this for brevity).

$$p(X_l - \frac{B}{p}) \geq (1 - \frac{B}{pX_l})pX_l \tag{17}$$

Then condition (17) holds. Similarly (16) holds because $X_h > X_l$.

Consider pooling with e. h should not be interested in deviating to d, that is

$$p(X_h - \frac{B}{p}) \leq (1 - \frac{B}{\mu pX_h + (1-\mu)pX_l})pX_h \tag{18}$$

and similarly for l:

$$p(X_l - \frac{B}{p}) \leq (1 - \frac{B}{\mu pX_h + (1-\mu)pX_l})pX_l \tag{19}$$

(19) does not hold because $X_h > X_l$.

Consider a separating equilibrium where h selects e and l selects d. Again, h should not be interested in deviating to d, that is

$$p(X_h - \frac{B}{p}) \leq (1 - \frac{B}{pX_h})pX_h \tag{20}$$

and l should not be interested in deviating to e

$$p(X_l - \frac{B}{p}) \geq (1 - \frac{B}{pX_h})pX_l \tag{21}$$

(21) does not hold because $X_h > X_l$.

Finally, consider a separating equilibrium where h selects d and l selects e. Non-deviation conditions for type h and l respectively are

$$p(X_h - \frac{B}{p}) \geq (1 - \frac{B}{pX_l})pX_h \tag{22}$$

and

$$p(X_l - \frac{B}{p}) \leq (1 - \frac{B}{pX_l})pX_l \tag{23}$$

Condition (23) holds. (22) holds because $X_h > X_l$.

Lemma 3. *When entrepreneurs are rational but information between entrepreneurs and investors is asymmetric, equilibrium is pooling with d or separating one where h selects d and l selects e.*

Proof. Follows from above. Note that both equilibria survive the misprcing criterion because the payoffs of type h are equal in each case.

Lemma 3 (see also Table 3) is generally consistent with signalling and pecking order models (Leland and Pyle (1977) and Myers and Majluff (1984)). Also it predicts a positive correlation between debt and firm performance which is usually not confirmed empirically (Titman and Wessels (1988)).

Table 3. The model predictions

Conditions	Result	Predictions
no tax no bankruptcy costs asymmetric information entrepreneurs are fully rational	Pooling equilibrium with d or separating where h selects d and l selects e	debt dominates equity high-quality firms do not issue equity

3.3 Biased entrepreneurs.

Now suppose that information is symmetric, i.e the market particpants know the firm's type however the entrepreneur is overconfident, i.e. he thinks that the project's earnings are $X + \varepsilon$. First consider the case without tax and bankruptcy costs.

Lemma 4. *If* $\varepsilon > 0$*, the entrepreneur prefers* d*.*

Proof. If e is selected, the entrepreneur's expected earnings (from his point of view) equals

$$(1 - \alpha)(X + \varepsilon) \tag{24}$$

The fraction of shares that has to be sold is determined by the following condition:

$$\alpha p X = B \tag{25}$$

Substituting α from (25) into (24) leads to the following:

$$(1 - \frac{B}{pX})p(X + \varepsilon) \tag{26}$$

If d is selected, then, objectively, the entrepreneur's profit equals $W_d = X - F$. The entrepreneur, however, thinks that it is $X + \varepsilon - F$. Since $F = B/p$, the entreprneur's earnings equal

$$p(X + \varepsilon - \frac{B}{p}) \tag{27}$$

Comparing with (26) we find that optimal strategy depends on the foloiwng. If

$$\varepsilon > 0$$

then optimal strategy is d.

Lemma 4 is generally consistent with the spirit of existing literature on capital structure that uses behavioural finance (eg. Fairchild (2005)).

Now consider the case with tax and bankruptcy costs.

Lemma 5. *1) If* $\varepsilon > \frac{(1-p)CX}{B} - tX$*, the entrepreneur prefers* d *to* e *and vice versa; 2) if* $\varepsilon = \frac{(1-p)CX}{B} - tX$*, the entrepreneur is indifferent between* d *and* e*.*

Proof. If e is selected, the entrepreneur's expected earnings (from his point of view) equals

$$(1-\alpha)(X+\varepsilon)(1-t) \tag{28}$$

The fraction of shares that has to be sold is determined by the following condition:

$$\alpha p X(1-t) = B \tag{29}$$

Substituting α from (29) into (28) leads to the following:

$$(1 - \frac{B}{pX(1-t)})p(X+\varepsilon)(1-t) \tag{30}$$

If d is selected, then, the entreprneur's expected earnings equal

$$p(X + \varepsilon - \frac{B}{p})(1-t) - (1-p)C$$

Comparing with (30) we find that optimal strategy depends on the following. If

$$\varepsilon > \frac{(1-p)CX}{B} - tX$$

then optimal strategy is d and vice versa.

Table 4. The model predictions

Conditions	Result	Predictions
tax bankruptcy costs no asymmetric information overconfidence	if $\varepsilon > \frac{(1-p)CX}{B} - tX$ d is better than e if $\varepsilon < \frac{(1-p)CX}{B} - tX$ e is better than d	overconfidence is positively correlated with debt

One interpretation of Lemma 5 (see also Table 4) is that if the degree of entrepreneurial overconfidence is comparatively high, then he would think that the share price is too low and he would prefer debt. This is generally consistent with, for example, Fairchild (2005).

4 Four-Factor Model of Capital Structure

Now consider the case where all factors are taken into consideration. Note that when asymmetric information environment includes biased entrepreneur, the application of mispricing criterion discussed previously is different. Three cases are possible when we compare two different equilibria using mispricing criterion. One when misricing is objectively greater in one case and the entrepreneur of underpriced firm understands it. In this case an usual approach is used and we assume that the equilibrium with objectively minimal mispricing will dominate (strong dominance). The second case is when objectively mispricing is equal in both cases but subjectively the entrepreneur of one firm thinks that one case is better. We use it as a semi-strong form of dominance as well. Third possible case is when misricing is objectively greater in one equilibrium but the entrepreneur thinks that it is greater in the other equilibrium. We suppose that the entrepreneur's view would dominate in this case (weak dominance).

Below we present an analysis of 4 possible cases. These cases are based on different boundary conditions for ε_h and ε_l 1 which are based on Lemma 5 discussed previously.

4.1 Case 1. $\varepsilon_h > \frac{(1-p)CX_h}{B} - tX_h$, $\varepsilon_l > \frac{(1-p)CX_l}{B} - tX_l$

Consider pooling with d. Non-deviation conditions for each type are:

$$p(X_h + \varepsilon_h - \frac{B}{p})(1-t) - C(1-p) \geq \tag{31}$$

$$\geq (1 - \frac{B}{\mu_e^{off} pX_h(1-t) + (1-\mu_e^{off})pX_l(1-t)})p(X_h + \varepsilon_h)(1-t)$$

$$p(X_l + \varepsilon_l - \frac{B}{p})(1-t) - C(1-p) \geq \tag{32}$$

$$\geq (1 - \frac{B}{\mu_e^{off} pX_h(1-t) + (1-\mu_e^{off})pX_l(1-t)})p(X_l + \varepsilon_l)(1-t)$$

As was previously discussed (see Footnote 3) $\mu_e^{off} = 0$. In this case (31) and (32) become:

$$p(X_h + \varepsilon_h - \frac{B}{p})(1-t) - C(1-p) \geq (1 - \frac{B}{pX_l(1-t)})p(X_h + \varepsilon_h)(1-t) \tag{33}$$

$$p(X_l + \varepsilon_l - \frac{B}{p})(1-t) - C(1-p) \geq (1 - \frac{B}{pX_l(1-t)})p(X_l + \varepsilon_l)(1-t) \quad (34)$$

(34) holds because $\varepsilon_l > \frac{(1-p)CX_l}{B} - tX_l$. Similarly (33) holds because $\varepsilon_h > \frac{(1-p)CX_h}{B} - tX_h$ and $X_h > X_l$.

Consider pooling with e. Non-deviation conditions for each type are:

$$p(X_h + \varepsilon_h - \frac{B}{p})(1-t) - C(1-p) \leq \quad (35)$$

$$\leq (1 - \frac{B}{\mu p X_h(1-t) + (1-\mu)pX_l(1-t)})p(X_h + \varepsilon_h)(1-t)$$

$$p(X_l + \varepsilon_l - \frac{B}{p})(1-t) - C(1-p) \leq \quad (36)$$

$$\leq (1 - \frac{B}{\mu p X_h(1-t) + (1-\mu)pX_l(1-t)})p(X_l + \varepsilon_l)(1-t)$$

(35) does not hold because $X_h > X_l$ and $\varepsilon_h > \frac{(1-p)CX_h}{B} - tX_h$.

Consider a separating equilibrium where h selects e and l selects d. Non-deviation conditions for each type are:

$$p(X_h + \varepsilon_h - \frac{B}{p})(1-t) - C(1-p) \leq (1 - \frac{B}{pX_h(1-t)})p(X_h + \varepsilon_h)(1-t) \quad (37)$$

$$p(X_l + \varepsilon_l - \frac{B}{p})(1-t) - C(1-p) \geq (1 - \frac{B}{pX_h(1-t)})p(X_l + \varepsilon_l)(1-t) \quad (38)$$

(37) does not hold because $\varepsilon_h > \frac{(1-p)CX_h}{B} - tX_h$.

Finally, consider a separating equilibrium where h selects d and l selects e. Non-deviation conditions for each type are:

$$p(X_h + \varepsilon_h - \frac{B}{p})(1-t) - C(1-p) \geq (1 - \frac{B}{pX_l(1-t)})p(X_h + \varepsilon_h)(1-t) \quad (39)$$

$$p(X_l + \varepsilon_l - \frac{B}{p})(1-t) - C(1-p) \leq (1 - \frac{B}{pX_l(1-t)})p(X_l + \varepsilon_l)(1-t) \quad (40)$$

(40) does not hold because $\varepsilon_l > \frac{(1-p)CX_l}{B} - tX_l$.

This leads to the following proposition.

Proposition 1. *If $\varepsilon_h > \frac{(1-p)CX_h}{B} - tX_h$, $\varepsilon_l > \frac{(1-p)CX_l}{B} - tX_l$ and information between entrepreneurs and investors is asymmetric, equilibrium is pooling with d.*

Proof. Follows from above.

4.2 Case 2. $\varepsilon_h > \frac{(1-p)CX_h}{B} - tX_h$, $\varepsilon_l \leq \frac{(1-p)CX_l}{B} - tX_l$

Consider pooling with d. Non-deviation conditions are:

$$p(X_h + \varepsilon_h - \frac{B}{p})(1-t) - C(1-p) \geq \tag{41}$$

$$\geq (1 - \frac{B}{\mu_e^{off} pX_h(1-t) + (1-\mu_e^{off})pX_l(1-t)})p(X_h + \varepsilon_h)(1-t)$$

$$p(X_l + \varepsilon_l - \frac{B}{p})(1-t) - C(1-p) \geq \tag{42}$$

$$\geq (1 - \frac{B}{\mu_e^{off} pX_h(1-t) + (1-\mu_e^{off})pX_l(1-t)})p(X_l + \varepsilon_l)(1-t)$$

Again, $\mu_e^{off} = 0$. In this case (41) and (42) become:

$$p(X_h + \varepsilon_h - \frac{B}{p})(1-t) - C(1-p) \geq (1 - \frac{B}{pX_l(1-t)})p(X_h + \varepsilon_h)(1-t) \tag{43}$$

$$p(X_l + \varepsilon_l - \frac{B}{p})(1-t) - C(1-p) \geq (1 - \frac{B}{pX_l(1-t)})p(X_l + \varepsilon_l)(1-t) \tag{44}$$

(44) does not hold because $\varepsilon_l < \frac{(1-p)CX_l}{B} - tX_l$.

Consider pooling with e. Non-deviation conditions are:

$$p(X_h + \varepsilon_h - \frac{B}{p})(1-t) - C(1-p) \leq \tag{45}$$

$$\leq (1 - \frac{B}{\mu pX_h(1-t) + (1-\mu)pX_l(1-t)})p(X_h + \varepsilon_h)(1-t)$$

$$p(X_l + \varepsilon_l - \frac{B}{p})(1-t) - C(1-p) \leq \tag{46}$$

$$\leq (1 - \frac{B}{\mu pX_h(1-t) + (1-\mu)pX_l(1-t)})p(X_l + \varepsilon_l)(1-t)$$

(45) does not hold because $X_h > X_l$ and $\varepsilon_h > \frac{(1-p)CX_h}{B} - tX_h$.

Consider a separating equilibrium where h selects e and l selects d. Non-deviation conditions are:

$$p(X_h + \varepsilon_h - \frac{B}{p})(1-t) - C(1-p) \leq (1 - \frac{B}{pX_h(1-t)})p(X_h + \varepsilon_h)(1-t) \tag{47}$$

$$p(X_l+\varepsilon_l-\frac{B}{p})(1-t)-C(1-p)\geq(1-\frac{B}{pX_h(1-t)})p(X_l+\varepsilon_l)(1-t) \quad (48)$$

(47) does not hold because $\varepsilon_h > \frac{(1-p)CX_h}{B} - tX_h$.

Consider a separating equilibrium where h selects d and l selects e. Non-deviation conditions are:

$$p(X_h+\varepsilon_h-\frac{B}{p})(1-t)-C(1-p)\geq(1-\frac{B}{pX_l(1-t)})p(X_h+\varepsilon_h)(1-t) \quad (49)$$

$$p(X_l+\varepsilon_l-\frac{B}{p})(1-t)-C(1-p)\leq(1-\frac{B}{pX_l(1-t)})p(X_l+\varepsilon_l)(1-t) \quad (50)$$

(49) holds because $X_h > X_l$ and $\varepsilon_h > \frac{(1-p)CX_h}{B} - tX_h$ and (50) holds because $\varepsilon_l < \frac{(1-p)CX_l}{B} - tX_l$.

Proposition 2. *If $\varepsilon_h > \frac{(1-p)CX_h}{B} - tX_h$, $\varepsilon_l \leq \frac{(1-p)CX_l}{B} - tX_l$ and information between entrepreneurs and investors is asymmetric, equilibrium is separating where h selects d and l selects e.*

Proof. Follows from above.

4.3 Case 3. $\varepsilon_h < \frac{(1-p)CX_h}{B} - tX_h$, $\varepsilon_l > \frac{(1-p)CX_l}{B} - tX_l$

Consider pooling with d. Non-deviation conditions are:

$$p(X_h+\varepsilon_h-\frac{B}{p})(1-t)-C(1-p)\geq \quad (51)$$

$$\geq(1-\frac{B}{\mu_e^{off}pX_h(1-t)+(1-\mu_e^{off})pX_l(1-t)})p(X_h+\varepsilon_h)(1-t)$$

$$p(X_l+\varepsilon_l-\frac{B}{p})(1-t)-C(1-p)\geq \quad (52)$$

$$\geq(1-\frac{B}{\mu_e^{off}pX_h(1-t)+(1-\mu_e^{off})pX_l(1-t)})p(X_l+\varepsilon_l)(1-t)$$

Again, $\mu_e^{off}=0$. In this case (51) and (52) become:

$$p(X_h+\varepsilon_h-\frac{B}{p})(1-t)-C(1-p)\geq(1-\frac{B}{pX_l(1-t)})p(X_h+\varepsilon_h)(1-t) \quad (53)$$

$$p(X_l+\varepsilon_l-\frac{B}{p})(1-t)-C(1-p)\geq(1-\frac{B}{pX_l(1-t)})p(X_l+\varepsilon_l)(1-t) \quad (54)$$

Then condition (54) holds because $\varepsilon_l > \frac{(1-p)CX_l}{B} - tX_l$. (53) holds if $\varepsilon_h > \frac{(1-p)CX_l}{B(1-t)} + X_l - X_h$.

The interpretation of this result is that there is a trade-off between advantages of equity related to Lemma 5 and condition $\varepsilon_h < \frac{(1-p)CX_h}{B} - tX_h$ and disadvantages of equity related to low equity value in this equilibrium. So in order for this equilibrium to exist, h should be sifficiently overconfident in order for the first effect to dominate.

Consider pooling with e. Non-deviation conditions are:

$$p(X_h+\varepsilon_h-\frac{B}{p})(1-t)-C(1-p)\leq(1-\frac{B}{\mu pX_h+(1-\mu)pX_l})p(X_h+\varepsilon_h)(1-t) \quad (55)$$

$$p(X_l+\varepsilon_l-\frac{B}{p})(1-t)-C(1-p)\leq(1-\frac{B}{\mu pX_h+(1-\mu)pX_l})p(X_l+\varepsilon_l)(1-t) \quad (56)$$

(55) holds if μ is sufficiently large. To see this note that it holds when $\mu=1$ because $\varepsilon_h < \frac{(1-p)CX_h}{B} - tX_h$. (56) does not hold when $\mu=0$ because $\varepsilon_l > \frac{(1-p)CX_l}{B} - tX_l$. When $\mu=1$, (56) becomes

$$p(X_l+\varepsilon_l-\frac{B}{p})(1-t)-C(1-p)\leq(1-\frac{B}{pX_h})p(X_l+\varepsilon_l)(1-t) \quad (57)$$

It holds if

$$\varepsilon_l < \frac{(1-p)CX_h}{B(1-t)} + X_h - X_l \quad (58)$$

Therefore (56) holds if (58) holds and μ is sufficiently large.

Consider a separating equilibrium where h selects e and l selects d. Non-deviation conditions are:

$$p(X_h+\varepsilon_h-\frac{B}{p})(1-t)-C(1-p)\leq(1-\frac{B}{pX_h})p(X_h+\varepsilon_h)(1-t) \quad (59)$$

$$p(X_l+\varepsilon_l-\frac{B}{p})(1-t)-C(1-p)\geq(1-\frac{B}{pX_h})p(X_l+\varepsilon_l)(1-t) \quad (60)$$

(60) holds if $\varepsilon_l > \frac{(1-p)CX_h}{B(1-t)} + X_h - X_l$ and (59) holds because $\varepsilon_h < \frac{(1-p)CX_h}{B} - tX_h$.

Consider a separating equilibrium where h selects d and l selects e. Non-deviation conditions are:

$$p(X_h + \varepsilon_h - \frac{B}{p})(1-t) - C(1-p) \geq (1 - \frac{B}{pX_l})p(X_h + \varepsilon_h)(1-t) \quad (61)$$

$$p(X_l + \varepsilon_l - \frac{B}{p})(1-t) - C(1-p) \leq (1 - \frac{B}{pX_l})p(X_l + \varepsilon_l)(1-t) \quad (62)$$

(62) does not hold because $\varepsilon_l > \frac{(1-p)CX_l}{B} - tX_l$.

Proposition 3. *Consider $\varepsilon_h < \frac{(1-p)CX_h}{B} - tX_h$, $\varepsilon_l > \frac{(1-p)CX_l}{B} - tX_l$, $X_l > X_h(1-t)$ and let information between entrepreneurs and investors be asymmetric: 1) if $\varepsilon_l > \frac{(1-p)CX_h}{B(1-t)} + X_h - X_l$, equilibrium is separating where h plays e and l plays d; 2) if $\varepsilon_l < \frac{(1-p)CX_h}{B(1-t)} + X_h - X_l$, and μ is sufficiently large, equilibrium is pooling with e; 3) If $\varepsilon_l < \frac{(1-p)CX_h}{B(1-t)} + X_h - X_l$ and μ is sufficiently low, no equilibrium exists.*

Consider $\varepsilon_h < \frac{(1-p)CX_h}{B} - tX_h$, $\varepsilon_l > \frac{(1-p)CX_l}{B} - tX_l$, $X_l < X_h(1-t)$.1) If $\varepsilon_l > \frac{(1-p)CX_h}{B(1-t)} + X_h - X_l$, equilibrium is separating where h plays e and l plays d; 2) if $\varepsilon_l < \frac{(1-p)CX_h}{B(1-t)} + X_h - X_l$, $\varepsilon_h > \frac{(1-p)CX_l}{B(1-t)} + X_l - X_h$, and μ is sufficiently low, equilibrium is pooling with d; 3) if $\varepsilon_l < \frac{(1-p)CX_h}{B(1-t)} + X_h - X_l$, and μ is sufficiently high, equilibrium is pooling with e; 4) If $\varepsilon_l < \frac{(1-p)CX_h}{B(1-t)} + X_h - X_l$ and $\varepsilon_h < \frac{(1-p)CX_l}{B(1-t)} + X_l - X_h$, and μ is sufficiently low, no equilibrium exists.

Proof. Follows from above. Indeed consider $X_l > X_h(1-t)$. Then $\frac{(1-p)CX_l}{B(1-t)} + X_l - X_h > \frac{(1-p)CX_h}{B} - tX_h$ so $\varepsilon_h < \frac{(1-p)CX_l}{B(1-t)} + X_l - X_h$. Then pooling with d does not exist. For other cases we have only one equilibrium for each case.

Now consider $X_l < X_h(1-t)$. If $\varepsilon_l < \frac{(1-p)CX_h}{B(1-t)} + X_h - X_l$, $\varepsilon_h > \frac{(1-p)CX_l}{B(1-t)} + X_l - X_h$, and μ is sufficiently high, two pooling equilibria exist. However, mispricing is smaller with pooling with e as follows from the comparison of RHS (right-hand side) in (55) and LHS (left-hand side) in (53). if $\varepsilon_l > \frac{(1-p)CX_h}{B(1-t)} + X_h - X_l$ and $\varepsilon_h > \frac{(1-p)CX_l}{B(1-t)} + X_l - X_h$, two equilibria exist: separating where h plays e and l plays d or pooling with d. The former dominates the latter by mispricing: from h point view, the mispricing is lower in this case because of $\varepsilon_h < \frac{(1-p)CX_h}{B} - tX_h$ and Lemma 5.

4.4 Case 4. $\varepsilon_h < \frac{(1-p)CX_h}{B} - tX_h$, $\varepsilon_l \leq \frac{(1-p)CX_l}{B} - tX_l$

Consider pooling with d. Non-deviation conditions are:

$$p(X_h + \varepsilon_h - \frac{B}{p})(1-t) - C(1-p) \geq \tag{63}$$

$$\geq (1 - \frac{B}{\mu_e^{off} pX_h + (1-\mu_e^{off})pX_l})p(X_h + \varepsilon_h)(1-t)$$

$$p(X_l + \varepsilon_l - \frac{B}{p})(1-t) - C(1-p) \geq \tag{64}$$

$$\geq (1 - \frac{B}{\mu_e^{off} pX_h + (1-\mu_e^{off})pX_l})p(X_l + \varepsilon_l)(1-t)$$

Again, $\mu_e^{off} = 0$. In this case (63) and (64) become:

$$p(X_h + \varepsilon_h - \frac{B}{p})(1-t) - C(1-p) \geq (1 - \frac{B}{pX_l})p(X_h + \varepsilon_h)(1-t) \tag{65}$$

$$p(X_l + \varepsilon_l - \frac{B}{p})(1-t) - C(1-p) \geq (1 - \frac{B}{pX_l})p(X_l + \varepsilon_l)(1-t) \tag{66}$$

(66) does not hold because $\varepsilon_l < \frac{(1-p)CX_l}{B} - tX_l$.
Consider pooling with e. Non-deviation conditions are:

$$p(X_h + \varepsilon_h - \frac{B}{p})(1-t) - C(1-p) \leq \tag{67}$$

$$\leq (1 - \frac{B}{\mu pX_h + (1-\mu)pX_l})p(X_h + \varepsilon_h)(1-t)$$

$$p(X_l + \varepsilon_l - \frac{B}{p})(1-t) - C(1-p) \leq \tag{68}$$

$$\leq (1 - \frac{B}{\mu pX_h + (1-\mu)pX_l})p(X_l + \varepsilon_l)(1-t)$$

(68) holds. Indeed it holds when $\mu = 0$ because $\varepsilon_l < \frac{(1-p)CX_l}{B} - tX_l$ and RHS of (68) increases when μ increases. (67) holds if μ is sufficiently large.

To see this note that it holds when $\mu = 1$ because $\varepsilon_h < \frac{(1-p)CX_h}{B} - tX_h$. When $\mu = 0$, (67) becomes

$$p(X_h + \varepsilon_h - \frac{B}{p})(1-t) - C(1-p) \leq (1 - \frac{B}{pX_l})p(X_h + \varepsilon_h)(1-t) \tag{69}$$

It holds if $\varepsilon_h < \frac{(1-p)CX_l}{B(1-t)} + X_l - X_h$.

Consider a separating equilibrium where h selects e and l selects d. Non-deviation conditions are:

$$p(X_h + \varepsilon_h - \frac{B}{p})(1-t) - C(1-p) \leq (1 - \frac{B}{pX_h})p(X_h + \varepsilon_h)(1-t) \tag{70}$$

$$p(X_l + \varepsilon_l - \frac{B}{p})(1-t) - C(1-p) \geq (1 - \frac{B}{pX_h})p(X_l + \varepsilon_l)(1-t) \tag{71}$$

(60) holds if $\varepsilon_l > \frac{(1-p)CX_h}{B(1-t)} + X_h - X_l$ and (70) holds because $\varepsilon_h < \frac{(1-p)CX_h}{B} - tX_h$. However $\varepsilon_l > \frac{(1-p)CX_h}{B(1-t)} + X_h - X_l$ is infeasible since $\varepsilon_l < \frac{(1-p)CX_l}{B} - tX_l$ and RHS of the former is gerater than RHS of the latter.

Consider a separating equilibrium where h selects d and l selects e. Non-deviation conditions are:

$$p(X_h + \varepsilon_h - \frac{B}{p})(1-t) - C(1-p) \geq (1 - \frac{B}{pX_l})p(X_h + \varepsilon_h)(1-t) \tag{72}$$

$$p(X_l + \varepsilon_l - \frac{B}{p})(1-t) - C(1-p) \leq (1 - \frac{B}{pX_l})p(X_l + \varepsilon_l)(1-t) \tag{73}$$

(73) holds because $\varepsilon_l < \frac{(1-p)CX_l}{B} - tX_l$. (72) holds if $\varepsilon_h > \frac{(1-p)CX_l}{B(1-t)} + X_l - X_h$.

Proposition 4. *Consider $\varepsilon_h < \frac{(1-p)CX_h}{B} - tX_h$, $\varepsilon_l < \frac{(1-p)CX_l}{B} - tX_l$, $X_l > X_h(1-t)$ and information between entrepreneurs and investors is asymmetric, equilibrium is pooling with e.*

Consider $\varepsilon_h < \frac{(1-p)CX_h}{B} - tX_h$, $\varepsilon_l < \frac{(1-p)CX_l}{B} - tX_l$, $X_l < X_h(1-t)$ and information between entrepreneurs and investors is asymmetric: 1) if $\varepsilon_h < \frac{(1-p)CX_l}{B(1-t)} + X_l - X_h$, or if $\varepsilon_h > \frac{(1-p)CX_l}{B(1-t)} + X_l - X_h$ and μ is sufficiently large, equilibrium is pooling with e; 2) If $\varepsilon_h > \frac{(1-p)CX_l}{B(1-t)} + X_l - X_h$ and μ is sufficiently small, equilibrium is separating where h selects d and l selects e.

Proof. Follows from above. Indeed consider $X_l > X_h(1-t)$. Then $\frac{(1-p)CX_l}{B(1-t)} + X_l - X_h > \frac{(1-p)CX_h}{B} - tX_h$ so $\varepsilon_h < \frac{(1-p)CX_l}{B(1-t)} + X_l - X_h$. Then the only equilibrium is pooling with e.

Now consider $X_l < X_h(1-t)$. If $\varepsilon_h > \frac{(1-p)CX_l}{B(1-t)} + X_l - X_h$, then pooling with e dominates a separating equilibrium where h plays d and l plays e by mispricing. If $\varepsilon_h < \frac{(1-p)CX_l}{B(1-t)} + X_l - X_h$, pooling with e exists if μ is sufficiently large.

The results of our analysis in Section 4 are summarized in Tables 5 and 6.

Table 5. The model predictions when $X_l > X_h(1-t)$

Condition	Equilibrium	Empirical prediction
$\varepsilon_h > \frac{(1-p)CX_h}{B} - tX_h$, $\varepsilon_l > \frac{(1-p)CX_l}{B} - tX_l$	*pooling with d*	equity is not issued
$\varepsilon_h > \frac{(1-p)CX_h}{B} - tX_h$, $\varepsilon_l < \frac{(1-p)CX_l}{B} - tX_l$	*separating: h plays d and l plays e*	positive correlation between debt and profitability
$\varepsilon_h < \frac{(1-p)CX_h}{B} - tX_h$, $\varepsilon_l > \frac{(1-p)CX_l}{B} - tX_l$	$\varepsilon_l > \frac{(1-p)CX_h}{B(1-t)} + X_h - X_l$, *then separating: h plays e and l plays d* $\varepsilon_l < \frac{(1-p)CX_h}{B(1-t)} + X_h - X_l$, *$\mu$ is sufficiently high pooling with e*	equity and debt are issued; negative correlation between debt and profitability; equity is positively correlated with macroeconomic situation
$\varepsilon_h < \frac{(1-p)CX_h}{B} - tX_h$, $\varepsilon_l < \frac{(1-p)CX_l}{B} - tX_l$	*pooling with e*	debt is not issued

Table 6. The model predictions when $X_l < X_h(1-t)$

<table>
<tr><th>Condition</th><th>Equilibrium</th><th>Empirical prediction</th></tr>
<tr><td>$\varepsilon_h > \frac{(1-p)CX_h}{B} - tX_h$,
$\varepsilon_l > \frac{(1-p)CX_l}{B} - tX_l$</td><td>pooling with d</td><td>equity is not issued</td></tr>
<tr><td>$\varepsilon_h > \frac{(1-p)CX_h}{B} - tX_h$,
$\varepsilon_l < \frac{(1-p)CX_l}{B} - tX_l$</td><td>separating: h plays d
and l plays e</td><td>positive correlation between
debt and profitability</td></tr>
<tr><td>$\varepsilon_h < \frac{(1-p)CX_h}{B} - tX_h$,
$\varepsilon_l > \frac{(1-p)CX_l}{B} - tX_l$</td><td>1) $\varepsilon_l > \frac{(1-p)CX_h}{B(1-t)} + X_h - X_l$,
then separating:
h plays e and l plays d
2) $\varepsilon_l < \frac{(1-p)CX_h}{B(1-t)} + X_h - X_l$,
2a. $\varepsilon_h > \frac{(1-p)CX_l}{B(1-t)} + X_l - X_h$,
μ is sufficiently low
then pooling with d
2b. μ is sufficiently high
then pooling with e</td><td>equity and debt
are issued;
negative correlation
between debt
and profitability;
equity is positively
correlated with
macroeconomic situation;
overconfidence
is positively
correlated with debt</td></tr>
<tr><td>$\varepsilon_h < \frac{(1-p)CX_h}{B} - tX_h$,
$\varepsilon_l < \frac{(1-p)CX_l}{B} - tX_l$</td><td>$\varepsilon_h > \frac{(1-p)CX_l}{B(1-t)} + X_l - X_h$,
or $\varepsilon_h < \frac{(1-p)CX_l}{B(1-t)} + X_l - X_h$
and μ is sufficiently high
pooling with e
$\varepsilon_h < \frac{(1-p)CX_l}{B(1-t)} + X_l - X_h$
and μ is sufficiently low
separating: h plays d
and l plays e</td><td>debt and equity are issued;
equity is positively
correlated with
macroeconomic situation</td></tr>
</table>

5 The model implications.

Let us now summarize the results of our analysis. First note that an important condition is

$$\frac{(1-p)C}{B} > t \tag{74}$$

If it does not hold then RHS of conditions determing thresholds for ε ($\varepsilon_h > \frac{(1-p)CX_h}{B} - tX_h$ and $\varepsilon_l > \frac{(1-p)CX_l}{B} - tX_l$) that separate different cases are negative and therefore they hold automatically because $\varepsilon \geq 0$.[4] Then the only possible case is case 1 that has very similar predictions to traditional theory. The interpetation of situation when this conditon does not hold is if tax rate is too high or bankruptcy cost are too low or firm size is too large. We focus on the case when (74) holds. Then all four cases considered in previous section are possible. Note that based on empirical research not all entrepreneurs are overconfident (Malmendier, Tate and Yan (2011)). Secondly we think that it is more likely when the extent of overconfidence of low-quality firm is not lower than the high-quality firm. Although this has not been tested sofar but seems to be consistent with the spirit of some findings in Trinugroho and Sembel (2011). Therefore we think that empirical predictions of our model are mostly related to case 3 and case 4.

Let us look closely at the impact of each variable on the outcome of the model.

Debt and firm size. In the model, firm size is related to variable B. If B increases then it is more likely that case 3 occurs because the condition $\varepsilon_l > \frac{(1-p)CX_l}{B} - tX_l$ is more likely to hold. If we compare case 3 and case 4, in case 4 if we assume that each subcase is equally likely, each type of firm would issue debt with probability 50% (it will issue debt in one case but not in the other one). In case 3 type h issues debt with probability 50% but type l will always issue debt in this case. Therefore, the model predicts that as B increases, more debt will be issued in equilibrium. Empirical literature usually confirms that debt is postively correlated with firm size. Large firms have more debt than small firms (eg Frank and Goyal (2009)).

Expected bankruptcy costs and debt. If C increases then the effect is opposite to the previous one, i.e case 4 will prevail and debt will be issued less. As the expected bankruptcy costs increase, the advantages of using equity increase. This result has several interpretations. Tangible assets suffer a smaller loss of value when firms go into distress. Hence, firms with more tangible assets, such as airplane manufacturers, should have higher leverage compared to those that have more intangible assets, such as research firms. Growth firms tend to lose more of their value than non-growth firms when they go into distress. Hence, the model predicts a negative relationship between leverage and growth. Empirical evidence by Rajan and Zingales

[4] We consider a model of start-up firm choice of organizational structure with pessimistic entrepreneurs (analogous to $\varepsilon < 0$ in our model) in Miglo and Brodziak (2019) and a case of capital structure with pessimistic entrepreneurs is discussed in Miglo (2020).

(1995), Barclay, Morellec, and Smith (2006), and Frank and Goyal (2009) generally supports the above predictions.

Taxes and debt. The effect of increase in t is similar to that of B described above. So tax rate is positively correlated with debt. Debt should increase because higher taxes lead to a greater tax advantage of using debt. Hence, firms with higher tax rates should have higher debt ratios compared to firms with lower tax rates. Inversely, firms that have substantial non-debt tax shields such as depreciation should be less likely to use debt than firms that do not have these tax shields. If tax rates increase over time, debt ratios should also increase. Debt ratios in countries where debt has a much larger tax benefit should be higher than debt ratios in countries whose debt has a lower tax benefit.

Note that Graham (1996) finds some support for tax factor. Faulkender and Smith (2016) discuss tax strategies of international companies. It is mentioned that multinational groups are using significantly higher debt in high-tax jurisdictions, which is consistent with the tax shield idea. Devereux, Maffini and Xing (2018) find support for positive correlation between tax rate and firm debt using confidential company-level tax returns for a large sample of UK firms.

Debt and Profitability. A separating equilibrium where high-quality firms issue equity and low-quality firms issue debt appears more often than one where high-quality firms issue debt and low-quality firms issue equity. An implication of this result is that debt and proftability are negatively correlated. This is a new result compared to the traditional pecking-order theory or behavioral finance literature (Fairchild (2005)).

Empirical studies typically find a negative relationship between profitability and leverage (Titman and Wessels (1988), Rajan and Zingales (1995), Fama and French (2002), Frank and Goyal (2007), Vithessonthi and Tongurai (2015), Le and Phan (2017), Mai, Meng and Ye (2017)).

Extent of asymmetric information and debt. In our model, if $X_h = X_l$, then, as follows from Table 3, (if we assume, for example, that ε is equally likely to be below or abive the level $\frac{(1-p)C}{B}$) debt and equity are equally likely. When $X_h \neq X_l$ then as we dicsused above, case 3 and case 4 in Table 5 prevail. Also, as we mentioned previously, in case 3 debt dominates equity on average while in case 4 they are equally likely. So on average debt will dominate equity meaning that the extent of asymmetric information favors debt which is consistent with empirical findings. D'Mello and Ferris (2000) and Bharath, Pasquariello, and Wu (2008) fimd that debt dominates equity when the extent of asymmetric information is large. Choe, Masulis, and Nanda (1993) find that equity issues are more frequent when the economy is doing well and information asymmetry is low.

Overconfidence and debt. In our model overconfidence is positively correlated with debt. Indeed if ε increases, it is more likely that case 3 will prevail over case 4 and as was previously mentioned, debt will prevail over equity. This result is generally consistent with empirical findings such as Malmendier, Tate and Yanv (2011). Also it follows from the separating equilibrium analysis that firms with overconfident managers issue more debt and/or less equity than firms with unbiased managers.

Capital structure and the business cycle. The model predicts that when the economy is bad (μ is low), firms are less likely to issue equity (Case 3 and Case 4). When the economy is booming (μ is high), equity issues are more likely. Empirical work by Choe et al. (1993), Bayless and Chaplinsky (1996), and Baker and Wurgler (2002), Baum, Stephan and Talavera (2009) and Zeitun, Temimi and Mimouni (2017) suggests a positive relationship between equity issues and the business cycle.

Also as follows from case 3, when μ is large debt is negatively correlated with proftability while when it is small, the opposite is true. Recent study finds, for example, French civil law countries show a positive influence of leverage on operating performance when the industry has suffered a downturn (González (2013)).

6 Discussion

This section discusses different asummptions made in the article, the model robustness with regard to these assumptions and also possible model extensions and directions for future research.

Different profit functions. Our focus in this article is to analyze the role of different market imperfections and behavioural bias simultaneously. That is why we adopt a relatively simple project return function. Most of our results are intuitively sound and will hold if different profit functions (eg. with continuous support) are used. It will not, however, affect the results although it can change some proofs. For example, an equilibrium where the high-quality type issues equity (case 3) would still exist. If the level of overconfidence of low-quality type is significantly large then it will not be interested in mimicking the high-quality type issuing equity although the calculations become longer.

The distribution of types. In our model we use two types of firms to illustrate the main ideas. This is also very typical in literature. A natural question though is whether the results stand if one considers a case with multiple types. Our analysis shows that most conclusions remain the same. It is well known, for example, that POT results hold under asymmetric information with multiple types (see Myers and Majluf (19884) and Nachman and Noe (1994)). In the case of multiple types (and assuming that overconfidence level is negatively correlated with a firm's quality) one can show that a semi-separating equilibrium exists with a cut-off level of expected performance such that all firms with expected performance higher than this level issue equity and all firms with expected performance lower issue debt. Qualitatively it has similar interpretations to our main results.

More types of financing. Introducing additional financing strategies such as convertible securities is an interesting direction for future research. Most results regarding the costs and benefits of different financing strategies found in this paper are quite general and do not depend on the introduction of additional options into the model. The idea holds that if some firms are run by overconfident managers and some firms are run by rational managers then overconfident managers would prefer securities that are less sensitive to future performance since these securities are less "penalized" by the market from their point of view. Rational managers would not mind to issue securities that have relative high sensitivity to future performance when they believe that prices will more or less correctly reflect their true values. Under asymmetric information (unlike the case when all managers are rational) they would anticipate that overconfident managers (if the level of overconfidence is relatively high) will issue securities with low sensitivity and do not mimic their strategies.

Moral hazard. In our model we assume that managers act in the interest of shareholders. One can extend the model by allowing managerial moral hazard. For example, one can consider a scenario where managerial moral hazard takes place because a manager's equity stake in his firm is reduced while his individual effort is costly and this cost is not shared. This approach is very common in financing literature (starting with Jensen and Meckling (1976)) and typically creates an agency cost of equity financing (also see Fairchild (2005)). This will reduce incentives for high-quality firms to issue equity in equilibrium. However, there are many different ways to analyze moral hazard issues, for example, to explicitly model a manager's level of effort and it's impact on the probability distribution of his firm's profit and respectively how earnings are shared between different claimholders. This approach is quite common in contract literature. In finance literature this approach was used, for example, in Innes (1990). Debt may have its own cost related to moral hazard issues such as underinvestment and overinvestment problems for example (see, for example, Myers (1977)). Adding moral hazard is an interest line for future research.

Behavioural biases exist regarding other variables. Another possible extension of our research is to analyze the case when entrepreneurs are biased with regard to not only the project return but, for example, the probability of project success p. Two points are worth mentioning though. The main result of our paper, that the combination of four factors (namely asymmetric information, behavioural bias, tax and bankruptcy costs) leads to a richer set of predictions compared to traditional theories will not be affected. Quantitatively, the results may change though.

7 Conclusion.

This article presents a new capital structure model based on four factors well documented in literature: asymmetric information, taxes, bankruptcy costs and decision-makers' overconfidence. The model can simultaneously explain several facts about capital structure including those that remain puzzling from existing theories point of view eg negative correlation between debt and profitability; why firms issue equity etc. Unlike many advanced research on capital structure, a closed-form solution is obtained for most results.

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