



An Incomplete Contracts Approach to Financial Contracting

Philippe Aghion; Patrick Bolton

The Review of Economic Studies, Vol. 59, No. 3. (Jul., 1992), pp. 473-494.

Stable URL:

<http://links.jstor.org/sici?sici=0034-6527%28199207%2959%3A3%3C473%3AAICATF%3E2.0.CO%3B2-C>

The Review of Economic Studies is currently published by The Review of Economic Studies Ltd..

Your use of the JSTOR archive indicates your acceptance of JSTOR's Terms and Conditions of Use, available at <http://www.jstor.org/about/terms.html>. JSTOR's Terms and Conditions of Use provides, in part, that unless you have obtained prior permission, you may not download an entire issue of a journal or multiple copies of articles, and you may use content in the JSTOR archive only for your personal, non-commercial use.

Please contact the publisher regarding any further use of this work. Publisher contact information may be obtained at <http://www.jstor.org/journals/resl.html>.

Each copy of any part of a JSTOR transmission must contain the same copyright notice that appears on the screen or printed page of such transmission.

JSTOR is an independent not-for-profit organization dedicated to creating and preserving a digital archive of scholarly journals. For more information regarding JSTOR, please contact support@jstor.org.

An Incomplete Contracts Approach to Financial Contracting

PHILIPPE AGHION

The European Bank for Reconstruction and Development and DELTA, Paris

and

PATRICK BOLTON

*Laboratoire d'Econometrie de L'Ecole Polytechnique, Paris and Institut d'Etudes
Europeennes, Universite Libre de Bruxelles*

First version received November 1988; final version accepted February 1992 (Eds)

We analyze incomplete long-term financial contracts between an entrepreneur with no initial wealth and a wealthy investor. Both agents have potentially conflicting objectives since the entrepreneur cares about both pecuniary and non-pecuniary returns from the project while the investor is only concerned about monetary returns. We address the questions of (i) whether and how the initial contract can be structured in such a way as to bring about a perfect coincidence of objectives between both agents (ii) when the initial contract cannot achieve this coincidence of objectives how should control rights be allocated to achieve efficiency? One of the main results of our analysis concerns the optimality properties of the (contingent) control allocation induced by standard debt financing.

I. INTRODUCTION

This paper develops a theory of capital structure based on control rights. Underlying our approach is the recognition that financial contracts are inherently incomplete. As a result, the founders of the firm must determine how future investment and operating decisions left out of the corporate charter ought to be taken. We model contractual incompleteness by assuming that some important future variables have to be left out of the contract if they are difficult or impossible to describe initially. Grossman–Hart (1986) and Hart–Moore (1988) have developed a theory of vertical integration and ownership based on this form of contractual incompleteness. An important assumption in their work is that all individual agents are sufficiently wealthy to be able to purchase any assets they ought to own. Such an assumption, of course, is meant to circumvent the issues relating to financing and capital structure (which are not directly relevant to the problem they address). Therefore, we depart from the models of Grossman–Hart and Hart–Moore by explicitly introducing wealth constraints into their framework. We are thus able to develop a theory of capital structure based on transactions costs and contractual incompleteness.

The main ideas underlying this theory can be illustrated with the following simple story: consider an entrepreneur who needs to raise funds to finance an investment project. Future decisions concerning this project have to be taken, which due to its inherent incompleteness, cannot be perfectly determined in the initial contract. Moreover, the

entrepreneur and the investor may have conflicting objectives regarding the future developments of the project which as a result of contractual incompleteness and wealth constraints, cannot be perfectly realigned by the initial contract. Take, for example, the case of a business run by a family whose members attach value to the business remaining in the family. Typically this value cannot be shared with an outside investor and, if the family has little wealth (consistent with its need to borrow funds), it may not be able to compensate outside investors for actions taken to preserve the integrity of the family business at the expense of profits. It is then important for outside investors to be able to limit the extent to which the family can take such actions. Outside investors will be able to do this by acquiring some control rights. Then the following trade-off arises in the allocation of control rights:

If the funds are raised by issuing *voting equity* the family will have to share control with the new shareholders. The latter may then be in a position where they can force the family to give up the integrity of the business despite the fact that the family attaches a very high value to this integrity being preserved (again, because the family has limited wealth it may not be able to bribe the investors to take an action which preserves the integrity of the business).

Alternatively, the firm could raise funds by issuing *debt*, thereby allowing the family to preserve its full ownership rights as long as it meets its debt obligations. The problem with debt, however, is the risk of default and the danger for the family of losing control to the creditors in that event. The more debt raised, the higher the risk of bankruptcy. In short, the family will choose its financial structure by weighing the marginal costs of diluting its control-rights to new shareholders against the marginal costs of debt and default.

Of course, the best of all worlds for the family would be to obtain the funding “no-strings attached” by, say, issuing *non-voting equity*. But this may not be an acceptable arrangement for outside investors. Contractual incompleteness and wealth constraints are again the source of the problem; due to the family’s wealth constraint, outside investors cannot be sure of being adequately repaid independently of how the firm is run.

The principles developed in this paper apply to any type of closely-held firm. It is our contention that the different control rights attached to instruments such as debt or equity may be just as important in determining the financial structure of these firms as the difference in their revenue-streams or tax-treatments. The problem of choosing between voting-shares and debt involves in particular a problem of deciding how ownership of the firm should be allocated between the various contracting parties. In this respect, as Williamson (1988) has pointed out, the problem of selecting the adequate capital structure is similar to the question of vertical integration. To quote:

“The Corporate finance decision to use debt or equity to support individual investment projects is closely akin to the vertical integration decision to make or buy individual components or subassemblies”.

In our model we do not put any restrictions on the payment streams of financial contracts other than the parties’ wealth constraints. We provide an explanation for the widespread use of securities such as debt and equity in terms of the optimality properties of their induced governance structures. In this respect our paper contributes to the emerging literature on security design. Three papers on security design are closely related to our work.

The first paper by Townsend (1979) (see also Diamond (1984) and Gale-Hellwig (1985)) explains the optimality of debt in terms of private information about revenues and ex post monitoring costs. As Townsend has pointed out, the major weakness of this

approach is that it is unable to explain the use of outside equity (see, however, Chang (1987)). Moreover, the optimality of debt disappears in this model as soon as one brings in dynamic considerations such as repeated interactions between the debtor and creditor or ex post renegotiation.

The optimality properties of debt in a dynamic context have been explored more recently by Hart-Moore (1989) (see also Bolton-Scharfstein (1990)). They consider a dynamic model with incomplete contracts where issues of control and ownership naturally arise. Specifically, the problem they focus on is how to get the borrower to transfer non-verifiable revenues to the lender. This problem is solved by giving the lender liquidation rights, in the event of default. Our model and theirs share many features in common, most importantly perhaps, the relationship between wealth constraints and renegotiation.

Another paper closely related to ours, emphasizing the idea that debt serves as a mechanism for the contingent allocation of control, is Zender (1991). He considers an agency model with wealth constraints where the limited wealth of both the entrepreneur and the investor prevents one of them of becoming a full residual claimant. Under some special circumstances, however, debt financing allows the entrepreneur to be a full residual claimant as long as he can meet his debt obligation and the investor (debt-holder) to become a full residual claimant when the entrepreneur defaults. This arrangement then replicates the outcome where only one of them is a full residual claimant.

The paper is organized as follows: Section II outlines the model of bilateral contracting between an entrepreneur and an investor; it discusses the nature of contractual incompleteness and describes the origin of the conflict of interest between the two contracting parties. Section III considers control allocations in situations where future actions are not contractible. We show that essentially two forms of control allocations may be efficient in this case: (i) unilateral control allocations where the entrepreneur or the investor are the sole owners of the firm (such control allocations can be induced by financing the firm with respectively non-voting and voting equity). (ii) contingent allocations of control where one or the other party may be in control depending on the verifiable realization of a random variable (this type of allocation is induced by debt-financing since the entrepreneur retains control of the firm only if he does not default on his debt obligations; otherwise the investor gets some or all of the control rights). Note that the unilateral control allocations are akin to vertical integration. The financial structure corresponding to non-integration is joint-ownership. In our model this structure is typically dominated for reasons which are developed in Section III. Section IV considers situations where future action plans can be described and verified sufficiently accurately that the initial contract can specify *ex ante* action restrictions. Debt covenants and restrictive clauses in the corporate charter are examples of such restrictions. Section V provides further interpretations of our results and a general discussion.

II THE MODEL

Consider the bilateral contracting problem where a penniless entrepreneur seeks funding from a wealthy investor to finance the set-up costs, K , of his new project. We suppose for simplicity that there are many wealthy investors looking for good investment opportunities and fewer entrepreneurs with good projects, so that our entrepreneur has all the bargaining power and can make a take-it-or-leave-it offer to the investor. If the contract

promises an expected return to the investor of at least K , she is willing to take the offer.¹ This defines the investor's individual rationality constraint. The technological characteristics of this project are described in the time-line shown in Figure 1.

Thus, the returns of the project are stochastic and depend on an action a chosen from the set of feasible actions A , after the realization of a state of nature θ . Θ , is the set of possible states of nature.

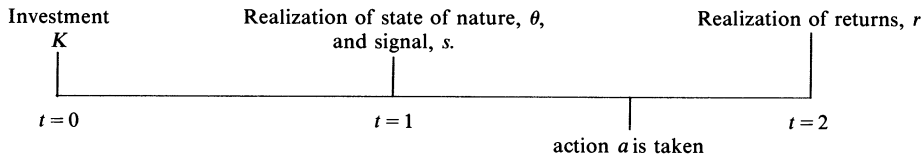


FIGURE 1

Both the entrepreneur (E) and the investor (I) are risk neutral in income. Their Von-Neumann-Morgenstern utility functions over income and action pairs are denoted by $U_E(r, a)$ and $U_I(r, a)$ respectively. We suppose that they take the following simple form:

$$U_E(r, a) = r + l(a, \theta) \quad (1)$$

$$U_I(r, a) = r. \quad (2)$$

The investor is only interested in the monetary returns of the project. The entrepreneur, who thought about the project and took the initiative of setting it up, cares not only about the monetary returns but also about other less tangible things such as reputation, specific human capital, effort, etc. These non-monetary elements in his payoff depend on the choice of action and on the state of nature; they are represented by the function $l(a, \theta)$. (Note that $l(a, \theta)$ can be positive or negative). We shall refer to them as the *private benefits* of the entrepreneur since they are not observable or verifiable by third parties. It is clear, given our specification of preferences, that potential conflicts of interest may arise between the entrepreneur and the investor concerning the choice of action. Most of this paper is concerned with the following questions: (i) whether and how the initial contract can be structured in such a way as to bring about a perfect coincidence of objectives between E and I , and (ii) when the initial contract cannot achieve this coincidence of objectives how should control rights be allocated.

In practice the difficulty in confronting this problem arises from the inherent incompleteness of financial contracts. Most investment projects are sufficiently complex that it is impossible for the contracting parties to specify ex ante an action correspondence $\alpha: \Theta \rightarrow A$ determining which action ought to be taken as a function of the state of nature, θ . Even if such a correspondence $\alpha(\theta)$ could be specified it may be difficult to enforce ex post. Consequently, the contracting parties must find roundabout ways of implementing the most desired action-schedule, $\alpha(\theta)$, such as *partial* or *total* delegation of decision rights (over the future action choice) to one or the other party together with an appropriate monetary incentive scheme.

Following Grossman-Hart (1986) we model contractual incompleteness by assuming that the state of nature θ is impossible or very costly to describe ex ante, so that the ex ante contract cannot be contingent on θ . Ex post both parties can tell when the state of

1. Throughout the paper we refer to the entrepreneur as *he* and to the investor as *she*.

nature has been realized and we follow Grossman-Hart again in assuming that both parties can perfectly identify which state θ has occurred. The latter assumption is mostly for convenience since it allows us to abstract the analysis from issues of bargaining under asymmetric information.

However, we depart from Grossman-Hart in assuming that even though contracts cannot be made contingent on θ directly, they can be made contingent on a publicly verifiable signal, s , which is imperfectly correlated with θ . This signal is realized at date 1. In our context there are several natural interpretations of this signal. For example, s may represent a variable of short-term performance (or profits); alternatively, s may represent a default or no default event at date 1.

In Section III we also assume that actions are too costly to describe precisely to be included in the contract. In practice it is generally difficult to specify precisely future action schedules in a contract. There are exceptions, however. For example, very important decisions such as mergers, takeovers, spin-offs, liquidation or continuation decisions can be described and verified reasonably straightforwardly. Section IV therefore explores the consequences for control allocation of the introduction of initial restrictions on action choice.

Finally, we suppose that all monetary returns are verifiable, so that the standard incentive schemes considered in the Principal-Agent literature are feasible subject to the constraint that the entrepreneur's wealth cannot be negative. Given our assumption that the entrepreneur starts out with zero wealth, this latter constraint will play a crucial role in the analysis.

For the sake of exposition we shall simplify our problem by assuming that:²

- (1) There are only two states of nature: $\Theta = \{\theta_g, \theta_b\}$
- (2) There are only two actions in the action set: $A = \{a_g, a_b\}$, where $a_g = a^*(\theta_g)$ is the first-best (choice of) action in state θ_g and $a_b = a^*(\theta_b)$ is the first-best action in state θ_b .³
- (3) There are only two possible outcomes for the signal s in period 1: $s \in \{0, 1\}$; let β^θ denote the probability that $s = 1$ given θ .

The observation of the signal, s , only adds information if s is correlated with θ . Unless otherwise specified we shall assume throughout the paper that:

$$\begin{cases} \beta^g \equiv \text{Prob}(s = 1 | \theta = \theta_g) > \frac{1}{2} \\ \beta^b \equiv \text{Prob}(s = 1 | \theta = \theta_b) < \frac{1}{2} \end{cases} \quad (3)$$

In other words, when $s = 1$ the posterior probability that the firm is in state θ_g is going up, and when $s = 0$, the updated probability of state θ_b occurring is going up. Note that the distance $d(\tilde{\beta}, (1, 0)) \equiv [|1 - \beta^g| + |0 - \beta^b|]$ can serve as a measure of the *degree of incompleteness* of the *ex-ante* contract. If this distance is zero then the contract is complete, since the description of s is a perfect proxy for the description of θ . If it is equal to 1, s is uncorrelated with θ , so that the degree of incompleteness is the highest possible.

- (4) There are only two possible outcomes for the final-period returns: $r \in \{0, 1\}$. We then define y_j^i to be the expected final-period return in state θ_i when action a_j is chosen:

$$y_j^i = E(r / \theta = \theta_i, a = a_j) \equiv \text{Prob}(r = 1 / \theta = \theta_i, a = a_j).$$

2. See the previous version of this paper for more complicated and general set-ups: Aghion-Bolton (1988).

3. In other words, $a^*(\theta) = \arg \max_{a \in A} \{E(r/a, \theta) + l(a, \theta)\}$, where $E(r/a, \theta)$ is the expected realization of second-period revenue conditional on action a being chosen in state θ .

Also we denote by l_j^i the private benefits of the entrepreneur in state θ_i when action a_j is chosen.

In this simple set-up we have, by definition of the first-best pair of actions (a_g, a_b) :

$$\begin{cases} y_g^g + l_g^g > y_b^g + l_b^g \\ y_b^b + l_b^b > y_g^b + l_g^b \end{cases} \quad (4)$$

We shall also assume that $qy_g^g + (1-q)y_b^b > K$; for otherwise the first-best pair of actions would not be feasible.

We complete the description of our model by specifying precisely the set of feasible ex ante contracts and by determining the way in which initial contracts may be renegotiated (after the realization of θ). Note that since ex ante contracts are incomplete there may be room for Pareto-improving renegotiation once the parties learn the realization of θ .

The set of ex ante contracts includes all contracts specifying:

(i) a compensation schedule for the manager:

We adopt the convention here that all residual returns go to the investor and that the entrepreneur is compensated with a monetary transfer which is a function of the realization of the first-period signal as well as the return realization in period 2: thus the transfer schedule is given by $t(s, r)$. The only restriction imposed on this schedule is, $t(s, r) \geq 0$. This condition reflects the fact that the entrepreneur has zero wealth. (When actions are verifiable the transfer may also be made contingent on action choice, in which case we have $t(a, s, r) \geq 0$).

(ii) a control allocation rule:

We distinguish between individual control allocations and joint control allocations. The most general specification of individual control allocations is given by: $(\alpha_0; \alpha_1) \in [0, 1]^2$, where α_s denotes the probability that the entrepreneur gets the right to decide what action to choose when the signal realization is $s = 0$ or $s = 1$; $((1 - \alpha_s)$ then denotes the probability that the investor gets control).

Joint ownership allocations are formally defined by:

$$(\mu_0^I; \mu_1^I) \in [0, 1]^2 \quad \text{and} \quad (\mu_0^E; \mu_1^E) \in [0, 1]^2, \quad \text{where } \mu_s^I + \mu_s^E > 1 \text{ for some } s = \{0, 1\}^4$$

The terms μ_s^I and μ_s^E denote the probability that the investor and respectively the entrepreneur get a right to choose the future action contingent on the realization of s . When both get the right of choice simultaneously, the future action must be chosen by unanimous consent. In case of disagreement the firm is at a standstill; we assume that the payoff vector in case of disagreement is given by $(0, 0)$. The bargaining game over action choice when both agents get a right of control is specified as follows:

We assume that the entrepreneur makes a take-it-or-leave-it offer to the investor. If the investor accepts the offer of an action choice proposed by the entrepreneur, this is the action taken by the firm. If she rejects, the firm is at a standstill and both get a payoff of zero.

Our formulation of the ex post bargaining game looks at an extreme case of ex post opportunism on the part of the entrepreneur. We discuss the implications of changing the bargaining game by shifting the bargaining power more towards the investor in footnote 7.

4. If we had $\mu_s^E = 1 - \mu_s^I$ for all $s \in \{0, 1\}$, then the right to decide over future actions would be *exclusive*; in other words, we would again be dealing with an *individual* control allocation, namely the allocation (α_0, α_1) where $\alpha_s = \mu_s^E$ for $s = 0, 1$. *Joint* ownership refers instead to the complementary possibility that both contracting parties be simultaneously granted the right to decide over future actions. Such a possibility requires that $\mu_s^I + \mu_s^E > 1$ for some s .

In Section IV we consider the case where initial contracts can include action restrictions. Then, besides a compensation schedule for the manager and a control allocation rule, the contract also specifies an action plan. This action plan defines the disagreement point that applies under joint ownership when both parties get the right to choose the future action simultaneously but fail to achieve unanimity. The most general specification of action plans is given by $[\lambda_0, \lambda_1] \in [0, 1]^2$, where λ_s ($s = 0, 1$) denotes the probability of selecting action a_s when the first-period signal realization is s .

Clearly, a typical contract would either specify an individual control allocation rule, or an action-plan (with a joint ownership rule), but not both, since determining an action plan ex ante defeats the purpose of allocating control: if everything is predetermined control becomes vacuous.⁵

It appears from our description that the only types of contracts that we rule out are contracts where either the manager's compensation scheme, the firm's action-plan and/or the control allocation rule are contingent on the realization of the state of nature, θ , (or on the agents' announcements of θ).⁶ In practice the costs of writing contracts are such that a typical financial contract contains many more gaps than we impose here. Our aim here is to show that even a minimum degree of incompleteness in the financial contract raises issues of control allocation.

When the initial contract is incomplete the possibility may arise that once the parties learn the true state they may wish to renegotiate the initial contract. We model the renegotiation game in the same way as the bargaining game over action choice under joint ownership. We suppose that once θ is revealed to both parties, the entrepreneur can make a take-it-or-leave-it offer of a new contract to the investor. If the investor accepts the offer the old contract is torn up and the new contract is enforced, if the investor rejects the offer the old contract is enforced. Of course, the investor accepts the new contract offer if and only if she is made (weakly) better off under the new contract than under the old.⁷

III. OPTIMAL CONTROL ALLOCATIONS WHEN ACTIONS ARE NOT VERIFIABLE

Essentially two types of control allocations can be efficient here. Unilateral control allocations (where either the entrepreneur or the investor have full control) and contingent

5. It is natural to wonder about the possible co-existence of an incomplete action plan (one specifying an action choice only for one realization of s) with a control allocation rule (an example of such a contract is an action plan specifying what action must be taken when $s = 1$ and a control allocation when $s = 0$). Such arrangements are allowed here and are discussed in section IV. Also, one may wonder what happens if the contract specifies neither a control allocation rule nor an action plan. We take the convention here that such a contract is assimilated to joint control, with $\mu_0^I = \mu_1^I = \mu_0^E = \mu_1^E = 1$.

6. In Appendix 1 we discuss the implications of introducing contracts contingent on the agents' announcements of the state of nature. We argue that ex post renegotiation together with the presence of a limited wealth constraint for the entrepreneur make it impossible to achieve first-best efficiency with a so-called *Maskin-mechanism*.

7. The bargaining game specified above is such that the entrepreneur has all the bargaining power. One may wonder to what extent the results we derive later depend on this assumption. It is straightforward to verify that the general lesson of our paper that the value of the firm is not independent of the initial control allocation remains valid for any specification of the allocation of bargaining power. For example we can show that a contract giving all control rights to the investor will not always be first-best and will not always (weakly) dominate all other forms of control allocation for any given allocation of bargaining power in the ex post renegotiation game. The main effect of shifting the bargaining power from the entrepreneur to the investor is to increase the set of parameter values for which full entrepreneur-control is an efficient control allocation. Intuitively, when the investor is in a stronger position in future renegotiations, she needs fewer additional protections such as voting rights or security interests.

control allocations (where depending on the realization of the first-period signal either the entrepreneur or the investor have control). We explain at the end of this section why joint control allocations are (weakly) dominated by either unilateral or contingent control allocations.

We begin by establishing necessary and sufficient conditions under which respectively entrepreneur control and investor control are first-best efficient. We then establish sufficient conditions under which contingent control allocations are (first- or second-best) efficient.

III.A. *Entrepreneur control*

At date 0 the entrepreneur makes a take-it-or-leave-it contract offer to the investor specifying full control for the entrepreneur and a compensation schedule $t(s, r)$. The best contract (with entrepreneur control) maximises the entrepreneur's expected payoff subject to the investor's individual rationality constraint. This contract is first-best efficient if and only if it implements the first-best action plan (possibly after renegotiation).

Before proceeding it is useful to note that since second-period returns can only take two values (0 or 1) there is no loss of generality in restricting attention to affine transfer-schedules of the form:⁸

$$t(s, r) = (t(s, 1) - t(s, 0))r + t(s, 0) = t_s \cdot r + t'_s$$

Consider now an arbitrary compensation schedule $t_s \cdot r + t'_s$. With this incentive-scheme the entrepreneur chooses actions in respectively θ_g and θ_b to maximise his expected payoff:

$$a^E(\theta_i, s) \equiv \arg \max_{a_j \in A} \{t_s \cdot y_j^i + t'_s + l_j^i\} (i = g, b) (j = g, b)$$

The entrepreneur's preferred action $a^E(\theta_i, s)$ may in general differ from the first best action $a^*(\theta_i)$. There is then scope for renegotiation.

To see how renegotiation affects the final outcome suppose that t_s and t'_s are such that without renegotiation the entrepreneur prefers to choose a_g when $s = 1$ and a_b when $s = 0$ irrespectively of the realization of θ . Then there is scope for renegotiation when $s = 1$ and the realized state is θ_b or when $s = 0$ and the realized state is θ_g .

Consider first renegotiation in the event $(\theta_b, s = 1)$. In the absence of renegotiation the investor's payoff is $y_g^b(1 - t_1) - t'_1$. The entrepreneur's equilibrium renegotiation offer thus provides the investor with this payoff and the entrepreneur's return under renegotiation is given by

$$(y_b^b + l_b^b) - y_g^b(1 - t_1) + t'_1$$

This payoff is strictly greater than $y_g^b \cdot t_1 + t'_1 + l_g^b$, since by assumption $y_b^b + l_b^b > y_g^b + l_g^b$. The initial contract will therefore be renegotiated in the event $(\theta_b; s = 1)$, so that the first-best action in state θ_b is always selected. In the event $(\theta_g; s = 0)$ renegotiation takes place in exactly the same fashion and the first-best action in state θ_g is always selected. In other words, *when the entrepreneur has full control, ex post renegotiation guarantees that the first-best action is always implemented.*

It seems that we have identified a simple solution to our problem: give full control to the entrepreneur and that's that. Unfortunately this solution is not always feasible, for when the entrepreneur has full control, the investor may not obtain a high enough

8. When $r \in \{0, 1\}$, we always have:

$$t(s, r) = (t(s, 1) - t(s, 0))r + t(s, 0).$$

expected return from her investment. True enough, renegotiation guarantees that there are no ex post inefficiencies but all the gains from renegotiation go to the entrepreneur. The expected size of these gains may be so large that the investor's ex ante individual rationality constraint is violated.

There is, however, one obvious case where entrepreneur control is efficient and feasible. This is when the entrepreneur's objectives are perfectly in line with the social objectives. Then the first-best action plan can be implemented without renegotiation in equilibrium. Feasibility is then guaranteed since the problem of excess dissipation of rents through renegotiation does not arise in this case. Proposition 1, below, states this result.

Proposition 1 *If private benefits l are comonotonic with total revenues $(y + l)$, that is, if $l_g^g > l_b^g$ and $l_b^b > l_g^b$, then entrepreneur control is always feasible.*

Proof. If private benefits are comonotonic with total revenues, then it suffices to choose $t(s, r) = t$ for all s and all r , for then the entrepreneur chooses the first-best action in each state.

Indeed, the incentive constraints for the selection of the first-best action, are then given by:

$$\begin{aligned} t + l_g^g &> t + l_b^g \\ t + l_b^b &> t + l_g^b. \end{aligned}$$

And these are verified by assumption for all $t \geq 0$.

The constant t can then be chosen so that $qy_g^g + (1 - q)y_b^b - t = K$; a transfer $t \geq 0$ satisfying this equation exists since by assumption we have $qy_g^g + (1 - q)y_b^b > K$. \parallel

In the case where private benefits are not comonotonic with total revenues, the feasibility of entrepreneur control is no longer guaranteed. Indeed, the first-best action plan can be implemented, in this case, only if the entrepreneur gets a sufficient share of monetary returns (either directly through the transfer schedule specified in the initial contract or indirectly through ex post renegotiation) to induce him to choose the efficient action in every state. But this requirement may be impossible to reconcile with the requirement of providing the investor with an adequate expected return. To see this, suppose, without loss of generality, that $l_b^b < l_g^b$. Under this configuration of payoffs, the entrepreneur's private benefits are not comonotonic with total revenues; Proposition 2 below establishes that for high values of K entrepreneur control is not feasible in this case. In order to state this proposition we define

$$\Delta^b \equiv (y_b^b + l_b^b) - (y_g^b + l_g^b) \quad \text{and} \quad \Delta_y^b \equiv y_b^b - y_g^b.$$

(By assumption, both Δ^b and Δ_y^b are strictly positive.)

$$\begin{aligned} \pi_1 &\equiv [q \cdot y_g^g + (1 - q) \cdot y_b^b] \cdot \Delta^b / \Delta_y^b \\ \pi_2 &\equiv q \cdot y_g^g + (1 - q) \cdot y_g^b \\ \pi_3 &\equiv q \cdot [\beta^g \cdot y_g^g + (1 - \beta^g) \cdot y_g^b \cdot \Delta^b / \Delta_y^b] \\ &\quad + (1 - q) \cdot [\beta^b \cdot y_g^b + (1 - \beta^b) \cdot y_b^b \cdot \Delta^b / \Delta_y^b]. \end{aligned}$$

Proposition 2 *Entrepreneur-control is feasible and implements the first-best action plan, if and only if $\max(\pi_1, \pi_2, \pi_3) \geq K$. Thus, if the set-up cost, K , belongs to the non-empty interval $[\max(\pi_1, \pi_2, \pi_3), qy_g^g + (1 - q)y_b^b]$, entrepreneur control is not feasible.*

Proof. See Appendix 2. ||

The following numerical example illustrates the main points.

Example. Assume that the two states of nature θ_g and θ_b occur each with probability $1/2$, and take the following numerical values for the parameters:

in state θ_g , let $y_g^g = 100$; $l_g^g = 150$; $y_b^g = 200$; $l_b^g = 0$,

in state θ_b , let $y_b^b = 50$; $l_b^b = 0$; $y_g^b = 0$; $l_g^b = 49$.

Note that private (non-verifiable) returns are not comonotonic with total revenues. There are three different types of ex ante contracts to consider. Those contracts that are renegotiation-proof and two types of contracts that allow for renegotiation in equilibrium. In the set up of this example (and more generally whenever private benefits are not comonotonic with total revenues) we can restrict attention to compensation schemes such that $t'_s = 0$ and $t_s \leq 1$: When $t'_s > 0$ the contract can be improved by lowering t'_s (this leaves the incentive constraints unaffected and relaxes the individual rationality constraint). When $t_s > 1$, the entrepreneur may be induced to choose the inefficient action in state θ_g . Then by lowering t_s , both incentive constraints for the implementation of the first-best action plan can be met and the individual rationality constraint is relaxed. Thus, we shall restrict attention to proportional sharing rules:

$$t(s, r) = t_s \cdot r, \text{ where } t_s \leq 1.$$

(1) *Renegotiation-proof contracts*

Such contracts must give the entrepreneur a sufficiently large share of verifiable returns for him to choose the first-best action a_b in state θ_b (with $t_s \leq 1$, the entrepreneur always chooses a_g in state θ_g). Specifically, we must have:

$$t_s \cdot y_b^b + l_b^b \geq t_s \cdot y_g^b + l_g^b \text{ or } t_s \geq 49/50.$$

The investor's expected payoff is then maximized for $t_s = 49/50$, all s . Her corresponding payoff is equal to:

$$\pi_1 = 1/2 \cdot 1/50 \cdot 100 + 1/2 \cdot 1/50 \cdot 50 = 3/2.$$

(2) *Contracts with full renegotiation in state θ_b*

These contracts specify such low transfers that, no matter what the realization of s , the entrepreneur prefers a_g to a_b in state θ_b . Within this class of contracts, the investor's expected payoff is maximized for $t_0 = t_1 = 0$. This induces the entrepreneur to choose action a_g in both states θ_b and θ_g . The corresponding payoff for the investor is then:

$\pi_2 = 1/2 \cdot 100 + 1/2 \cdot 0 = 50$, since the entrepreneur has all the bargaining power in the renegotiation phase. Thus, renegotiation-proof contracts are strictly dominated by contracts which involve full renegotiation in equilibrium when $K \in (3/2; 50)$. For those values of K the former contracts are not feasible while the latter are. (If $K \in (50, 75)$, no contract from those two classes is feasible).

(3) *Contracts involving partial renegotiation in state θ_b .*

These are contracts where, say, t_1 is too low but t_0 is high enough to induce the entrepreneur to choose a_b . The investor's expected payoff is maximized within this class of contracts for $t_1 = 0$; $t_0 = 49/50$. Renegotiation takes place in state θ_b only when $s = 1$. The investor's payoff is then given by:

$$\begin{aligned} \pi_3 &= 1/2[\beta^g \cdot 100 + (1 - \beta^g)(1 - 49/50) \cdot 100] \\ &\quad + 1/2 \cdot [\beta^b \cdot 0 + (1 - \beta^b)(1 - 49/50) \cdot 50] \\ &= 50\beta^g + 1 - \beta^g + ((1 - \beta^b)/2). \end{aligned}$$

Note that for β^g sufficiently close to 1 and β^b sufficiently close to zero, we have: $\pi_3 > 50 = \pi_2$. Intuitively, by setting $t_0 \geq 49/50$ instead of $t_0 = 0$, the investor gives up little surplus in state θ_g when β^g is close to 1; but in state θ_b , the investor can avoid dissipating rent through renegotiation (when $\beta^b \rightarrow 0$). The benefit of avoiding renegotiation (partially) is then larger than the cost. Given that $\pi_3 > 50$, there are values of K ($K \in (50, \pi_3)$) such that only contracts with partial renegotiation are feasible).

Remark. This example reveals that renegotiation-proof contracts can be strictly dominated by contracts allowing for renegotiation in equilibrium. To make sure that the entrepreneur always chooses the first-best efficient action without renegotiation he must get a large fraction of the monetary returns of the project. But this may leave the investor with too small a fraction of the returns to cover the initial costs, K . A contract allowing for some renegotiation could provide the investor with a higher expected return, even taking into account the fact that all the renegotiation-gains go to the entrepreneur, since allowing for renegotiation means that the transfers to the entrepreneur, t_s , can be lowered so that the investor gets a higher payoff in those events where there is no renegotiation. It is somewhat surprising that when a renegotiation-proof contract is dominated by a contract allowing for renegotiation, it is not the case that the contract should go for maximum renegotiation. The reason for this outcome is that the entrepreneur has all the bargaining power in the renegotiation phase, so that he may extract too high a surplus when there is maximum renegotiation.

To summarize, when the entrepreneur's private benefits are not comonotonic with total benefits it may not be feasible to implement the first-best action plan (with entrepreneur control) without renegotiation in equilibrium. Moreover, when there is renegotiation a contract with entrepreneur-control may not be feasible since the entrepreneur may appropriate an excessively large fraction of the project's returns through the renegotiation. In this case the investor is willing to invest in the project only if she gets some protection against the entrepreneur's future opportunistic behaviour. The next sub-section examines the opposite extreme of entrepreneur control where the investor has full protection against the entrepreneur's opportunistic behaviour.

III.B Investor control

Under investor control ex post renegotiation typically does not guarantee that the first-best action is always implemented. When the initial contract induces the investor to choose an action other than the first-best action, there is room for Pareto-improving renegotiation, but *renegotiation may not take place if the entrepreneur's wealth constraint prevents him from compensating the investor for choosing an action which yields a lower expected monetary return*. Before we illustrate this point by means of an example, we state the obvious result that when the investor's objective is perfectly in line with the social objectives the implementation of the first-best action plan is feasible under investor control.

Proposition 3. *When monetary benefits are comonotonic with total revenues, ($y_g^g > y_b^g$ and $y_b^b > y_g^b$) the first-best can be achieved under investor control.*

Proof. Consider any contract (with investor control) with a proportional sharing-rule $t(s, r) = t \cdot r$. With this transfer rule the investor chooses a_g in state θ_g since she then gets:

$$\pi^g(a_g) = (1 - \bar{t})y_g^g > (1 - \bar{t})y_b^g = \pi^g(a_b).$$

Similarly, the investor chooses a_b in state θ_b .

Now it suffices to choose \bar{t} so as to make the contract individually rational for the investor, which is always possible when $qy_g^g + (1-q)y_b^b > K$. \parallel

When monetary benefits are not comonotonic with total revenues, we show that, due to the entrepreneur's wealth constraint, investor control may not implement the first-best plan of actions. To see this, suppose without loss of generality, that $y_g^g < y_b^g$. For the same reasons as before, we can restrict attention to contracts where $t'_s = 0$ here. Then the investor does not take the first-best action a_g in state θ_g in the absence of renegotiation unless $t_s \geq 1$, since $(1-t_s)y_g^g < (1-t_s)y_b^g$. In order to induce the investor to switch from a_b to the first-best action a_g (when $t_s \leq 1$), the entrepreneur must renegotiate the initial contract and offer a cut in his monetary transfer; the new transfer, \hat{t}_s , must then satisfy:

$$(1-\hat{t}_s)y_g^g \geq (1-t_s)y_b^g$$

or

$$\hat{t}_s \leq 1 - (1-t_s)(y_b^g/y_g^g). \quad (5)$$

Clearly, if the ratio y_b^g/y_g^g is large and/or the entrepreneur's initial share t_s is small, the entrepreneur's wealth constraint, $\hat{t}_s \geq 0$, is violated; in other words, when y_b^g/y_g^g is large and/or t_s is small, the entrepreneur's wealth constraint prevents him from offering a Pareto-improving contract to the investor. It follows from (5) that investor control implements the first-best outcome after renegotiation in state θ_g if and only if the initial compensation scheme, t_s , specified in this contract is such that there exists $\hat{t}_s \geq 0$ satisfying (5), or equivalently: $t_s \geq 1 - y_g^g/y_b^g$.

The next proposition follows immediately from this observation.

Proposition 4. *When monetary benefits are not comonotonic with total returns, a necessary and sufficient condition for the first-best action plan to be feasible under investor control is: $\pi_4 \equiv (qy_g^g + (1-q)y_b^b) \cdot y_g^g/y_b^g \geq K$.*

Proof. See above. \parallel

Thus, if the second-best action, a_b , yields substantially higher monetary returns than those generated by the first-best action, a_g , then any transfer-scheme satisfying the investor's individual rationality constraint would not leave the entrepreneur with enough wealth to induce the investor to choose the first-best action after renegotiation.

As an illustration consider again the numerical example introduced earlier, where $y_b^b = 50$ and $y_g^g = 100 < y_b^g = 200$. For these parameter values the first-best action plan cannot be implemented under investor control whenever $K > (1/2 \cdot 200 + 1/2 \cdot 50) \cdot 1/2 = 62.5$.

We shall now establish that in situations where neither private benefits nor monetary returns are comonotonic with total revenues, there are circumstances where contingent control allocations strictly dominate both entrepreneur and investor control.

III.C Contingent control

When entrepreneur control is not feasible and investor control does not achieve the first-best outcome an intermediate control allocation where the entrepreneur gets control contingent on some realizations of s and the investor gets control for the other realizations of s may dominate both unilateral control allocations. We know from Propositions 1

and 3 that one of the two unilateral control allocations achieves the first-best whenever monetary or private benefits are comonotonic with total benefits. Therefore, contingent control may dominate both unilateral control allocations only when neither monetary nor private benefits are comonotonic with total benefits. We consider this latter case here and thus assume that $y_g^s < y_b^s$ and $l_b^b < l_g^b$.

For these parameter values, the first-best action is selected under investor-control only in state θ_b (irrespective of the realization of s) and under entrepreneur-control only in state θ_g (again, for all s). If control could be made contingent on θ an obvious candidate for efficiency would then be to give control to the entrepreneur in state θ_g and to the investor in state θ_b . But control can only be made contingent on the realization of s . Nevertheless, if s is sufficiently well correlated with θ a contingent control allocation where control is allocated to the entrepreneur when $s = 1$ and to the investor when $s = 0$ may approximate the first-best outcome. If, in addition, the conditions in Propositions 2 and 4 are violated (for these parameter values) so that entrepreneur control is not feasible and investor control does not achieve the first-best, then the contingent control allocation described above may dominate both unilateral control allocations. We establish this result formally in this sub-section.

Consider a contract with the above contingent control allocation and with a transfer schedule such that $t(s, r) = 0$ for all s and r . This contract induces the following action plan in the absence of renegotiation:

$$\begin{aligned} \text{in state } \theta_g, \quad a &= \begin{cases} a_g & \text{if } s = 1 \\ a_b & \text{if } s = 0 \end{cases} \\ \text{in state } \theta_b, \quad a &= \begin{cases} a_g & \text{if } s = 1 \\ a_b & \text{if } s = 0 \end{cases} \end{aligned}$$

Given that the entrepreneur obtains all the rents from renegotiation, the investor's expected return from this action plan is given by:

$$\pi_c = q \cdot [\beta^g \cdot y_g^g + (1 - \beta^g) \cdot y_b^g] + (1 - q) [\beta^b \cdot y_g^b + (1 - \beta^b) \cdot y_b^b]. \quad (6)$$

When $\beta^g \rightarrow 1$ and $\beta^b \rightarrow 0$, π_c approximates the first-best expected monetary return, $q y_g^g + (1 - q) y_b^b$. Therefore, in the limit we have $\pi_c > \pi_1$ and π_2 . When $\beta^g \rightarrow 1$ and $\beta^b \rightarrow 0$, π_3 may also converge to the first-best payoff; the above argument is thus not adequate to establish that $\pi_c > \pi_3$. However, when calculating the difference $\pi_c - \pi_3$ one obtains:

$$\pi_c - \pi_3 = q(1 - \beta^g)[y_b^g - y_g^g \cdot \Delta^b / \Delta_y^b] + (1 - q)(1 - \beta^b)[1 - \Delta^b / \Delta_y^b] y_b^b.$$

Now $\Delta^b / \Delta_y^b < 1$, since $l_b^b < l_g^b$; moreover $y_g^g < y_b^g$. so that $\pi_c > \pi_3$.

Thus, when $\beta^g \rightarrow 1$ and $\beta^b \rightarrow 0$, there exist values of K for which contingent control is feasible but entrepreneur control is not.

It remains to show that contingent control dominates investor control in those circumstances. Consider the limit case where $\beta^g = 1$. Suppose in addition that the condition $\pi_4 \geq K$ in Proposition 4 is violated. Then, investor control achieves action a_b in state θ_g , so that aggregate payoffs under investor control are bounded away from the first-best aggregate payoffs (this is also true for $\beta^g < 1$ but close to one). Now, under contingent control, as $\beta^g \rightarrow 1$ and $\beta^b \rightarrow 0$, aggregate payoffs converge to the first-best aggregate payoffs so that the contingent control allocation strictly dominates investor control. We summarize our discussion in the proposition below:

Proposition 5. *When neither monetary nor private returns are comonotonic with total benefits there are values of K such that:*

- (i) *entrepreneur control is not feasible*

- (ii) *investor control is not first-best efficient*
- (iii) *both unilateral control allocations are dominated by the contingent control allocation* ($\alpha_0 = 0; \alpha_1 = 1$) when $(\beta^g, \beta^b) \rightarrow (1, 0)$.

Proof. See above. \parallel

As pointed out earlier, the contingent control allocation considered here can be interpreted as a control allocation associated with debt financing. If the first-period signal represents a default–no default event, then we have described a control allocation where the entrepreneur gets control as long as he does not default on his debt obligations but the creditor gets control in the event of default. Our model thus sheds new light on the optimality properties of debt. Previous authors have emphasized the signalling role of debt (Ross (1977) and Myers–Majluf (1984)), the role of debt in facilitating monitoring (Townsend (1979)) and Gale–Hellwig (1985)), the commitment value of debt (Grossman–Hart (1982)) and Jensen (1986)), or the value of debt in getting the firm to pay out its returns on past investments (Hart–Moore (1990) and Bolton–Scharfstein (1990)). Here the value of debt arises from the control allocation it induces. It allows the entrepreneur to reap some private benefits and at the same time it gives adequate protection to the investor. By giving control to the investor when $s = 0$, the debt contract can limit the extent of rent extraction through ex post renegotiation. At the same time, when $s = 1$, the investor cannot prevent the entrepreneur from obtaining his private benefits. Section V discusses the relative merits of other capital structures in the context of our model at greater length. We close this section with a brief discussion of joint-ownership.

In our model, joint ownership is always (weakly) dominated by either unilateral or contingent control. The reason for this is that joint ownership exacerbates ex post hold-up problems to the extent that either party can always threaten to veto any action choice and thus force the firm to a standstill. As a result ex post negotiation rents are typically larger under joint ownership than under any other control allocation. Given our specification of the ex post bargaining game all these rents go to the entrepreneur so that completely joint ownership is never feasible in our model (the equilibrium expected returns of the investor are zero in this case). As for partial joint ownership (where either μ_s^I or μ_s^E are different from zero and one) it is (weakly) dominated by control allocation such that in all events where control is joint (under the partial joint ownership rule) the entrepreneur gets full control, for in those events the same equilibrium actions are chosen under both control allocation rules but the renegotiation rents are smaller when joint control is replaced by entrepreneur control.⁹

In the next section we explain that when the initial contract can pre-specify an action plan the notion of joint control essentially becomes vacuous.

IV. OPTIMAL CONTROL ALLOCATIONS WITH VERIFIABLE ACTIONS

In situations where actions are verifiable, the initial contract can specify transfers contingent on actions taken and can set restrictions on the action set from which future

9. Another reason why joint ownership is typically inefficient here is that the respective positions of the entrepreneur and the investor are extremely asymmetric: the investor provides the funding and the entrepreneur runs the firm. In a more symmetric situation where each agent's financial contribution is similar and where each agent participates in the management of the business (so that each gets a share of the private benefits), joint ownership may well be the most efficient arrangement. In such situations it is likely that each agent's bargaining power is more evenly distributed so that joint ownership ensures that each gets an approximately equal share of the benefits. This may be one reason for the widespread use of partnership arrangements in professional activities.

actions can be selected. From the point of view of the investor, these are new instruments available to limit ex post opportunistic behaviour by the entrepreneur. If those instruments are available, it may become redundant for the investor to obtain control rights to protect her interests. We show here that introducing restrictions on the action set may indeed reduce the entrepreneur's future renegotiation rents, but this does not necessarily mean that the investor can now do without control rights. In fact, we begin by showing that in our set-up where the choice is only between two actions, the additional instrument of restricting the action set from which future actions can be chosen is redundant, so that the control allocations that are potential candidates for efficiency are the same as those in the previous section. However, when the action set comprises more than two actions, we provide an example where ex ante action restrictions improve the overall efficiency of the contract. In sum, this section illustrates that it is optimal to use action restrictions in conjunction with control rights.

Proposition 6. *When $A = \{a_g, a_b\}$, any investment contract with some ex ante action restriction is (weakly) dominated by either a unilateral or a contingent control contract without action restrictions.*

Remark. Note that when the initial contract can predetermine a future action-plan contingent on the realization of s , any additional allocation of control rights becomes redundant (even if there is ex post renegotiation).

Therefore, we need to show that:

- (i) a contract with a predetermined action plan is dominated by a contract specifying control rights and no action restrictions,
- (ii) that partial action restrictions are unnecessary.

As mentioned above, when actions are verifiable the monetary transfer to the entrepreneur may also be contingent on the action choice: Let $t(a, s, r) \geq 0$ denote such a transfer where a is the action chosen by whoever is in control. As in the previous case with unverifiable actions, given that second-period returns can only take two values (0 and 1), there is no loss of generality in restricting attention to affine transfer rules such that:

$$t(a, s, r) = t_{sa} \cdot r + t'_{sa}.$$

We shall concentrate our attention on the case where private benefits are not comonotonic with total returns (otherwise, any investment contract is (weakly) dominated by entrepreneur control without any action restriction); there is then no loss of generality in assuming that $t'_{sa} = 0$. We denote by t_{sg} (respectively t_{sb}) the entrepreneur's share of monetary returns when action a_g (resp. a_b) is taken and s is the realization of the first-period signal.

What is the main difference then between a contract specifying contingent or unilateral control and a contract with a predetermined action plan (from which the contracting parties may renegotiate away in the future)? The latter governance structure specifies a status-quo action plan *directly*, while the former governance structure specifies such a plan only *indirectly* as a result of the anticipated optimal choice of action by the party in control.

We know that in state θ_g for example, the entrepreneur always prefers to choose a_g and the investor always prefers to choose a_b (given any *ex ante* transfer scheme such that $t_s \leq 1$ for all s). Why then is there any difference in outcomes between a contract that specifies a_g if $s = 1$ and a_b if $s = 0$, and a contract specifying control to the entrepreneur if $s = 1$ and to the investor if $s = 0$? There is indeed no difference in state θ_g when $s = 1$

and in θ_b when $s = 0$. But when $s = 1$ in state θ_b , it may be the case that under contingent control the entrepreneur prefers to choose action a_b if t_{1b} is sufficiently high, while the predetermined action would be a_g in this event. (Similarly, when $s = 0$ in state θ_g , it may be the case that the investor prefers a_g if t_{0g} is sufficiently high, while the predetermined action would be a_b). The induced status-quo action plan under contingent control in respectively states θ_g and θ_b then is:

$$a_s(\theta_g) = \begin{cases} a_g & \text{if } s = 1 \\ a_b & \text{if } s = 0 \end{cases}; \quad \text{and } a_s(\theta_b) = a_b \text{ for all } s, \quad (7)$$

while under joint ownership the status-quo action plan is

$$a_s(\theta_g) = a_s(\theta_b) = \begin{cases} a_g & \text{if } s = 1 \\ a_b & \text{if } s = 0 \end{cases}. \quad (8)$$

It thus appears that one can specify more flexible status-quo action plans under contingent control than under predetermined actions. This added flexibility is welfare improving here since it results in less frequent renegotiation.

Proof of Proposition 6. First, note that when either private benefits or monetary returns are comonotonic with total returns, entrepreneur or investor control are first-best efficient and therefore (weakly) dominate any contract with initial action restrictions. In all other cases, the general argument relies on showing that the entrepreneur's renegotiation rents are smaller under a contract with contingent control and no action restrictions.

It suffices to consider the case where $y_g^g < y_b^g$ and $l_b^b < l_g^b$ and, given the linearity of the contracting problem with respect to monetary returns, to show that a contract with the prespecified action plan ($\lambda_1 = 1, \lambda_0 = 0$) is dominated (weakly) by a contract with contingent control and no action restrictions. Thus, consider a contract specifying an initial plan such that a_g is chosen when $s = 1$ and a_b is chosen when $s = 0$. It is easy to see that this contract is (weakly) dominated by the following contract with contingent control and no action restrictions:

(a) $\alpha_1 = 1$ and $\alpha_0 = 0$.

(Allocating control to the entrepreneur when $s = 1$ and to the investor when $s = 0$.)

(b) $\hat{t}_{sg} = \hat{t}_{sb} = 0, s \in \{0, 1\}$.

(We denote by t_{sa} the transfer schedule specified in the contract with prespecified action plan.)

In the absence of renegotiation, both contracts would induce action a_g , when $s = 1$. In the event $(\theta_b, s = 1)$ where action a_g is inefficient, the contract with prespecified action plan yields a renegotiation rent to the entrepreneur of $R_1^{ar} = y_b^b - y_g^b(1 - t_{1g})$, which is clearly greater than the renegotiation rent $R_1^{nar} = y_b^b - y_g^b$ under the above contingent control contract without action restrictions.

Similarly, in the absence of renegotiation both contracts would implement action a_b when $s = 0$. In the event $(\theta_g, s = 0)$ where action a_g is inefficient the contract with a pre-specified action plan yields a renegotiation rent to the entrepreneur equal to $R_0^{ar} = y_g^g - y_b^g(1 - t_{0b})$ which is larger than $R_0^{nar} = y_g^g - y_b^g$ under the contingent control contract without action restrictions. Therefore, in all events, the contract with the pre-determined action plan specified above is (weakly) dominated by a contract with contingent control allocation and without action restrictions. One can appeal to similar reasoning to show

that entrepreneur control or investor control contracts with partial action restrictions are weakly dominated by unilateral or contingent control contracts without any action restrictions. This establishes the Proposition. \parallel

Remark. The redundancy of action restrictions established in Proposition 6 depends on the restriction of our model to an action set with only two actions. In more general settings, where the action set comprises more than two actions, control allocations without any action restriction are more likely to provide large renegotiation rents to the entrepreneur. This, in turn, can make it harder to meet the investor's ex ante individual rationality constraint than if some (partial) action restrictions had been specified in the initial contract.

We shall briefly illustrate this point with the following example: suppose that the action set contains three actions, $A = \{a_b, a_g, a_c\}$, where a_b and a_g are respectively the first-best actions in states θ_b and θ_g and a_c is a Pareto-dominated action in both states. Specifically, suppose that $y_c^b = 0$ and $l_c^b = y_b^b + l_b^b - \delta$, so that action a_c provides high private benefits to the entrepreneur even though it is sub-optimal in state θ_b . Then a contingent control contract such that control is given to the entrepreneur when $s = 1$ would, in the absence of any action restriction, induce the entrepreneur to choose action a_c instead of a_g or a_b in event $(\theta_b, s = 1)$. (Provided δ is sufficiently small, this would be true for any $t_{1s} \leq 1$).

Now, if the status-quo action is a_c in the event $(\theta_b, s = 1)$, the investor must abandon all of the monetary returns to the entrepreneur so as to renegotiate away from the inefficient action a_c to the first-best action a_b . If instead an action restriction banning a_c had been included into the otherwise identical contingent control contract, the investor could have guaranteed a status-quo monetary return of $\min(y_b^b(1 - t_{1b}), y_g^b(1 - t_{1g}))$ in the same event $(\theta_b, s = 1)$. There are thus values of K for which the first-best could only be implemented once the above action restriction has been introduced in the initial contingent control contract.

More generally, when actions are verifiable ex post, one should expect to see contractual arrangements with both control allocations between the two parties and action restrictions. First, for a given control allocation, prespecifying some action-restrictions in the initial contract can reduce ex post opportunism on the entrepreneur's side and thus make it easier to satisfy the investor's ex ante individual rationality constraint. Second, allowing some scope for control can improve upon a contract with a fully prespecified action plan, to the extent that it permits more flexible status-quo actions and thereby reduces the likelihood of future renegotiation.

Our earlier analysis of entrepreneur control, investor control, and (strictly) contingent control can thus be extended to the case where actions become verifiable. It is easy to extend Propositions 1, 3 and 5 to the case where actions are verifiable. The fact that the compensation scheme t is also contingent on the action choice has the effect of relaxing the necessary and sufficient conditions stated in Propositions 2 and 4. However, it remains true that when neither private nor monetary returns are comonotonic with total revenues, there exist values of K sufficiently close to $qy_g^g + (1 - q)y_b^b$ such that neither entrepreneur control nor investor control can both be feasible and implement the first-best action plan. When, in addition, the signal s is sufficiently well-correlated with the state of nature, then contingent control dominates again unilateral control.

The basic reasonings are the same as in the non-verifiable actions case. The entrepreneur's wealth constraint is again crucial and although it can be more easily circumvented with transfer schedules contingent on actions, these are not sufficiently

effective to make control redundant. We can thus account for the existence of financial contracts that combine control allocations and action restrictions, such as debt-contracts with covenants, which are common in practice.

V. INTERPRETATIONS AND CONCLUSIONS

We have developed a highly stylized model where, as a result of contractual incompleteness and wealth constraints, not all potential conflicts of interest between the entrepreneur and the investor can be resolved through *ex ante* contracting. In this model it therefore matters who controls the firm. We have shown that different control arrangements or governance structures are efficient for different values of monetary returns and private benefits.

In this section we wish to illustrate and discuss at greater length the general theme of this paper that the problem of selecting an efficient governance structure is closely related to the problem of selecting an adequate financial structure for the firm.

Thus, when it is optimal to give full control to the investor, the firm should finance its investment by issuing *voting equity*. Since the investor finances the entire project she gets most or all of the shares and thus obtains full control of the firm. Note that an alternative arrangement would be for the entrepreneur to become the employee of the investor. If it is best to give full control to the entrepreneur the firm should issue *non-voting shares (preferred stock)*. If joint ownership is the most efficient arrangement, the entrepreneur and the investor should raise the necessary funds by setting up a *partnership* or a *trust* where decisions are taken through unanimous consent. Finally, if it is efficient to allocate control contingent on the realization of the signal, s , then other financial instruments must be considered among which are *ordinary debt*, *convertible debt* and/or *warrants*, and *convertible preferred stock*.

It is worth being somewhat more explicit than we have been so far about the signal, s . A natural signal of the firm's future profitability (and more generally of the state of nature the firm is in) is first-period project returns. Our model can easily be modified to accommodate first-period returns (see an earlier version of this paper, Aghion-Bolton (1988)). When first-period returns are introduced, efficient contracting requires that all of these returns go to the investor since this relaxes the investor's individual rationality constraint. Then, if first-period expected returns are not high enough to cover the investor's initial outlays the analysis is identical to that carried out here. As an illustration, consider the most plausible scenario where low first-period revenues ($s = 0$) indicate that the firm is likely to be in state θ_b and high first-period revenues ($s = 1$) that the firm is likely to be in state θ_g ; then if it is efficient to allocate control to the entrepreneur when $s = 1$ and to the investor when $s = 0$ the firm should issue an ordinary debt contract with a repayment of 1 in period 1. This repayment can only be met by the entrepreneur if $s = 1$, in which case he retains control; otherwise he is forced to default on the debt and to hand over control to the investor. Thus, *debt financing is a natural way of implementing contingent control allocations of a particular kind*. The ability for the entrepreneur of retaining control is contingent on meeting the debt obligations. If the entrepreneur defaults or goes bankrupt he must abandon his control rights to the investor. The latter can then choose her most preferred action or get the entrepreneur to bribe her into choosing the first-best action. Viewed in this light, default and bankruptcy are not synonymous with liquidation. They can result in either reorganisation or liquidation. More specifically, let action a_b be liquidation and action a_g be continuation. Then, if the entrepreneur defaults in state θ_b , the investor liquidates the firm (under the assumptions of Proposition 6). If, however,

the entrepreneur defaults in state θ_g , then the investor either liquidates (if renegotiation to the first-best action a_g is not feasible) or the entrepreneur and the investor *reorganise* the firm (reorganisation here simply involves a restructuring of claims).¹⁰

While this representation of default and bankruptcy is familiar to practitioners and bankruptcy lawyers, this is not the way bankruptcy has been represented in the existing finance and economics literature (a notable recent exception is White (1984)).

Debt is by no means the only way of implementing contingent control arrangements. A few other examples come immediately to mind, such as *venture capital* and, of course, all *convertible securities*. It is worth pointing out that convertible preferred stock and convertible debt do not implement the same contingent control structures as debt. For instance, if it is efficient to allocate control to the entrepreneur when first-period revenues are zero and to the investor when these returns are high, then the firm might issue convertible preferred stock (or a combination of preferred stock and warrants). With such a financial arrangement, conversion would only take place if the firm's return prospects improve (i.e. when $s = 1$), so that the entrepreneur would have to share or give up control only if the firm's future profitability suddenly increases. It is often argued that convertible securities are a cheap way for fast growing firms to raise funds since it allows investors to share the potentially high returns generated by the firm's investments. Our model suggests another advantage of those securities in terms of control allocation. It may be the case, for instance, that incumbent management performs well when the firm is small, but that it may not be able to handle a much bigger firm. In this case, financing through convertible securities may enable the investors to take control in those contingencies where the firm grows large.

While clear analogies can be drawn between the governance structures described earlier and financial arrangements observed in practice, it is less clear how our results about optimal revenue sharing relate to standard financial contracting practices. For example, when we consider contingent control structures, we find that when the investor gets control she does not necessarily get all the monetary return. This does not square well with the standard representation of a debt contract where the creditor gets all the residual claims after default or bankruptcy. This discrepancy is not as troublesome as it may at first appear, for in practice it is often the case that even after default the debtor manages to obtain a net positive return. There is some evidence that in bankruptcy the absolute priority rule is not in general strictly implemented (see Franks and Torous (1990)). Moreover our optimal contracts are of the form that when the creditor does not have control she does not get a flat repayment, but instead she gets a fraction of revenues. This is perfectly compatible with a financial arrangement where the creditor holds debt-claims with warrants attached in sufficiently small numbers that when the warrants are exercised, the entrepreneur still retains control.

To conclude, this paper provides a complete characterization of the efficient governance structures for all possible values of the parameters y and l . Basically, three types of efficient governance structures emerge from our analysis (entrepreneur control, investor control, contingent control).

Each of these governance structures is associated with a standard financial structure. Using a terminology introduced by Myers, our characterization can be described as a *pecking-order* theory of governance structures: it is always best to start first with entrepreneur control if that is feasible. If, however, entrepreneur control does not

10. In an extended version of our model with more than two actions, reorganization in the absence of renegotiation simply corresponds to the investor choosing as his most preferred action some third alternative $a_r \notin (a_g, a_b)$.

sufficiently protect the investor's claims, one should go for contingent control. Finally if that is still not enough to protect the investor's interests, one wants to give full control to the investor. This ordering of governance structures corresponds to the following ordering of financial contracts: first, try non-voting equity; if that doesn't work, try to share ownership by issuing some but not all voting shares to outside investors and/or issue debt; finally, give away all the control rights to the investor by raising all funds in return for voting-equity.

Of course, this simple characterization was obtained in a model with only two states and only two actions. The advantage of restricting attention to such a simple setting is that the necessary and sufficient conditions establishing the optimality of a given governance structure are simple to express. Moreover, the general economic principles underlying our results emerge very clearly in this simplified setting. We wish to emphasize that these principles remain valid in a more general setting with an arbitrary number of actions and states, and that the efficient governance structures identified here will continue to be efficient in the general setting under particular conditions (such as comonotonicity). The cost of restricting ourselves to a two-state two-action setting is that we thereby eliminate other potential types of governance structures as possible efficient arrangements.

For example as we hinted at in Section IV above, in a more general setting, one may want to set up a governance structure where the entrepreneur has full control over most actions but where, at the same time, the investor has the option to enforce (or prevent) the choice of other actions. Debt covenants and other contractual clauses in debt contracts, can implement such governance structures, so that the more general setting may lead to a theory accounting for the observed complexity of debt contracts. Many other dimensions are worth exploring, particularly those concerning multiple investors and the exchange of financial contracts on the capital market. Our future research efforts will be devoted to some of those issues.

APPENDIX 1

In a seminal paper, Maskin (1977) has shown that in situations where the state of nature is observable but not verifiable, one can improve efficiency by making final allocations contingent on the agents' announcements of the state of nature. Such mechanisms are ruled out here, partly because we think that there are substantial transaction costs in implementing such mechanisms. We explain here that even when one takes the opposite view that such mechanisms are costless to implement, they do not in general achieve first-best efficiency (even if one does not require unique implementation), so that the question of how to allocate control does not become irrelevant once one allows for such mechanisms. The basic reasons for which so-called Maskin schemes do not achieve first-best efficiency here are related to the presence of wealth constraints (for the entrepreneur) and to ex post renegotiation.

Formally, the problem of implementation in our set up can be formulated as follows:
Let $F: H \rightarrow A \times R_+$ be the outcome function to be implemented. F is defined as follows:

$$F(\theta_g) = (a_g, t_g) \quad \text{and} \quad F(\theta_b) = (a_b, t_b),$$

where $q(1 - t_g)y_g^g + (1 - q)(1 - t_b)y_b^b \geq K$.

(In other words, the investor's IR-constraint is satisfied for the first-best pair of actions (a_g, a_b)).

A *Maskin mechanism* is defined as follows: for any pair of announcements (θ_E, θ_I) by respectively the entrepreneur and the investor, the mechanism specifies:

—an action selection $a(\theta_E, \theta_I)$

—monetary payoffs for respectively the entrepreneur and the investor which we denote as follows:

$$t(\theta_E, \theta_I)y[a(\theta_E, \theta_I)/\hat{\theta}] \geq 0$$

and

$$(1 - t(\theta_E, \theta_I))y[a(\theta_E, \theta_I)/\hat{\theta}] - K(\theta_E, \theta_I).$$

where $\hat{\theta}$ denotes the true state of nature.

A Maskin-mechanism implements the first best if and only if the following set of conditions is satisfied:

$$\begin{aligned} a(\theta_g, \theta_g) &= a_g; \quad a(\theta_b, \theta_b) = a_b; \\ t(\theta_g, \theta_g) &= t_g; \quad t(\theta_b, \theta_b) = t_b, \quad \text{and} \end{aligned}$$

in state θ_g :

$$\begin{aligned} t_g \cdot y_g^g + I_g^g &\geq t(\theta_b, \theta_g) \cdot y[a(\theta_b, \theta_g)/\theta_g] + I[a(\theta_b, \theta_g)/\theta_g]; \\ (1 - t_g)y_g^g &\geq (1 - t(\theta_g, \theta_b))y[a(\theta_g, \theta_b)/\theta_g] - K(\theta_g, \theta_b); \end{aligned}$$

in state θ_b :

$$\begin{aligned} t_b \cdot y_b^b + I_b^b &\geq t(\theta_g, \theta_b) \cdot y[a(\theta_g, \theta_b)/\theta_b] + I[a(\theta_g, \theta_b)/\theta_b]; \\ (1 - t_b)y_b^b &\geq (1 - t(\theta_b, \theta_g))y[a(\theta_b, \theta_g)/\theta_b] - K(\theta_b, \theta_g). \end{aligned}$$

Notice that without ex post renegotiation, one can easily find a Maskin scheme implementing $F(\theta)$. For example, set $K(\theta_g, \theta_b) = K(\theta_b, \theta_g) = +\infty$, $t(\theta_b, \theta_g) = t(\theta_g, \theta_b) = 0$ and $a(\theta_b, \theta_g) = a(\theta_g, \theta_b) = 0$.

But if one allows for ex post renegotiation, the outcomes specified by the mechanism above when the two agents announce a different state ($\theta_E \neq \theta_I$) will not be implemented since they are ex post inefficient. We will now give an example where, with ex post renegotiation, there does not exist a Maskin scheme implementing the first best.

$$\text{Example. Let } y_g^g = 0 < y_b^g; \quad I_g^g > I_g^b; \quad y_b^b = 0 < y_b^g; \quad I_b^b = I_b^g + y_b^b - \varepsilon$$

An arbitrary Maskin mechanism as defined above gives rise to the following outcomes as a function of (θ_E, θ_I) after renegotiation:

—for (θ_g, θ_b) and (θ_b, θ_g) the equilibrium payoffs (after renegotiation, using the bargaining solution specified in the text where all the renegotiation rents go the entrepreneur) are:

(a) for the entrepreneur:

$$\text{if } (\theta_E, \theta_I) = (\theta_g, \theta_b): I[a(\theta_g, \theta_b)/\hat{\theta}] + y[a(\theta_g, \theta_b)/\hat{\theta}] - \{(1 - t(\theta_g, \theta_b))y[a(\theta_g, \theta_b)/\hat{\theta}] - K(\theta_g, \theta_b)\}$$

and symmetrically if $(\theta_E, \theta_I) = (\theta_b, \theta_g)$.

(b) for the investor, the payoffs remain the same as without renegotiation.

With these payoffs, the set of conditions that needs to be satisfied for the first best to be implemented by the mechanism is:

—for the entrepreneur:

$$\begin{aligned} t_g \cdot y_g^g + I_g^g &\geq I[a(\theta_b, \theta_g)/\theta_g] + t(\theta_b, \theta_g) \cdot y[a(\theta_b, \theta_g)/\theta_g] + K(\theta_b, \theta_g) \\ t_b \cdot y_b^b + I_b^b &\geq I[a(\theta_g, \theta_b)/\theta_b] + t(\theta_g, \theta_b) \cdot y[a(\theta_g, \theta_b)/\theta_b] + K(\theta_g, \theta_b). \end{aligned}$$

—for the investor, the constraints are the same as without renegotiation.

It is now easy to verify that, when ε and q are small, the above conditions, together with the investor's individual rationality constraint, cannot be simultaneously satisfied for any $a(\theta_E, \theta_I) \in \{a_b, a_g, 0\}$. (Indeed, for ε small, the above incentive constraints cannot be satisfied for any $a(\theta_E, \theta_I) \in \{a_b, a_g, 0\}$ unless t_b is sufficiently close to 1; and for q small the investor's individual rationality constraint is violated when t_b is close to 1.)

As the text makes clear, it is the combination of ex post renegotiation and wealth constraints that make it necessary for control to be allocated adequately in order to achieve efficiency.

APPENDIX 2

Proof of Proposition 2. There are three different types of contracts to consider. Those contracts that are renegotiation-proof, those contracts that involve full renegotiation in state θ_b (where $I_b^b < I_g^b$ by assumption), and finally those contracts that involve renegotiation in state θ_b only when $s = 1$.

1. Renegotiation-proof contracts.

We restrict our attention to proportional sharing-rules, for the reasons indicated in the text. For a contract to be renegotiation proof, it must induce the entrepreneur to choose the first-best action a_b in state θ_b , i.e.:

$$t_s \cdot y_b^b + I_b^b \geq t_s \cdot y_g^b + I_g^b$$

or

$$t_s \geq (I_g^b - I_b^b)/(y_b^b - y_g^b) = \hat{t}.$$

For the contract with $t_s = \hat{t}$ to be feasible, the following inequality must then be satisfied:

$$q(1 - \hat{t})y_g^g + (1 - q)(1 - \hat{t})y_b^b \geq K$$

which is equivalent to:

$$\pi_1 \geq K.$$

2. Contracts with full renegotiation in state θ_b .

The investor's expected payoff is maximized within this class of contracts for $t_1 = t_0 = 0$. This induces the entrepreneur to choose action a_g in both states of nature. The corresponding payoff for the investor is then simply equal to π_2 . Therefore, contracts with full renegotiation in state θ_b will be feasible if and only if: $\pi_2 \geq K$.

3. Contracts with partial renegotiation in state θ_b .

The investor's expected payoff is maximized within this class of contracts for $t_1 = 0$ and $t_0 = \hat{t}$. This induces renegotiation in state θ_b only when $s = 1$. The investor's payoff is then given by π_3 . Overall, entrepreneur control is feasible if and only if $\max(\pi_1, \pi_2, \pi_3) \geq K$. Proposition 2 is proved. \parallel

Acknowledgment. We are grateful to Oliver Hart and John Moore for their invaluable comments on several revisions of this paper. We have also benefited from discussions with Mathias Dewatripont, Ian Jewitt, Eric Maskin, Jean Tirole, Michael Whinston and from suggestions by Richard Caves, Bruno Jullien, Andreu Mas-Collel and Bengt Holmstrom. We also wish to thank the seminar participants at Berkeley, Chicago, Davis, Harvard, The London School of Economics, MIT, Northwestern, Toulouse, Yale, and the IMSSS workshop at Stanford. Philippe Aghion is grateful to the Sloan Foundation for financial support.

REFERENCES

- AGHION, P. and BOLTON, P. (1988), "An incomplete contracts approach to bankruptcy and the optimal financial structure of the firm" (Harvard University Discussion Paper, No. 1370).
- BOLTON, P. and SCHARFSTEIN, D. (1990), "A theory of predation based on agency problems in financial contracting", *American Economic Review*, **80**, 94-106.
- CHANG, C. (1987), "Capital structure as optimal contracts" (Mimeo, University of Minnesota).
- DIAMOND, D. (1984), "Financial Intermediation and Delegated Monitoring", *Review of Economic Studies*, **51**, 393-414.
- FRANKS, J. and TOROUS, W. (1989), "An empirical investigation of firms in reorganisation", *Journal of Finance*, **44**, 747-779.
- GALE, D. and HELLWIG, M. (1985), "Incentive-Compatible Debt Contracts: The One-Period Case", *Review of Economic Studies*, **52**, 647-664.
- GROSSMAN, S. and HART, O. (1982), "Corporate financial structure and managerial incentives", in E. Lippman and J. McCall (eds.), *The Economics of Uncertainty*, (Chicago: University of Chicago Press).
- GROSSMAN, S. and HART, O. (1986), "The costs and benefits of ownership: a theory of vertical and lateral integration", *Journal of Political Economy*, **94**, 691-719.
- HART, O. and MOORE, J. (1989), "Default and Renegotiation: a Dynamic Model of Debt" (Mimeo, MIT).
- HART, O. and MOORE, J. (1990), "Property rights and the nature of the firm", *Journal of Political Economy*, **98**, 1119-1158.
- JENSEN, M. (1986), "Agency Costs of Free Cash Flow, Corporate Finance and Takeovers", *American Economic Review*, **76**, 323-329.
- MASKIN, E. (1977), "Nash Equilibrium and Welfare Optimality", *Mathematics of Operations Research* (forthcoming).
- MASKIN, E. and MOORE, J. (1988), "Implementation and Renegotiation" (Mimeo, Harvard University).
- MYERS, S. and MAJLUF, N. (1984), "Corporate financing and investment decisions when firms have information investors do not have", *Journal of Financial Economics*, **13**, 187-221.
- ROSS, S. (1977), "The determination of financial structure: the incentive-signalling approach", *Bell Journal of Economics*, **8**, 23-40.
- TOWNSEND, R. (1979), "Optimal contracts and competitive markets with costly state verification", *Journal of Economic Theory*, **21**, pp. 265-293.
- WHITE, M. (1984), "Bankruptcy, liquidation and reorganisation", Chapter 35 in E. Logne (Ed.), *Handbook of Modern Finance*, (Boston: Warren, Gorham and Lamont).
- WILLIAMSON, O. (1987), "Corporate Finance and Corporate Governance", *Journal of Finance*, **43**, 567-592.
- ZENDER, J. (1991), "Optimal Financial Instruments", *Journal of Finance*, **46**, 1645-1665.