Leveraged Buy Out: Does the arrival of new targets increase the agents' incentives?

Ouidad YOUSFI*†

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Abstract

This paper studies the financial capital structure in Leveraged Buy Out (LBO) acquisitions. It analyzes how the arrival of new targets improves the agents' incentives when there is asymmetric information.

The entrepreneur and the LBO investor exert unobservable efforts to enhance the productivity of their project. We show that there are no debt-equity contracts that induce the entrepreneur and the LBO investor to provide the first-best levels of efforts. The decision of the LBO fund to exit prematurely the entrepreneur's project increases the agents' incentives. We also find that the entrepreneur's incentives increase with the amount of debt and when the LBO investor promises her the whole compensation cost.

Keywords: Leveraged Buy Out, incentives, prematurely exit, double moral hazard.

JEL classification: D82, D92, G33, G34.

1 Introduction

1.1 Motivation

Many public companies that go private issue a combination of debt and private equity to finance their management or *Leveraged Buy Out* (LBO). In many countries most notably

*Ouidad Yousfi is an assistant Professor of Finance, IUT de Montpellier and is at CR2M Université de Montpellier II, EconomiX, Université de Paris West Nanterre la Défense, and Fiesta, ISG de Tunis.

†Email : ouidad.yousfi@gmail.com.

in the United States, these companies are financed mostly with debt and a small amount of equity, hence the term *leveraged*: they are typically financed with anywhere from 60% to 90% debt (Jensen, 1986, 1989; Kaplan, 1989; Kaplan and Stein, 1993; Kaplan, 1997; Kaplan and Strömberg, 2008; and many others). Between the mid- and late 1980s such transactions absorbed most new private equity capital.

Despite its dramatic growth and increased significance for corporate finance, the LBO market has received little attention in the academic literature compared to the other private equity markets, like for example venture capital (VC)[1]. Many topics, such as, exits and syndication remain surprisingly poorly understood.

The reasons are many and varied. One is that any analysis of the buyout market is handicapped by a lack of readily available information: unlike VC organizations, little public information is available in buyout projects. In USA, private equity securities are not registered with the Securities Exchange Commission (SEC). Another explanation, related to the nature of the buyout market itself, the partners want to protect the confidential/secretive nature of their businesses: the targets are private and they do not reveal financial and operating data about themselves (Fenn et al., 1995). Another complication comes from the fact that the first buyout projects were financed through organizations/groups that have often made VC type of investments. Consequently, we cannot say whether the project is a VC or an LBO by just looking at the attributes of the investors (Cao and Lerner, 2009).

The present paper deals with two facts in LBO finance:

First, the financial capital structure, particularly the excessive use of debt in these acquisitions: this paper shows that the optimal financial contracts are consistent with this feature in a dynamic framework with double sided moral hazard. We characterize the optimal financial capital structure that results from the solution to a contract problem. We work out the optimal solution to the financing problem of an entrepreneur (hereafter she) who would like to acquire a company (called the target): she is a manager but she has no business experience to manage the acquired company alone or she is wealth constrained. She asks first for money and for advice from the LBO investor (hereafter he). The latter contributes technically and financially to the project and in exchange he gets a share of the project's outcome. In many cases, the LBO investor acquires large ownership stakes and takes an active role in monitoring and advising the entrepreneur. He may exercise

[1] LBO projects had been bought out by professional later-stage private equity investors and are characterized, in contrast with VC projects by the use of leverage.

as much control as her, or more. The partners sign the holding contract and can ask for additional funds from the bank (hereafter he). Therefore, they sign the debt contract. The optimal sharing rule of the project's outcome may change at the end of the first period. The optimal solution and the optimal sharing rule are constrained by the characteristics of the environment such as the information available to both parties and the arrival of new projects in the market. The entrepreneur and the LBO investor have to provide costly and unobservable efforts to improve the project's results. They face a moral hazard problem.

Second, motivated by some empirical observations on exit choices, we aim at investigating the question of what are the consequences of the prematurely exit decision, particularly those related to the agents' incentives and to the financial capital structure in buyout investments.

The exit is the most important and the last way the LBO investor can realize a high positive return on the investment: he invests in mergers and acquisitions projects with the clear desire of exiting after 3-5 years. His aim is to get his money back and to exit quickly in order to invest it in a new deal. If the entrepreneur's project turns out to be non-performing, the project is abandoned showing the ability of the LBO investor to filter out good from bad investments. The exit route and timing are therefore crucial for financing. The entrepreneur must know that the LBO investor will eventually want to exit the buyout, and that very often this means that the target's shares will be sold to another company (trade sale) or to another LBO investor (secondary LBO) or also to the entrepreneur (buyback). The choice of the exit date and route may lead to agency conflicts between the entrepreneur and the LBO investor. If the company is taking public through an IPO, the entrepreneur keeps the control and may even get private benefits because she shares the control with a large number of uninformed investors. This is no longer true when the buyout is taking private such in trade sales and buybacks: if she stays in the company, she shares the control with few informed partners. In the current paper, we do not consider the issue of the optimal timing/route of exit but we focus only on the prematurely exit, particularly on its effects on the agents' incentives when the entrepreneur and the LBO investor face moral hazard. The prematurely exit of the LBO investor is quite likely if there are more profitable projects in the LBO market looking for financing and for advice (he takes advantage of a change in market conditions that makes quick exits desirable) or when the target does not reach its short term objectives (this may be explained by a mistake made by the LBO investor when he chooses to invest in the entrepreneur's buyout). For the stake of simplicity, we do not make differences between the two cases.

We analyze how the entry of more profitable buyout in the market affects the financial structure of the established buyouts and what the entrepreneur should do in such case. To our knowledge, the current paper is the first theoretical one that addresses this issue in buyout acquisitions.

1.2 Related literature

The present model is related to two lines of literature.

First, various papers consider a dynamic agency model with information asymmetry. They analyze the interaction between the financial capital structure and incentives when there is an information asymmetry, due to unobservable efforts. The majority of these papers are dealing with the VC projects.

To our knowledge, there is no academic paper exploring the financial structure in buyouts when the entrepreneur and the LBO investor face double moral hazard.

For instance, Bergemann and Hege (1998), Cornelli and Yosha (2003), Repullo and Suarez (2004), Schmidt (2003)... These papers highlighted the importance of adequate incentive-rewarding schemes, the role of the *stage financing* and convertible securities to mitigate the moral hazard problem between the entrepreneur and the private equity investor.

Bergemann and Hege (1998) consider a dynamic agency model in the presence of learning and moral hazard problems. They show that short-term refinancing[2] is never optimal but long-term contract allowing for intertemporal risk-sharing such as the stage financing is optimal: it induces the entrepreneur to provide optimal effort so that the VC fund will invest further funds in the following stage. Otherwise, the VC firm leaves the project off. However, the *stage financing* creates a "*window dressing*" problem in order to induce the private equity investor to finance the second stage of the project. They conclude that with a convertible debt contract, such opportunistic behavior becomes non profitable; the private equity investor will convert his debt into equity if the project looks too profitable which decreases the entrepreneur's profit (Cornelli and Yosha, 2003). Schmidt (1999, 2003) shows that there is no debt-equity contract that induces both parties to invest efficiently and argues that the use of convertible securities mitigates the double sided moral hazard problem. Moreover, these securities outperform any mixture of debt and equity and they

[2] At the end of each period (round financing), the entrepreneur asks for financing and for advice from a new venture capitalist and signs a new contract; the VC market is supposed to be competitive.

induce both parties to provide optimal efforts. His result is robust to renegotiation and to changes in the timing of investments and information flows.

These papers consider agency model with just two agents; the entrepreneur and the venture capitalist. In contrast with these models, Casamatta (2003) adds a third party, the pure financier and shows that under specific conditions, his or her presence lead the two agents to exert the first-best levels of efforts. We show that the presence of the bank does not implement these efforts: there are no debt-equity contracts that solve the moral hazard. Repullo and Suarez (2004) consider a wealth constrained entrepreneur asking for advice and for money from two VC investors. One of them does not provide effort so he may be considered as a pure or passive financier. They conclude that the entrepreneur must ask for advice and fund from the partner who provides both. In the current model, the entrepreneur hires both the bank and the LBO investor despite the fact that the latter is not a wealth constrained agent.

My model is also related to the financial literature on exit vehicles in private equity investments. Most of the papers are dealing with the choice of exit route in VC. Few papers, mostly empirical studies, focus on the topic of buyouts particularly the threat of prematurely exit. They argue that the buyout is abandoned when the quality is mediocre (in the sense it is only able to return the initial investment) or the private equity investor did a mistake when he invested in the firm.

For instance, Schwienbacher (2008) analyzes the relationship between the level of innovation of the project and the exit decision. He shows that going public is more profitable than trade sale when the project is very innovative. In an IPO strategy, the entrepreneur remains in the firm, keeps its control and can get private benefit. Consequently, she is tempted to distort the innovation strategy so that the IPO looks the preferred exit route. Giot and Schwienbacher (2007) argue that the exit decision depends on the type of exit strategy and on the timing. For instance, biotechnology and Internet projects are the fastest in exiting through IPO. Unprofitable Internet firms are abandoned quickly. Schmidt et al. (2009) focus on buyout exit strategies in Europe and USA. They consider a sample of 666 buyouts between 1990 and 2005 and analyze the determinants influencing the choice of the exit option. Their results show strong support for signaling effect. If the return is very poor, the LBO investor leaves the project early instead of holding it in his portfolio as *living-dead* buyout. He is able to differentiate between good and bad investments quickly. Only the most profitable projects (*high-flyers*) are taken public through an IPO. Nikoskelian and Wright

(2005) consider a sample of 321 UK buyouts, exited between 1995 and 2004. They find a positive relationship between the value increase and the management ownership. Das et al. (2002) analyze the options of exit of VC and LBO investors in the American market. They estimate the probability of various exit options and they conclude that the probability of sales exit is the highest. Groh and Gottschalg (2008) point out that the US targets clearly outperform the market benchmark. Ick (2006) investigates the risk and return relationship of private equity relative to public market equity and finds that the private equity returns depend on the stage of the investment. Later stage investments achieve higher risk adjusted returns. Cumming and MacIntosh (2003) show in an empirical analysis in Canada and USA that IPO are the most profitable followed by secondary sales and buybacks for the less profitable projects. More recently, Cao and Lerner (2009) conduct a study about the performance of 496 reverse LBO (RLBO) in the USA. Their results indicate that the IPOs that had been bought by LBO investors outperform other IPOs and the stock market as a whole, and that quick flips[3] perform much worse than the firms kept longer than one year by the LBO firm.

In all these papers, the exit decision depends only on the performance of the project, but they do not consider the relationship between the agents' incentives and the choice of the exit route when there is an asymmetric information, and the characteristics of the company's market: the private equity firm invests in the project in the hope that he will get a high return in a short period of time and he exits as soon as possible in order to invest his money in a new deal. The LBO investor looks continuously for *high-flyer* targets. These issues are still pending.

1.3 Results

The model allows to derive the following results:

First, if there is no competitive project, the entrepreneur and the LBO investor provide the first best efforts only when the project is not very risky and the debt's payments are decreasing with the project's revenues. The presence of the bank, particularly the threat of liquidation leads the entrepreneur and the LBO investor to exert high levels of efforts[4] and the whole surplus value of the project is captured by the entrepreneur. The bank is

[3] Private equity firms sell off their investments within a year after acquisition.

[4] This result is in line with those of Jensen and Meckling (1976), Jensen (1986, 1989) and many others who highlight the disciplinary value of the debt

regarded as a *budget breaker*. Whether the project is very risky or not, the optimal financial contracts should reward the entrepreneur and the LBO investor only in the good state of the nature. If the project is very risky, the bank receives no payments in success states of the nature. The optimal debt contract should exhibit the features of a "*live or die*" contract but these contracts cannot be implemented in the real world with a bank but with a pure financier such in Casamatta (2003).

When the payments of the bank are constrained to be non-decreasing with the project's outcome, he is paid the liquidation values of the buyout in the good and bad states. Besides, the agents do not exert the first-best levels of efforts. We conclude that there are no debt-equity contracts that implement the first best. Moreover, in contrast with the traditional literature[5] which highlights the disciplinary role of debt, we show that financing the project through equity improves the agents' incentives. It is explained by the fact that with a standard equity contract, they have strictly positive payments in the bad states of nature in contrast with debt-equity contracts.

Second, the threat of prematurely exit induces the entrepreneur and the LBO investor to exert high levels of efforts. Both are better off if the result of the first period is a success. Otherwise, they would have no payments and the LBO investor cannot get his money back to invest in the new project. The threat of prematurely exit is a powered incentive scheme but no high enough to let them exert the first-best levels of efforts.

Third, under the threat of prematurely exit, the LBO investor issues higher level of equity and the leverage increases with the compensation's share of the bank. When there is an arrival of very profitable project to the target's market, the LBO fund prefers surrendering all the compensation cost to the entrepreneur for incentive motive. If the competitive buyout is not very profitable, the bank gets a strictly positive compensation's share and accepts to raise a higher amount of debt. This implies also that the leveraged is decreasing with the performance of the competitive target. Whether the competitive project is very profitable or not, the LBO's incentives do not change.

Fourth, the entrepreneur's incentives increases with the compensation cost and decreases with the net revenue of the competitive target. If she shared the compensation cost with the bank, the two agents exert equal levels of efforts. But, if the optimal contracts surrender to her the entire compensation cost, she provides higher effort.

[5] See among others Jensen and Meckling (1976), Jensen (1986, 1989, 1991).

Fifth, we show at a macroeconomic level that only a set of the targets looking for financing through the LBO investor and bank can be taken private through a buyout acquisition: the entrepreneur must be wealthy enough.

The paper is structured as follows. The model and the assumptions are presented in Section 2. The optimal financial contracts are characterized in Section 3. Section 4 analyzes the optimal financial contracts when the project is financed only through equity. We add the threat of prematurely exit in Section 5 and study the financial structure of the capital. Section 6 concludes the paper. All proofs are presented in the Appendix.

2 The model

Consider a dynamic agency model with two periods (the starting and productive stages) and three agents (the entrepreneur E, the LBO investor A and the bank B). The entrepreneur wants to acquire a company. She asks for money and advice from the LBO investor. If he accepts to undertake the project, he issues the amount of equity i in exchange of a share of the project's outcome. For the stake of simplicity, we consider that the buyout is initiated by the entrepreneur such in LMBO investments.[6]

The acquisition of the firm requires a fixed initial investment K at time 0, K is exogenously given and is significantly high. Let W and i denote respectively the capital issued by E and A, and I the amount of debt raised by B, $K = W + i + I$. At the end of the period t, the entrepreneur and the LBO investor get respectively the shares β_t and $1 - \beta_t$, $0 \leq \beta_t \leq 1$, $t = 1, 2$ of the project's outcome.

First, the entrepreneur and the LBO investor sign the holding contract in order to establish the holding company[7]. Then, if they still need further funds, they sign the debt contract.

The entrepreneur and the LBO investor provide respectively the unobservable efforts e and a. These efforts enhance the productivity of the project. The entrepreneur's effort is related to her technical skills and/or to her past experience as a manager. The LBO investor

[6]This is not always the case since the main job of the LBO fund staff is to seek out and exploit profitable buyout investments.

[7]The holding company acquires the target called also the *Op Co*, using mostly debt and a small amount of equity. The debt is secured by the *Op Co* assets. The acquiring company uses these assets as collateral for the debt in hopes that the future cash-flows will cover the debt's payments.

provides a managerial and/or control effort to run properly the project.[8]

2.1 The revenues

The project yields the revenue $\tilde{X}_1$ ($\tilde{X}_2$) at the end of the starting stage (the productive stage) such that:

$$\tilde{X}_t = \begin{cases} X_t & \text{with the probability } p_t = \min\{e_t + a_t, 1\} \\ \gamma^{t-1}C & \text{with the probability } (1 - p_t) = \max\{0, 1 - (e_t + a_t)\} \end{cases}$$

C is the liquidation value/collateral of the project at the end of the first period. $1 - \gamma$ ($0 \leq \gamma \leq 1$) is the depreciation rate. The value of the equipment and machines decreases due to the usage, the passage of time and the outdated technologies. We assume that $X_t \geq \gamma^{t-1}C$, $t = 1, 2$.

e_t and $a_t \in [0, 1]$ are the efforts provided at stage t. These efforts are perfect substitutes. If one agent provides unitary effort, the project will succeed with probability 1: $p_t(0, 1) = p_t(1, 0) = 1$.

The entrepreneur and the LBO investor choose their efforts simultaneously. When efforts are unobservable, they may not exert sufficiently high levels of efforts. The entrepreneur will rely on the effort of the LBO investor in hopes that the latter will provide unitary effort and vice versa. Consequently, they face a moral hazard problem.

Efforts are costly. The cost functions are given by:

$$c_E(e_t) = \frac{\lambda}{2}e_t^2 \quad \text{and} \quad c_A(a_t) = \frac{\lambda}{2}a_t^2,\ t = 1, 2$$

where $\lambda > 0$ is assumed to be significantly high and $C \leq \frac{\lambda}{2\gamma}$. Efforts have equal costs when E and A make the same levels of efforts. Given the fact that they are perfect substitutes, they have equal impacts on the project's performance.

2.2 The sequence of events

The sequence of events is presented in figure 1:

[8] The LBO fund provides the same kind of effort as the entrepreneur. He learns these skills from his past investments.

- At date $t = 0$, the entrepreneur and the LBO investor sign the holding contract. Then, they may ask for additional funds from the bank. They sign the debt contract.
- At date $t = 1$, the agents E and A provide simultaneously and respectively the efforts e_1 and a_1.
  - If $\tilde{X}_1 = X_1$, the bank perceives the payment D_1. The entrepreneur and the LBO investor get respectively $\beta_1 (X_1 - D_1)$ and $(1 - \beta_1)(X_1 - D_1)$. The LBO investor may leave the entrepreneur's project even if it succeeded, to invest in a competitive buyout which gives him exogenous net revenue $R \geq 0$.
    - If there is exit, the entrepreneur's project ends at date 1. The LBO investor must pay an exogenous compensation cost L to the other partners because he breaks the holding and debt contracts. The revenue of the competitive project must be superior to the compensation's cost, otherwise, the LBO investor has no reason to abandon the target: $R \geq L$. Let η and $1 - \eta$ $(0 \leq \eta \leq 1)$ denote the shares of the compensation paid to the entrepreneur and the bank, respectively. The variable η is an endogenous variable to be determined in the optimal financial contracts. We suppose that the LBO investor will leave the entrepreneur's project with the probability ζ, $0 \leq \zeta \leq 1$. For simplicity, we exogenize this probability.
    - Otherwise, the entrepreneur's project is continued and the entrepreneur and the LBO investor choose respectively the efforts e_2 and a_2.
  - If $\tilde{X}_1 = C$, the entrepreneur's project is supposed to be liquidated and the bank perceives the collateral C.
- At date $t = 2$, the project is completed.
  - If $\tilde{X}_2 = X_2$, the bank, the entrepreneur and the LBO investor get respectively the payments D_2, $\beta_2 (X_2 - D_2)$ and $(1 - \beta_2)(X_2 - D_2)$ with the probability p_2.
  - If $\tilde{X}_2 = \gamma C$, the project fails and it is liquidated. The bank is paid the whole failure's revenue γC.

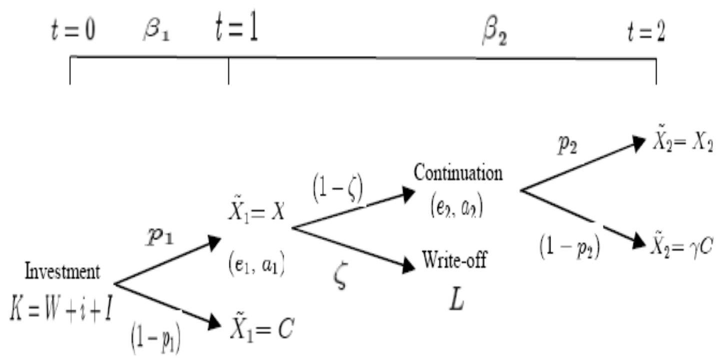

Figure 1- Time line of the game.

The riskless interest rate is normalized to 0. All agents are risk neutral and protected by limited liability: they can only share the project's revenues.

2.3 The contracts

The agents sign two financial contracts.

a) The debt contract must specify:

- The amount of the debt I issued by the bank.
- The bank's payments at the starting and productive stages D_1 and D_2.

The bank raises the amount of debt I only if he gets a positive expected gain:

$$\begin{aligned} E(\pi_B) &= p_1 \{D_1 - C + (1-\zeta)[p_2 (D_2 - \gamma C) + \gamma C] + \zeta (1-\eta) L\} \\ &\quad + C - I \geq 0 \end{aligned} \tag{CP_B}$$

(CP_B) is his participation constraint. The banks compete for the right to fund the target, then we expect the debt contract to be the best possible for the entrepreneur. Accordingly, the bank B earns no profits.

We suppose that:

$$0 \leq D_t \leq X_t \text{ , } t = 1, 2. \tag{1}$$

b) The holding contract which specifies

- The amount of funds i issued by the LBO investor.
- The outcome's shares β_t and $1-\beta_t$, $t=1,\ 2$, of the entrepreneur and the LBO investor, respectively.
- The compensation cost L to be shared between the entrepreneur and the bank.
- The shares of compensation η and $1-\eta$ paid respectively to the entrepreneur and the bank, if the LBO investor chooses to leave the entrepreneur's project at the date 1.

The LBO investor issues i only if his expected gain is positive. This condition is written:

$$\begin{aligned} E(\pi_A) = \; & p_1\left\{(1-\beta_1)(X_1-D_1)+\zeta(R-L)\right. \\ & \left.+(1-\zeta)\left[(1-\beta_2)\,p_2\,(X_2-D_2)-c_A(a_2)\right]\right\} \\ & -c_A(a_1)-i\;\geq 0 \end{aligned} \tag{CP_A}$$

(CP_A) is his participation constraint. Competition between the LBO investors implies that this constraint is binding.

Because of the competition among the LBO investors and the banks, both agents A and B are induced to propose contracts maximizing the expected gain of the entrepreneur which is given by:

$$\begin{aligned} E(\pi_E) = \; & p_1\left\{\beta_1(X_1-D_1)+(1-\zeta)\left[\beta_2 p_2\,(X_2-D_2)-c_E(e_2)\right]+\zeta\eta L\right\} \\ & -c_E(e_1)-W. \end{aligned}$$

Using the fact that $W=K-i-I$, $E(\pi_E)$ is written:

$$\begin{aligned} E(\pi_E) = \; & p_1\left\{\beta_1(X_1-D_1)+(1-\zeta)\left[\beta_2 p_2\,(X_2-D_2)-c_E(e_2)\right]+\zeta\eta L\right\} \\ & -c_E(e_1)-K+i+I. \end{aligned} \tag{2}$$

2.4 The first best solution

Before solving the game, let us compute the social value of the project without double sided moral hazard and exit problems. The social value of the project is given by:

$$\begin{aligned} V = \; & p_1[X_1-(1-\gamma)\,C+p_2\,(X_2-\gamma C)-c_E(e_2)-c_A(a_2)] \\ & +C-K-c_E(e_1)-c_A(a_1). \end{aligned}$$

The first order conditions of V gives the following first best efforts:

$$e_1^{FB}=a_1^{FB}=\frac{1}{\lambda}\left[X_1-(1-\gamma)C+\frac{1}{\lambda}(X_2-\gamma C)^2\right] \tag{3}$$

$$e_2^{FB}=a_2^{FB}=\frac{1}{\lambda}\left(X_2-\gamma C\right). \tag{4}$$

They lead to the success of the project with the probabilities:

$$p_1^{FB} = \frac{2}{\lambda}\left[X_1 - (1-\gamma)C + \frac{1}{\lambda}(X_2-\gamma C)^2\right] \quad \text{and} \quad p_2^{FB} = \frac{2}{\lambda}\left(X_2 - \gamma C\right) \ . \tag{5}$$

In the following, we assume that:

$$X_1 < \frac{\lambda}{2} + (1-\gamma)C \quad \text{and} \quad X_2 < \frac{\lambda}{2} + \gamma C \ . \tag{6}$$

to ensure that $p_t^{FB} < 1$, $t = 1, 2$.

The equations (3) and (4) show that the entrepreneur and the LBO efforts exert strictly positive efforts in both stages. The efforts of the first period, in contrast with those of the second period, depend on revenues of both stages. They increase with the project's revenues and decrease with the parameter cost λ and the collateral $\gamma^{t-1}C$, $t = 1, 2$.

It is straightforward to see that the efforts of the second period are decreasing when γ increases. In the starting stage, the impact of γ on the efforts of the first period is less intuitive: if γ is high enough $\left(\gamma\epsilon\left[\frac{2X_2-\lambda}{2C}, 1\right]\right)$, e_1^{FB} and a_1^{FB} are increasing with γ. A low depreciation rate increases the failure revenue γC which boosts their incentives. Otherwise, a high depreciation rate $\left(\gamma\epsilon\left[0\ ,\ \frac{2X_2-\lambda}{2C}\right]\right)$ reduces the agents' payments in the bad state of nature. Consequently, they make low efforts.

Notice that the entrepreneur and the LBO investor provide equal levels of efforts: (1) the efforts have equal impacts on the success probabilities and (2) the agents have the same cost function.

The optimal social value of the project is written:

$$V^{FB} = \frac{1}{\lambda}\left[X_1 - (1-\gamma)C + \frac{1}{\lambda}(X_2-\gamma C)^2\right]^2 + C - K. \tag{7}$$

We assume that $V^{FB} > 0$. There are many ways to implement the first best solution: the identities of the agents providing advice and financial investments are irrelevant as long as the LBO investor and the bank are not wealth constrained and there are no transaction costs.

2.5 The efforts in equilibrium

In order to maximize their expected gain, each agent will take into account the levels of efforts chosen by the other agent. These strategies are described by their reaction functions.

We solve optimal financial contracts using a dynamic programming approach (*the backward induction process*). We consider the subgame that begins at the end of the productive stage: first, we determine the efforts in equilibrium of the second period. Then, we replace them in the expected gain of each agent to deduce those of the first period.

Each agent chooses the level of effort that maximizes his expected gain of the second period. The LBO investor provides the effort a_2^* solution of:

$$a_2^* \in \underset{a_2}{\arg\max} E(\pi_A^2 | \tilde{X}_1 = X_1)$$

where $E(\pi_A^2 | \tilde{X}_1 = X_1) = p_2 (1 - \beta_2)(X_2 - D_2) - c_A (a_2)$ is his expected gain of the second period.

The entrepreneur effort is given by:

$$e_2^* \in \underset{e_2}{\arg\max} E(\pi_E^2 | \tilde{X}_1 = X_1)$$

where $E(\pi_E^2 | \tilde{X}_1 = X_1) = p_2 \beta_2 (X_2 - D_2) - c_E (e_2)$ is her expected gain of the second period.

Lemma 1 *The efforts of the second period of the entrepreneur and the LBO investor e_2^* and a_2^* are given respectively by:*

$$e_2^* = \frac{1}{\lambda} \beta_2 (X_2 - D_2) \quad \textit{and} \quad a_2^* = \frac{1}{\lambda} (1 - \beta_2)(X_2 - D_2) \tag{8}$$

If the benefit's share of one agent increases, his effort will increase: e_2^* (respectively a_2^*) is an increasing function of β_2 (respectively $1 - \beta_2$). When the difference between the success revenue and the bank's payment is large, the levels of efforts are high. Consequently, we need high-powered incentives to make them exert first-best levels of efforts. Notice that these efforts do not depend on the threat of prematurely exit since they are provided only if the LBO firm does not leave the entrepreneur's project.

Given the fact that the revenues of the second period are fixed, if the optimal financial contracts give powerful incentives to one agent, they will reduce the incentives of the other agent. The optimal financial contracts must boost simultaneously the two agents' incentives.

The entrepreneur and the LBO investor provide respectively the efforts e_1^* and a_1^* given by:

$$e_1^* \in \underset{e_1}{\arg\max} E(\pi_E | e_2^*, a_2^*) \quad \text{and} \quad a_1^* \in \underset{a_1}{\arg\max} E(\pi_A | e_2^*, a_2^*)$$

We replace the optimal efforts deduced in the previous paragraph, in their expected gains. The first order conditions of $E(\pi_E | e_2^*, a_2^*)$ and $E(\pi_A | e_2^*, a_2^*)$ enable us to deduce the following lemma:

Lemma 2 *The efforts of the first period e_1^* and a_1^* are written:*

$$e_1^* = \frac{1}{\lambda}\left\{\beta_1 (X_1 - D_1) + \frac{1}{2\lambda}\beta_2 (2 - \beta_2)(1 - \zeta)(X_2 - D_2)^2 + \zeta\eta L\right\} \tag{9}$$

$$a_1^* = \frac{1}{\lambda}\left\{(1 - \beta_1)(X_1 - D_1) + \zeta (R - L) + \frac{1}{2\lambda}\left(1 - \beta_2^2\right)(1 - \zeta)(X_2 - D_2)^2\right\} \tag{10}$$

The lemmas 1 and 2 state that the agents' efforts are independent since they are substitutes. As in the previous lemma, the entrepreneur's effort e_1^* (respectively the LBO's effort a_1^*) increases with the outcome's shares β_1 and β_2 (respectively $1 - \beta_1$ and $1 - \beta_2$). Both efforts are decreasing with the debt's payments D_t, $t = 1, 2$.

An increase of the exit probability ζ increases the levels of efforts exerted by both agents in the first stage. This implies that the entrepreneur's project will be continued with a small probability but both parties prefer providing efforts to make the project succeed, otherwise the project will fail with $p_1 = 1$ and both agents have no payments (the LBO investor cannot get his money back). Even if the project will not be continued, the entrepreneur is better off if the first period result is a success because this ensures her a strictly positive payment ηL in addition to $\beta_1 (X_1 - D_1)$. The entrepreneur's effort, in contrast with the LBO's effort, is increasing with the compensation cost L. If she would not exert effort, she gets no payment. The entrepreneur's effort, in contrast with the LBO's effort, is increasing with the compensation cost L.

Another intuitive result: the net revenue of the competitive buyout R has an impact only on the LBO's effort since the exit probability is assumed to be exogenous and does not depend on R.

The probability p_1^* does not depend on β_1 and p_2^* does not depend neither on β_1 nor on β_2. As explained above, this result is closely related to the assumptions of the model: the efforts are substitutes and the agents have the same cost function.

The entrepreneur's objective is to maximize her expected gain given the participation constraints of A and B, and the incentive constraints:

$$\max_{i,\ I,\ \beta_t,\ D_t,\ \ e_t,\ a_t,\ t=1,\ 2} E\left(\pi_E\right) = p_1\left\{\beta_1(X_1 - D_1) + (1-\zeta)\left[\beta_2 p_2\left(X_2 - D_2\right) - c_E\left(e_2\right)\right] + \zeta\eta L\right\} - c_E\left(e_1\right) - K + i + I.$$

$$\text{s.t.} \qquad \left(CP_A\right),\ \left(CP_B\right),\ (8),\ (9)\text{ and }(10)$$

with the following conditions:

$$(1)\text{ and } 0 \leq \beta_t \leq 1, \quad t = 1, 2.$$

3 The optimal financial contracts without the *threat of* prematurely exit

In this section, we consider first the case where the LBO investor cannot abandon the entrepreneur's project. Consider that there is no competitive buyout looking for advice and for money.

If $\zeta = 0$, the equations (9) and (10) are written:

$$e_1^* = \frac{1}{\lambda}\left[\beta_1(X_1 - D_1) + \frac{1}{2\lambda}\beta_2(2-\beta_2)\left(X_2 - D_2\right)^2\right] \tag{11}$$

$$a_1^* = \frac{1}{\lambda}\left[\left(1-\beta_1\right)\left(X_1 - D_1\right) + \frac{1}{2\lambda}(1-\beta_2^2)\left(X_2 - D_2\right)^2\right] \tag{12}$$

But those of the second period do not change: they are given by (8).

The participation constraints of the LBO investor and the bank enable us to write:

$$E(\pi_A) = p_1\left\{\left(1-\beta_1\right)\left(X_1 - D_1\right) + \left(1-\beta_2\right)p_2\left(X_2 - D_2\right) - c_A\left(a_2\right)\right\} - c_A\left(a_1\right) - i \geq 0 \tag{13}$$

$$E(\pi_B) = p_1\left\{D_1 - (1-\gamma)\,C + p_2\left(D_2 - \gamma C\right)\right\} + C - I \geq 0 \tag{14}$$

Accordingly, the entrepreneur's program is written:

$$\max_{\beta_t,\ i,\ I,\ D_t,\ e_t,\ a_t,\ t=1,\ 2} E(\pi_E) = p_1\left[\beta_1(X_1 - D_1) + \beta_2 p_2(X_2 - D_2) - c_E(e_2)\right] - c_E(e_1) - K + i + I$$

$$\text{s.t.} \qquad (8),\ (11),\ (12),\ (13)\ \text{ and, } (14)$$

with the following conditions:

$$(1) \text{ and } 0 \leq \beta_t \leq 1,\, t = 1,\, 2.$$

Because of the competition among the LBO investors and the banks, the participation constraints (CP_A) and (CP_B) are binding. So we can write:

$$i = p_1 \left\{(1-\beta_1)(X_1 - D_1) + p_2(1-\beta_2)(X_2 - D_2) - c_A(a_2)\right\} - c_A(a_1), \tag{15}$$

$$I = p_1 \left\{D_1 - (1-\gamma)\, C + p_2\, (D_2 - \gamma C)\right\} + C. \tag{16}$$

We replace (15) and (16) in the objective function of the entrepreneur's program. Consequently, the optimal financial contracts induce her to maximize the expected social value of the project under the incentive constraints such that:

$$\max_{\beta_t,\, D_t,\, e_t,\, a_t,\, t=1,\, 2} V = \begin{array}{l} p_1[X_1 - (1-\gamma)\, C + p_2\, (X_2 - \gamma C) - c_E(e_2) - c_A(a_2)] \\ +C - K - c_E(e_1) - c_A(a_1) \end{array}$$

$$\text{s.t.} \qquad (8),\, (11) \text{ and } (12)$$

with the following conditions:

$$(1) \text{ and } 0 \leq \beta_t \leq 1, \quad t = 1, 2.$$

The following proposition summarizes the properties of the optimal financial contracts:

Proposition 1 *There are no debt-equity contracts that implement the first best.*

See appendix A.

This proposition states that whether the project is very risky or not, the acquisition must be funded jointly by the entrepreneur, the LBO investor and the bank: all agents have to invest strictly positive amount of money in the entrepreneur's project. Once the bank is paid, the residual amount must be shared between the entrepreneur and the LBO investor. The intuition is the following: if the optimal contracts assign high outcome's share to one of them, they will induce him/her to provide high effort but simultaneously, they will reduce the incentives of the other one. Hence, the optimal financial contracts have to induce both parties to provide optimal efforts.

First, we find that the debt's payments are decreasing with the outcome in the starting and the productive stages. Consequently, E and A are tempted to announce a success to the bank whether the good states occurred or not: if the bad state of nature occurred, they are better off if they sell the project's assets and pay D_t to the bank and share the residual amount between them (see, among others, Innes, 1990, Casamatta, 2003).

When the project is not very risky in the sense $X_1 \leq 2(1-\gamma)C$ and $X_2 \leq 2\gamma C$, the entrepreneur and the LBO investor exert the first-best levels efforts. These efforts are not very high since the differences between the revenues of success and failure are small, it is easy to make them providing the first-best levels of efforts. The presence of the bank induces them to make efficient investment decisions: the project's revenues are paid to the bank in the bad states of nature.

The entrepreneur captures the optimal social value of the project $\left(E\left(\pi_E^*\right) = V^{FB}\right)$. This is no longer true when the differences between the revenues of failure and success are large. Despite the fact that we use a powered incentive scheme in which the optimal debt contract exhibits the features of a "*live or die*" contract[9], both agents provide low efforts:

$$e_1^* = a_1^* = \frac{1}{2\lambda}\left[X_1 + \frac{3}{4\lambda}\left(X_2\right)^2\right] \quad \text{and} \quad e_2^* = a_2^* = \frac{1}{2\lambda}X_2 \tag{17}$$

Under moral hazard, the entrepreneur cannot capture the optimal social value of the project:

$$\begin{aligned} E\left(\pi_E^*\right) = \; & \frac{1}{\lambda}\left[X_1 + \frac{3}{4\lambda}\left(X_2\right)^2\right]\left\{\frac{3}{4}\left[X_1 + \frac{3}{4\lambda}\left(X_2\right)^2\right]\right. \\ & \left. -\left(1-\gamma\right)C - \frac{1}{\lambda}X_2\gamma C\right\} + C - K < V^{FB} \end{aligned}$$

Whether the project is very risky or not, given λ high, the amount of the outside debt I is larger than the amount of equity $i + W$. This is consistent with the high level of debt noticed in buyout investments. One explanation is that the LBO investor has no payments in the bad states of nature: the optimal financial contracts assign the entire liquidation values to the bank.

Moreover, the entrepreneur, in contrast with the bank and the LBO investor, must put larger amount of money when the project is very risky. This implies that she should be wealthier when the target is very risky. Consequently, at a macroeconomic level, very risky targets will find more difficulties to get financing than less risky targets.

Paying the bank lower payments in the good state of the world is not a feature of a debt contract, as known the bank is expecting higher payments in case of success. These

[9] The entrepreneur and the LBO investor share equally the revenues of success and surrender to the bank the failure ones.

contracts cannot be implemented in the presence of the bank but can be done in the presence of a pure financier: as shown in Casamatta (2003), the pure financier plays the role of a budget breaker who increases their incentives to exert efforts.

When we constrain the debt's payments to be non-decreasing with the project's outcome ($D_1 \geq C$ and $D_2 \geq \gamma C$) and add these conditions to the entrepreneur's program, we show that the bank's payments do not depend on the quality of the project and that the entrepreneur and the LBO investor provide the following efforts:

$$e_1^c = a_1^c = \frac{1}{2\lambda}\left[X_1 - C + \frac{3}{4\lambda}\left(X_2 - \gamma C\right)^2\right] \tag{18}$$

$$e_2^c = a_2^c = \frac{1}{2\lambda}\left(X_2 - \gamma C\right) \tag{19}$$

It is easy to check that these efforts are lower than the first-best levels of efforts and they are even lower than those given by (17). The nondecreasing condition decreases the agents' incentives to exert efforts. We conclude that there are no debt-equity contracts that implement the first best.

These contracts, however, are consistent with some characteristics of buyout investments. One is buyouts are typically leveraged to a substantial degree: given λ high, the amount of outside debt is larger than the amount of outside equity. Another characteristic is that I is an increasing function of $\gamma^{t-1}C$, $t = 1$, 2. Only firms that have stable growth, important cash-flows and assets to serve as collateral, can issue debt, in contrast with firms that need venture capital and Middle market firms.[10]

Whether the project is very risky or not, the bank has equal payments in the bad and good states of nature. These payments are equal to the liquidation values C and γC, this is why the project is riskless for the bank.

Moreover, the financial contribution of the entrepreneur must be larger than the LBO's contribution which is consistent with the financial capital structure in buyouts. The assumption of the model that all agents are wealthy is an important one. The results state that the financial contribution of the entrepreneur is important to undertake the project. If she is wealth constrained, for example, she has no/limited personal wealth, her project is

[10] VC firms have few physical assets to serve as collateral, and little capital in the form of reputation (start-ups). Any debt issued by such firms would be extremely difficult to price owing to the riskiness of the firm's activities and uncertainty among investors about how great the true level of risk was. Even Middle-market firms face difficulties to get bank financing: they have either exceeded their debt capacity or are undertaking an expansion that is too risky, or whose risks are too uncertain, to finance with debt (Fenn et al., 1995).

not taken. Only the projects where the entrepreneur has an initial capital $W \geq W^c$, can be financed through a buyout acquisition[11]. This condition implies that the initial wealth of the entrepreneur W must be larger than a minimum level W^c for financing to be granted.

4 Pure equity financing versus combination of debt-equity financing?

Hereafter, we suppose that the buyout investment is implemented without an outside debt financing. The project's cost K is funded through the equity issued by the entrepreneur and the LBO investor. Consequently, they have to sign only a standard equity contract in which we must determine endogenously the outcome's shares. We assume that the failure revenues C and γC are shared between the two agents.[12]

The entrepreneur and the LBO investor choose the levels of efforts $\tilde{e}_t$ and $\tilde{a}_t$, $t = 1, 2$ that maximize their expected gains. Using the backward induction process, the efforts in equilibrium are given by:

$$\tilde{e}_2 = \tfrac{1}{\lambda}\beta_2 \left(X_2 - \gamma C\right) \quad \text{and} \quad \tilde{a}_2 = \tfrac{1}{\lambda}(1-\beta_2)\left(X_2 - \gamma C\right) \tag{20}$$

$$\tilde{e}_1 = \frac{1}{\lambda}\left[\beta_1(X_1 - C) + \beta_2\gamma C + \frac{1}{2\lambda}\beta_2(2-\beta_2)\left(X_2 - \gamma C\right)^2\right] \tag{21}$$

$$\tilde{a}_1 = \frac{1}{\lambda}\left[(1-\beta_1)(X_1 - C) + (1-\beta_2)\gamma C + \frac{1}{2\lambda}(1-\beta_2^2)\left(X_2 - \gamma C\right)^2\right] \tag{22}$$

Then the optimal financial contracts induce the entrepreneur to maximize the social value of the project under the incentive constraints (20), (21) and (22). It is written:

$$\begin{aligned} \max_{\beta_t,\ i,\ e_t,\ a_t,\ t=1,2} V = \quad & p_1[X_1 - (1-\gamma)\,C + p_2\left(X_2 - \gamma C\right) - c_E(e_2) - c_A(a_2)] \\ & + C - K - c_E(e_1) - c_A(a_1) \end{aligned}$$

$$\text{s.t.} \qquad (20),\ (21)\ \text{and}\ (22)$$

with the following conditions:

$$0 \leq \beta_t \leq 1,\ t = 1, 2$$

[11] W^c is the optimal level of fund that should be issued by the entrepreneur when the debt's payments are non-decreasing with the project's outcome (see the appendix A).

[12] Whether C and γC are shared between them or paid to one of them, this does change our results

The properties of the optimal holding contract are presented in the proposition 2:

Proposition 2 *Financing the project only through equity improves the incentives of the entrepreneur and the LBO investor to exert efforts.*

See appendix B.

The optimal equity contract leads the entrepreneur and the LBO investor to exert the following levels of efforts:

$$\tilde{e}_1 = \tilde{a}_1 = \frac{1}{2\lambda}\left[X_1 - (1-\gamma)\,C + \frac{3}{4\lambda}\,(X_2 - \gamma C)^2\right] \quad \text{and} \quad \tilde{e}_2 = \tilde{a}_2 = \frac{1}{2\lambda}\,(X_2 - \gamma C) \qquad (23)$$

Financing the project through the LBO investor and the bank or solely through the former give the same levels of efforts in the productive stage. But this is no longer true in the starting stage: the pure equity contract outperforms debt-equity contracts but does not implement the first best. At a first sight, this result is such a break with previous literature since it is not consistent with Jensen and Meckling (1976), Jensen (1986, 1989) and many others who highlighted the disciplinary value of the debt. But it is explained by the hypothesis of the model:

(1) We assume that the debt and equity are substitutes, in the sense we ignore some features of the debt financing, like for example, the deductibility of the debt's interests.

(2) In the previous section, the failure payments of the project are supposed to be paid to the bank. The entrepreneur and the LBO investor have therefore no payments in case of failure. However, when the LBO investor is the only outside financier, the revenues C and γC are supposed to be paid to both of them which boosts their incentives to exert higher levels of efforts than with a combination of debt and equity.[13]

Given the assumptions discussed above, we conclude that the presence of the bank decreases the agents' incentives to exert efforts under moral hazard. The optimal compensation scheme depends on the agents' incentives. As explained in the previous section, the optimal financial contracts must boost simultaneously their incentives to make efforts. This is why they must share equally the project's outcome and put jointly money into the project. The entrepreneur and the LBO investor have the same cost function and their efforts have equal

[13] Whether these payments are shared between the entrepreneur and the LBO fund or paid to one of them does not change their incentives to exert higher efforts. However, if the LBO fund is paid the whole revenues of failure, the entrepreneur gets the lowest shares of benefit and vice-versa.

impacts on the success probabilities. This also means that the entrepreneur and the LBO investor must be wealthy enough to undertake the project because both of them must issue larger amounts of equity than in standard debt-equity contracts.

5 The optimal financial contracts under the threat of prematurely exit

Consider now that the LBO investor may leave the project after the success of the first period because of the arrival of a competitive and more profitable project: $\zeta > 0$. The entrepreneur's program becomes:

$$\max_{\beta_t,\ D_t,\ e_t,\ a_t,\ t=1,\ 2} E(\pi_E) = \begin{aligned}[t] & p_1 \{X_1 - [1-(1-\zeta)\gamma]C + \zeta R \\ & + (1-\zeta)[p_2(X_2 - \gamma C) - c_E(e_2) - c_A(a_2)]\} \\ & + C - K - c_E(e_1) - c_A(a_1) \end{aligned} \tag{24}$$

$$\text{s.t.} \qquad (8),\ (9) \text{ and } (10)$$

with the following conditions:

$$(1),\ D_t \geq \gamma^{t-1} C \text{ and } 0 \leq \beta_t \leq 1, \quad t = 1, 2. \tag{25}$$

5.1 The financial structure when the information is perfect

If there is no moral hazard, the expected gain of the entrepreneur is given by (24). Notice that $E(\pi_E)$ does not depend neither on η nor on L but it depends on R. Hereafter, we show that the entrepreneur's share of compensation η is an increasing function of R.

When the information is perfect, both agents exert the first-best levels of efforts in the productive stage:

$$e_1^{PI} = a_1^{PI} = \frac{1}{\lambda}\{X_1 - [1-(1-\zeta)\gamma]C + \zeta R\} \tag{26}$$

$$e_2^{PI} = a_2^{PI} = \frac{1}{\lambda}(X_2 - \gamma C) \tag{27}$$

The efforts of the starting stage depend on the net revenue of the competitive buyout: if $R \geq \gamma C$, the entrepreneur and the LBO investor exert higher levels of efforts than e_1^{FB} and a_1^{FB}, otherwise, the threat of prematurely exit decreases their efforts.

The optimal financial contracts are given by:

$$\eta = \frac{R}{L} - 1 \ \text{ and } \beta_t = \frac{1}{2}, \ \ t = 1, 2$$

$$D_1 = 2\left[1 - (1-\zeta)\gamma\right] C - X_1 - 2\zeta L + \frac{3}{\lambda}(1-\zeta)(X_2 - \gamma C)^2$$

$$D_2 = 2\gamma C - X_2$$

These contracts are signed only if the project is not very risky in the sense $X_2 < 2\gamma C$ and $X_1 < 2\left[1 - (1-\zeta)\gamma\right] C - 2\zeta L$. Moreover, we assume $L \leq R \leq 2L$ so that $0 \leq \eta \leq 1$. It is easy to check that $D_1 \leq C$ and $D_2 \leq \gamma C$ which are not consistent with standard debt contracts.

5.2 The threat of prematurely exit and the agents' incentives

Hereafter, the bank's payments are assumed to be nondecreasing with the revenues. The following proposition shows that the threat of not to continue the project is a powered incentive scheme:

Proposition 3 *The threat of prematurely exit improves the agents' incentives but is still not enough to solve the double sided moral hazard problem.*

The proof of the proposition 3 is presented in the appendix C.

We assume that L is exogenous[14]. Consider the case where it is given by the legislature. The financial contracts have some of the characteristics discussed in proposition 1 but they depend now on the quality of the competitive project. Raising debt to finance the target is not a risky task for the bank since he is paid the same payments in the good and bad states of nature. In addition, LBO investor puts larger amount of money into the project when he has the possibility to abandon the target.

If the competitive buyout is not very profitable ($R \leq 2L$), the entrepreneur and the bank share L in the following way: she gets the highest share only if the net revenue of the competitive buyout is large; in the sense $\frac{3}{2}L < R \leq 2L$. Otherwise the largest compensation amount should be assigned to the bank. The compensation's share of the entrepreneur, in contrast with the bank, increases with R and decreases with L. The intuition is the following, a large revenue R makes the exit too profitable for the LBO investor. He should give her higher powered incentives to make her exert higher level of effort. In contrast, a

[14] The case where L is endogenous is discussed in the appendix C.

large compensation cost L makes it too costly for him ($R-L$ is too small): exit is less likely to occur and even if it occurred, the entrepreneur gets a small amount of compensation.

The levels of efforts in the starting stage are given by:

$$\hat{e}_1 = \hat{a}_1 = \frac{1}{2\lambda}l \tag{28}$$

where $l = X_1 - C + 2\zeta(R-L) + \frac{3}{4\lambda}(1-\zeta)(X_2 - \gamma C)^2$. Those of the second stage are given by (19) since they do not depend on the continuation decision. Despite the threat of leaving the project, this is not enough to let them exert the first-best levels of efforts, but it helps to increase their incentives. They exert higher levels of efforts than when the target is supposed to be continued without the exit threat. Given R fixed, the increase of L decreases the exit gain of the LBO investor, (28) converge then to (18).

If $R > 2L$, the competitive target is very attractive. In order to undertake it, the LBO investor needs to give higher-powered incentives to the entrepreneur, otherwise he would lose the money invested. This is why he should assign her the entire compensation cost. The bank will not be compensated since he is paid C whether the target succeeded or failed. Despite the fact that e and a are substitute and the agents have the same cost function, the entrepreneur provides higher effort than the LBO fund:

$$\hat{e}_1 = \frac{1}{2\lambda}l + \frac{1}{\lambda}\zeta(2L-R) > \hat{a}_1 = \frac{1}{2\lambda}l \tag{29}$$

The additional entrepreneur's effort increases with L and decreases with R. She is better off if the target succeeds at the end of the first period. This is an interesting result because the LBO firm may use the decision to leave the project as a high-powered incentive scheme to make the entrepreneur working hard. This is consistent with what is noticed in buyout projects: if the project is not too profitable, the LBO investor may leave the project (Schmidt et al., 2009).

Notice that the bank is compensated only if the competitive target is not very profitable. One explanation is that the leverage increases with $1-\eta$ (which in turn increases with L). In fact, the LBO investor puts small amount of equity when there is an arrival of not very profitable project to the market. So in order to make the bank raise higher amount of debt, the optimal financial contracts should concede him a strictly positive share of L. This is no longer true when the competitive target is very profitable, the LBO investor issues higher level of equity and puts an additional capital $\frac{1}{2\lambda}l\zeta(2L-R)$ into the buyout. Whether the new target is very profitable or not, the LBO investor provides the same levels of efforts in the first stage.

Suppose now that the project is implemented without debt. The optimal contracts do not depend on the quality of the competitive target and the entrepreneur and the LBO investor will share equally the revenues (as in the proposition 3). If there is an abandon threat, he must pledge the entire amount of compensation to the entrepreneur. So, the entrepreneur and the LBO investor provide the following efforts:

$$e_1 = \frac{1}{2\lambda} l + \frac{1}{2\lambda} \{2\zeta (2L - R) X_1 + (1 - \zeta) \gamma C\} \tag{30}$$

$$a_1 = \frac{1}{2\lambda} l + \frac{1}{2\lambda} (1 - \zeta) \gamma C \tag{31}$$

It is easy to check that these efforts are higher than those provided when the LBO firm cannot exit the target before date 2 and than those exerted when he is the only financier in the project. The entrepreneur's incentives depend on the quality of the competitive target. If $R \leq 2L$, sharing equally the target's outcome and paying the entrepreneur L leads her to exert lower effort than the LBO firm. Otherwise, the arrival of a very profitable target to the market increases the entrepreneur's incentives. In contrast, the LBO firm exerts the same level of effort whether the competitive target is very profitable or not. But pure equity financing improves his incentives, in the sense he provides a supplementary effort $\frac{1}{2\lambda} (1 - \zeta) \gamma C$ than with a debt-equity contracts. We conclude that an equity financing outperforms any combination of debt and equity financing under the threat of prematurely exit.

6 Conclusion

The aim of this paper was to study the financial structure of LBO projects. We focused on the debt's effects on the agents' incentives under a double sided moral hazard problem: the entrepreneur and the LBO investor provide unobservable efforts to improve the project's performance. We show that there are no debt-equity contracts that make them exert the first best levels of efforts. If the LBO investor may leave the target to invest in a more profitable one, the abandon threat help to improve the agents' incentives but it is not sufficient to solve the moral hazard.

In the current paper, we focused only on the characteristics of the standard debt-equity and pure-equity contracts. However, the use of convertible securities such as convertible bonds and convertible preferred stocks becomes prevalent in buyout projects. To our knowledge, there is no academic paper explaining the use of these securities.

Another topic for future research, the choice of the exit route can create agency conflicts between the entrepreneur and the LBO investor. The former prefers taking public the target through an IPO exit: she keeps her position and the control, and can get private benefits. Moreover, she is well informed about the buyout. In IPO, the shares are very often sold to a wide spectrum of uniformed investors. In contrast with the entrepreneur, the LBO investor prefers quick and full exits to get his money back and to put it into a new deal, like for example, sales.

In future research, it would be interesting to study the other exit routes such as IPO, trade sale and buyback and their effects on the agents' incentives. Research in this direction is still pending.

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Appendix

A Proof of proposition 1

The question raised now is the following: what are the parameters' values that the incentive constraints (8), (11) and (12) must satisfy in order to implement the first best solution?

Technically, this is possible if the first best efforts given by (3) and (4) satisfy the conditions (8), (11) and (12). We deduce that:

$$\beta_1^* = \beta_2^* = \frac{1}{2},\ D_1^* = 2(1-\gamma)C - X_1 + \frac{1}{\lambda}(X_2 - \gamma C)^2 \text{ and } D_2^* = 2\gamma C - X_2$$

Note that these solutions exist under the conditions:

$$X_2 \leq 2\gamma C \tag{32}$$

$$(1-\gamma)\,C + \frac{1}{2\lambda}(X_2 - \gamma C)^2 \leq X_1 \leq 2(1-\gamma)C + \frac{1}{\lambda}(X_2 - \gamma C)^2 \tag{33}$$

The left-hand side of (33) is always satisfied given λ high and $X_1 \geq C$ but the right-hand side is satisfied if $X_1 \leq 2(1-\gamma)C$.

We conclude that when the project is not very risky, in the sense $X_1 \leq 2(1-\gamma)C$ and $X_2 \leq 2\gamma C$, the entrepreneur and the LBO investor exert the first-best levels of efforts in the two periods.

Replacing $\beta_t = \frac{1}{2}$ and D_t^*, $t = 1, 2$ in the equations (15) and (16) gives the optimal financial investments of the LBO investor and the bank so that we have:

$$i^* = \frac{3}{2\lambda}\left[X_1 - (1-\gamma)\,C + \frac{1}{\lambda}\,(X_2 - \gamma C)^2\right]^2$$

$$I^* = C - \frac{2}{\lambda}\left[X_1 - (1-\gamma)\,C + \frac{1}{\lambda}\,(X_2 - \gamma C)^2\right]^2$$

Given λ high, check that I^* is strictly positive and significantly high.

If the project is very risky, in the sense $X_1 > 2\,(1-\gamma)\,C$ and $X_2 > 2\gamma C$, the straight application of the Kuhn-Tucker theorem gives the following financial contracts:

$$D_1^* = D_2^* = 0$$
$$I^* = C - \frac{1}{\lambda}\left[(1-\gamma)\,C + \frac{1}{\lambda}X_2\gamma C\right]\left[X_1 + \frac{3}{4\lambda}\,(X_2)^2\right]$$
$$i^* = \frac{3}{8\lambda}\left[X_1 + \frac{3}{4\lambda}\,(X_2)^2\right]^2$$

The entrepreneur and the LBO investor have equal payoffs: $\beta_t^* = \frac{1}{2}, \quad t = 1,\, 2$ even if the project is very risky. The amount of equity issued by the entrepreneur is given by: $W^* = K - i^* - I^*$. It is easy to check that the efforts provided in the latter case are not optimal.

However, the bank is expecting higher payment in the good states of nature. When we add the condition of non-decreasing bank's payments to the entrepreneur's program, the Lagrangian is written

$$\begin{aligned}\mathcal{L}= \; & \tfrac{1}{\lambda}\left\{X_1 - D_1 + \tfrac{1}{2\lambda}(1+2\beta_2-2\beta_2^2)\,(X_2-D_2)^2\right\} \\ & \left\{X_1-(1-\gamma)C + \tfrac{1}{\lambda}(X_2-\; D_2)(X_2-\gamma C) - \tfrac{1}{2\lambda}(1-2\beta_2+2\beta_2^2)(X_2-\; D_2)^2\right\} \\ & -\tfrac{1}{2\lambda}\left\{\beta_1(X_1-D_1)+\tfrac{1}{2\lambda}\beta_2(2-\beta_2)\,(X_2-D_2)^2\right\}^2 \\ & -\tfrac{1}{2\lambda}\left\{(1-\beta_1)\,(X_1-D_1)+\tfrac{1}{2\lambda}(1-\beta_2^2)\,(X_2-D_2)^2\right\}^2 \\ & +C-K+\mu_1\beta_1+\mu_2\beta_2+\mu_3(1-\beta_1)+\mu_4(1-\beta_2)+\mu_5 D_1 \\ & +\mu_6 D_2+\mu_7\,(X_1-D_1)+\mu_8\,(X_2-D_2)+\mu_9\,(D_1-C)+\mu_{10}\,(D_2-\gamma C)\end{aligned}$$

Where μ_j, $j = 1..10$ are the Kuhn-Tucker multipliers. The Kuhn-Tucker theorem enables us to deduce:

$$D_1^c = C \quad \text{and} \quad D_2^c = \gamma C \tag{34}$$
$$I^c = C\left\{1 + \frac{\gamma}{\lambda}\left[X_1 - C + \frac{3}{4\lambda}\,(X_2-\gamma C)^2\right]\right\} \tag{35}$$

and

$$\beta_t^c = \frac{1}{2},\; t = 1,\, 2 \tag{36}$$
$$i^c = \frac{3}{8\lambda}\left[X_1 - C + \frac{3}{4\lambda}\,(X_2-\gamma C)^2\right]^2 \tag{37}$$
$$W^c = K - i^c - I^c \tag{38}$$

More detailed proof is available under request.

B Proof of the proposition 2

We replace (20), (21) and (22) in the objective function. The entrepreneur's program is written:

$$\max_{\beta,\ t=1,\ 2} V = \frac{1}{\lambda}\left[X_1-(1-\gamma)\,C+\tfrac{1}{2\lambda}(1+2\beta_2-2\beta_2^2)\,(X_2-\gamma C)^2\right]^2+C-K$$
$$-\tfrac{1}{2\lambda}\left[\beta_1(X_1-C)+\beta_2\gamma C+\tfrac{1}{2\lambda}\beta_2(2-\beta_2)\,(X_2-\gamma C)^2\right]^2$$
$$-\tfrac{1}{2\lambda}\left[(1-\beta_1)(X_1-C)+(1-\beta_2)\,\gamma C+\tfrac{1}{2\lambda}(1-\beta_2^2)\,(X_2-\gamma C)^2\right]^2$$

The first order conditions of V give the following equations system:

$$(1-2\beta_1)\,(X_1-C)+(1-2\beta_2)\left[\gamma C+\frac{1}{2\lambda}\,(X_2-\gamma C)^2\right]=0$$
$$(2-3\beta_2)\left[X_1-(1-\gamma)\,C+\frac{1}{2\lambda}(1+2\beta_2-2\beta_2^2)\,(X_2-\gamma C)^2\right]$$
$$-\beta_1(X_1-C)-\beta_2\gamma C-\frac{1}{2\lambda}\beta_2(2-\beta_2)\,(X_2-\gamma C)^2=0$$

This system has two possible solutions but one of them is real and varies from 0 to 1. This solution is given by:

$$\tilde{\beta}_t=\frac{1}{2},\ t=1,\ 2$$

We conclude therefore that the entrepreneur and the LBO investor issue the following amounts of equity:

$$\tilde{W}=K-\frac{1}{2}C-\frac{3}{8\lambda}\left[X_1-(1-\gamma)\,C+\frac{3}{4\lambda}\,(X_2-\gamma C)^2\right]$$
$$\tilde{\imath}=\frac{1}{2}C+\frac{3}{8\lambda}\left[X_1-(1-\gamma)\,C+\frac{3}{4\lambda}\,(X_2-\gamma C)^2\right]$$

C Proof of the proposition 3

1^{st} case L is exogenous

Replacing the efforts $\hat{a}_t$ and $\hat{e}_t$, $t=1,\ 2$ in the objective function gives

$$\max_{\eta,\ \beta_t,\ D_t,\ t=1,\ 2} E\,(\pi_E)=$$
$$\tfrac{1}{\lambda}\left\{X_1-D_1+\zeta\,[R-(1-\eta)\,L]+\tfrac{1}{2\lambda}\,(1-\zeta)\left(1+2\beta_2-2\beta_2^2\right)(X_2-\ D_2)^2\right\}$$
$$\left\{X_1-[1-(1-\zeta)\,\gamma]\,C+\zeta R+\tfrac{1}{2\lambda}\,(1-\zeta)\left[\ 2(X_2-\ D_2)\,(X_2-\gamma C)-\left(1-2\beta_2+2\beta_2^2\right)(X_2-\ D_2)^2\right]\right\}$$
$$-\ \tfrac{1}{2\lambda}\left\{(1-\beta_1)\,(X_1-D_1)+\zeta\,(R-L)+\tfrac{1}{2\lambda}\left(1-\beta_2^2\right)(1-\zeta)\,(X_2-\ D_2)^2\right\}^2$$
$$-\ \tfrac{1}{2\lambda}\left\{\beta_1\,(X_1-D_1)+\zeta\eta L+\tfrac{1}{2\lambda}\beta_2\,(2-\beta_2)\,(1-\zeta)\,(X_2-\ D_2)^2\right\}^2+C-K$$

with the following conditions

$$(1),\ D_1 \geq C,\ D_2 \geq \gamma C \text{ and } 0 \leq \beta_t \leq 1, \quad t = 1, 2.$$

The Lagrangian is given by

$$\mathcal{L} = \tfrac{1}{\lambda}\left\{X_1 - D_1 + \zeta\left[R - (1-\eta)L\right] + \tfrac{1}{2\lambda}(1-\zeta)\left(1 + 2\beta_2 - 2\beta_2^2\right)(X_2 - D_2)^2\right\}$$
$$\left\{X_1 - \left[1 - (1-\zeta)\gamma\right]C + \zeta R + \tfrac{1}{2\lambda}(1-\zeta)\left[\, 2(X_2 - D_2)(X_2 - \gamma C) - \left(1 - 2\beta_2 + 2\beta_2^2\right)(X_2 - D_2)^2\right]\right\}$$
$$- \tfrac{1}{2\lambda}\left\{(1-\beta_1)(X_1 - D_1) + \zeta(R - L) + \tfrac{1}{2\lambda}\left(1 - \beta_2^2\right)(1-\zeta)(X_2 - D_2)^2\right\}^2$$
$$- \tfrac{1}{2\lambda}\left\{\beta_1(X_1 - D_1) + \zeta\eta L + \tfrac{1}{2\lambda}\beta_2(2-\beta_2)(1-\zeta)(X_2 - D_2)^2\right\}^2 + C - K + \mu_1\beta_1 + \mu_2\beta_2$$
$$+\mu_3(1-\beta_1) + \mu_4(1-\beta_2) + \mu_5 D_1 + \mu_6 D_2 + \mu_7(X_1 - D_1) + \mu_8(X_2 - D_2) + \mu_9(D_1 - C) + \mu_{10}(D_2 - \gamma C)$$
$$+\mu_{11}\eta + \mu_{12}(1-\eta)$$

The solution of this program is given by:

- If $R \leq 2L$, the competitive buyout is not very profitable and

$$\hat{\eta} = \frac{R}{L} - 1$$
$$\hat{\imath} = \frac{3}{8\lambda}(l)^2$$
$$\hat{I} = C + \frac{1}{\lambda} l \left\{(1-\zeta)\gamma C + \zeta(2L - R)\right\}$$

- If $R > 2L$, the competitive buyout is very profitable and

$$\hat{\eta} = 1$$
$$\hat{\imath} = \frac{3}{8\lambda} l \left\{X_1 - C + \frac{2}{3}\zeta(R + L) + \frac{3}{4\lambda}(1-\zeta)(X_2 - \gamma C)^2\right\}$$
$$\hat{I} = C + \frac{1}{\lambda}(1-\zeta)\gamma C\left\{l - \zeta(R - 2L)\right\}$$

where $l = X_1 - C + 2\zeta(R - L) + \frac{3}{4\lambda}(1-\zeta)(X_2 - \gamma C)^2$.

The entrepreneur issues the amount of equity: $\hat{W} = K - \hat{\imath} - \hat{I}$.

Whether the competitive buyout is very profitable or not, the bank's payments of success are equal to the liquidation values of the project $\hat{D}_1 = C$ and $\hat{D}_2 = \gamma C$. The entrepreneur and the LBO investor have equal payoffs: $\hat{\beta}_t = \frac{1}{2}$, $t = 1,\ 2$.

2^{sd} case L is endogenous

After replacing the efforts in the objective function, we solve:

$$\max_{\eta,\ L,\ \beta_t,\ D_t,\ t=1,\ 2} E\left(\pi_E\right) =$$

$$\tfrac{1}{\lambda}\left\{X_1 - D_1 + \zeta\left[R - (1-\eta)L\right] + \tfrac{1}{2\lambda}(1-\zeta)\left(1+2\beta_2-2\beta_2^2\right)(X_2 - D_2)^2\right\}$$
$$\left\{X_1 - \left[1-(1-\zeta)\gamma\right]C + \zeta R + \tfrac{1}{2\lambda}(1-\zeta)\left[\ 2(X_2 - D_2)(X_2-\gamma C) - \left(1-2\beta_2+2\beta_2^2\right)(X_2 - D_2)^2\right]\right\}$$
$$-\ \tfrac{1}{2\lambda}\left\{(1-\beta_1)(X_1-D_1) + \zeta(R-L) + \tfrac{1}{2\lambda}\left(1-\beta_2^2\right)(1-\zeta)(X_2 - D_2)^2\right\}^2$$
$$-\ \tfrac{1}{2\lambda}\left\{\beta_1(X_1-D_1) + \zeta\eta L + \tfrac{1}{2\lambda}\beta_2(2-\beta_2)(1-\zeta)(X_2 - D_2)^2\right\}^2 + C - K$$

with the following conditions

$$(1),\ D_1 \geq C,\ D_2 \geq \gamma C,\ 0 \leq L \leq R \text{ and } 0 \leq \beta_t \leq 1, \quad t = 1, 2.$$

The solution is given by the Kuhn-Tucker theorem:

$$D_1^* = C \quad \text{and} \quad D_2^* = \gamma C$$
$$I^* = C + \frac{1}{\lambda}\phi(1-\zeta)\gamma C$$

and

$$L^* = \tfrac{1}{2}R\ ,\quad \eta^* = 1 \quad \text{and} \quad \beta_t^* = \tfrac{1}{2},\ t = 1,\ 2$$
$$i^* = \frac{3}{8\lambda}\phi^2$$
$$W^* = K - i^* - I^*$$

where $\phi = X_1 - C + \zeta R + \frac{3}{4\lambda}(1-\zeta)(X_2 - \gamma C)^2$.

The agents' incentives do not depend on the quality of the competitive project:

$$e_1^* = a_1^* = \frac{1}{2\lambda}\phi \tag{39}$$

where $\phi = X_1 - C + \zeta R + \frac{3}{4\lambda}(1-\zeta)(X_2 - \gamma C)^2$.

The entrepreneur and the LBO investor provide higher levels of efforts than (29). Notice that the LBO investor should pay a large compensation L if he would leave the target. If the project is financed only through equity, the two agents exert higher levels of efforts.

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