ASSET OWNERSHIP AND RELATIONAL CONTRACTS*

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In a setting where two managers make relationship- and asset-specific investments, the optimal relational contract specifies the same payments that renegotiations would have led to in a spot mode, plus a fixed transfer and a one-step bonus scheme. The choice of ownership is shown to depend critically on the punishment strategies and the nature of the uncertainty.

Key words: Relational Contracts, Property Rights, Theory of the Firm.
JEL Classification: D23, L14, L22.

Williamson (1985) and Klein, Crawford and Alchian (1978) observed that specific investments might explain integration. Building on this idea, Grossman and Hart (1986) and Hart and Moore (1990) have developed models of one-shot relationships, to discuss how integration may impact the incentives to make relationship- and asset-specific investments. But, as Williamson (1985) points out, relationships where integration is considered tend to have recurrent transactions. Reputation effects can therefore discipline the parties, enabling them to enter into a relational contract that improves the incentives. This paper studies such a dynamic setting. It aims to understand how the relational contract should be designed, and how the use of relational contracts may impact the choice of ownership structure and technology.

It is shown that the optimal self-enforcing relational contract (Bull, 1987) pays what a party would get after renegotiations (the spot mode outcome), a one-step bonus, and a fixed transfer. The two latter elements are due to Levin (2002), who derives the optimal relational contract in a setting where only one party invests, the outside options are invariant to investments and uncertain environmental variables, and the parties cannot renegotiate after a relational contract violation to capture gains from trade. These restrictive assumptions are relaxed in my model.

The difference between the payments specified by the relational contract and the outcome of renegotiations determines the temptation to renege after uncertainty is resolved in a given period. To base a one-step bonus on the renegotiations outcome maximises the incentive effect of the relational contract for a given temptation to renege. The fixed transfer is used to make the dynamic enforcement constraints for each manager equally binding, and it is paid to the manager with the worst spot incentives when the production technologies otherwise are identical. If the managers

* I thank Robert Gibbons, Frøystein Gjesdal, Terje Lensberg, Jonathan Levin, James March, Trond Olsen, John Roberts, Giancarlo Spagnolo, Steven Tadelis, and participants in seminars at Stanford University, the 2002 CEPR 'Incentives and Beyond' workshop, the Norwegian School of Management (BI), and the Norwegian School of Economics and Business Administration (NHH) for insightful comments. A first version was written in 1998 under the name 'Asset Ownership and Implicit Contracts.' Correspondence: Iver Bragelien, FOR, NHH, Helleveien 30, N-5045 Bergen, Norway; or iver.bragelien@nhh.no.

also have identical bargaining positions, no fixed transfer is necessary, and the one-step bonus is simply paid to the manager who had the best results in that period. The relational contract includes thus elements of both (non-linear) piece-rate schemes (e.g. Stiglitz, 1975) and rank-order tournaments (Lazear and Rosen, 1981).

Having characterised the optimal contract, I take up the discussion from Halonen (2002) on how the introduction of a relational contract should affect the choice of ownership structure. First, I follow Halonen's assumption that ownership transfers cannot take place in the punishment path. Her main result, that a bad ownership structure in the one-shot game is sometimes good in the repeated setting, can then be replicated. But, because I allow for effort being only imperfectly observed, I get different predictions for when that should be the case. I refute for example Halonen's claim (in her propositions 3 to 5) that inelastic investments favour a change in ownership.

Then I allow ownership to change hands in the punishment path, as in Baker, Gibbons and Murphy (2002). This assumption might be more consistent with the assumption that the parties are free to choose ownership structure at the start of the relationship. I show that it then cannot be good for the sustainment of a relational contract to switch to an ownership structure that implies worse spot incentives for one party (or one task), unless it improves the spot incentives of the other party (or another task). This is of course also the case in the spot mode.

We therefore have two predictions that are in direct conflict, depending on whether ownership transfers are allowed or not after contract violations. One way to bridge these two predictions is to allow asymmetrical bargaining, so that the (regretful or humble) violator gets less of the gain from ownership transfers than the other (angry) manager. Halonen's main result will then hold for sufficiently asymmetrical bargaining powers also when ownership transfers are allowed. I further argue that the result is relevant for the initial choice of technology, irrespective of what punishment strategy that is used. A technology with higher mutual dependency can promote 'trust', as the reputational capital becomes more important.

Finally, I discuss how the form of the joint probability distribution might affect the choice of ownership. Independent of punishment strategy, I show that strong positive correlation between the performance measurements of the two managers favours ownership structures with relatively equal spot incentives, when technologies otherwise are identical. When performances are strongly negatively correlated, however, the managers should worry only about the sum of the spot incentives. Different joint probability distributions can in other words lead to very different predictions of ownership structure under a relational contract (while it has no impact on the choice of ownership in the spot mode when the managers are risk neutral).

Although space does not permit me to do so, the framework in this paper can be used to replicate the results on asset ownership and relational contracting found in Baker, Gibbons and Murphy (2002), hereafter BGM. The model can in fact be seen as an extension of theirs, although the idea to it was independently developed. It differs in that it allows investments by both managers to capture the benefits and costs of integration studied by Hart and Moore (1990), it uses continuous state variables making it better suited to discuss the properties of the optimal relational contract, and it allows for several punishment strategies. As in BGM, the model opens for both over- and underinvestment, so that all ownership structures (also joint ownership) can be optimal both in the spot mode and under relational contracting.

The paper proceeds as follows. In section 1, I develop the one-period model. Self-enforcing relational contracts are introduced in section 2. The optimal contract is derived in section 3. In section 4, I discuss the choice of ownership structure. Finally, in section 5, I make some concluding remarks.

1. The One-Period Model

There are two productive risk-neutral players, Manager 1 and Manager 2. At $t = 0$ they make non-observable investments in human capital. These investments are to some degree specific both to some future transaction with the other manager and to some assets owned by the managers. When uncertainty is resolved, the two managers make some further non-contractible decision (e.g. to trade a particular good) at $t = 1$. It is impossible to contract ex ante on this ex-post decision, because the costs of writing fully specified contracts, or to have them enforced, are prohibitive (Grossman and Hart, 1986).

With two underlying assets, a classical interpretation of the model would be that Manager 2 in combination with Asset 2 supplies an input to Manager 1, who with Asset 1 uses this input to produce output that is sold on the output market (Hart, 1995). The investments may stand for the development of competencies in manufacturing and marketing respectively. In the strategy literature the success of a company is thought to depend critically upon such investments (see for example Prahalad and Hamel, 1990). An asset could for instance be a factory, a distribution network or a company name, and a manager could include the whole management team. Asset ownership is defined as the right to deny other parties access to the asset (Hart and Moore, 1990).

The benefits at $t = 1$ are observable to Managers 1 and 2 but not verifiable to a third party. The benefits depend on the investments at $t = 0$ (e_1 and e_2), some stochastic variables (ε_1 and ε_2) and on whether the two parties choose to cooperate or not at $t = 1$. In the case of no cooperation, the benefits will further depend on the ownership structure. The outside option is worth more to a manager if she has access to assets. Whether cooperation has taken place or not is also observable to the two parties but not verifiable to outsiders.

When they cooperate, assume that the value added of each manager is linear in effort

$$\theta_1^C = e_1 + \varepsilon_1$$

$$\theta_2^C = e_2 + \varepsilon_{2,}$$

where $e_j \geq 0$ and $E[\varepsilon_j] = 0$, for $j \in \{1,2\}$. The probability density function for (ε_1, ε_2) is quasiconcave, taking its maximum value for (ε_1, ε_2) = (0, 0). If the two parties choose not to cooperate, their benefits are reduced to

$$\theta_1^{NC} = \gamma\,(\theta_1^C; k)$$

$$\theta_2^{NC} = \mu\,(\theta_2^C; k),$$

where $k \in K$ is an indicator of ownership structure. These functions reflect what a manager can achieve without the other manager's human capital, and without access to the assets owned by the other party. With some degree of relationship- and asset specificity, $\theta_1^{NC} < \theta_1^C$ and $\theta_2^{NC} < \theta_2^C$. To assure a concave maximisation problem, assume $\gamma'(\cdot)$, $\mu'(\cdot) \geq 0$ and $\gamma''(\cdot)$, $\mu''(\cdot) \leq 0$. This formulation is general in the sense that marginal benefits from more effort can be both lower and higher than under cooperation (allowing for both under- and overinvestment). For $\gamma'(\cdot)$, $\lambda'(\cdot) < 1$ (under-investment) non-cooperation is more costly when surplus is large, while for $\gamma'(\cdot)$, $\lambda'(\cdot) > 1$ (overinvestment) non-cooperation is more costly when times are bad.

As is becoming standard in the literature, assume a symmetrical Nash bargaining solution at $t = 1$. That is, cooperation takes place after renegotiations, and the gains are split 50:50. The risk-neutral managers then maximise

$$U_1 = \tfrac{1}{2}\,E\,[\,\theta_1^C + \theta_1^{NC} + \theta_2^C - \theta_2^{NC}\,] - c_1(e_1)$$

$$U_2 = \tfrac{1}{2}\,E\,[\,\theta_1^C - \theta_1^{NC} + \theta_2^C + \theta_2^{NC}\,] - c_2(e_2),$$

where $c_j(e_j)$ denotes manager *j's* private costs at $t = 0$ (in $t = 1$ dollars). $c_j'(\cdot)$, $c_j''(\cdot) > 0$.

Define functions for how much of her value added a manager gets to keep after negotiations: $\varphi(\theta_1^C; k) \equiv \tfrac{1}{2}(\theta_1^C + \gamma(\theta_1^C; k))$ and $\psi(\theta_2^C; k) \equiv \tfrac{1}{2}(\theta_2^C + \mu(\theta_2^C; k))$. These functions depend both on the parties' bargaining powers (here assumed to be equal) and on their outside options. In their general form they can accommodate any bargaining outcome. The maximisation problems of the two managers for a given ownership structure k are then given by

$$e_1 = \underset{e_1}{\text{Argmax}}\; U_1 = \underset{e_1}{\text{Argmax}}\; \{\, E[\varphi(e_1 + \varepsilon_1; k)] - c_1(e_1) \,\} \qquad (1a)$$

$$e_2 = \underset{e_2}{\text{Argmax}}\; U_2 = \underset{e_2}{\text{Argmax}}\; \{\, E[\psi(e_2 + \varepsilon_2; k)] - c_2(e_2) \,\}. \qquad (1b)$$

The incentives of the two managers in a spot mode, hereafter called their *spot incentives*, are given by $E[\varphi'(e_1 + \varepsilon_1; k)]$ and $E[\psi'(e_2 + \varepsilon_2; k)]$ respectively. The derivatives, $\varphi'(\cdot)$ and $\psi'(\cdot)$, indicate what share a manager will be able to secure from a one-dollar increase in her value added. $\varphi'(\cdot)$ ($\psi'(\cdot)$) can therefore be interpreted as

Manager 1's (2's) *bargaining position*, with respect to *marginal* changes in her value added, θ_1^C.

Given these incentive constraints, the parties should in a spot mode choose the ownership structure k that maximises the expected joint surplus

$$\Omega\,(e_1, e_2) \;=\; e_1 + e_2 - c_1(e_1) - c_2(e_2), \tag{2}$$

where e_1 and e_2 are given by (1a) and (1b).

Three simplifying assumptions have been made. First, that the value added under cooperation can be separated into two parts, where each part depends only on the investments by one of the managers. Second, that investment levels and the stochastic variables enter the benefit functions additively. And, third, that the value of the outside option is a function of the value that could have been created under cooperation.

The first and third assumptions will allow the relational contract to be based on two variables only, each manager's value added. The second assumption simplifies the necessary constraints to assure that the optimisation problem for each manager is concave. The assumptions are not necessary to derive the results in this paper, but they simplify the exposition and should help the reader interpret the model and its results.[1]

2. Self-enforcing Relational Contracts

Imagine that the cycle described in the previous section with investments, resolution of uncertainty, and decisions on cooperation is repeated in future periods. For simplicity assume that the managers and the assets live forever (or die together at a random date) and that the effect of the current-period investments is independent of past investments. There is a common positive discount rate, r, which is constant over all periods. In this setting relational contracts on the observable but not verifiable variables θ_1^C, θ_1^{NC}, θ_2^C and θ_2^{NC} can be sustained, when the managers are sufficiently patient.

Since θ_1^{NC} and θ_2^{NC} are functions of θ_1^C, θ_2^C and k, only the latter need to be included in the general formulation. Let $W_1(\theta_1^C, \theta_2^C, k)$ be Manager 1's share of the realised joint surplus as specified by the relational contract, while $W_2(\theta_1^C, \theta_2^C, k)$ is Manager 2's share. It turns out to be useful, however, to consider a manager's share relative to what she would get in a spot mode. Therefore write Manager 1's share as

$$W_1(\theta_1^C, \theta_2^C) \;=\; [\, \varphi(\theta_1^C) + \theta_2^C - \psi(\theta_2^C)\,] + [\,\omega(\theta_1^C, \theta_2^C) + t\,], \tag{3a}$$

[1] One could instead use the following general functions: $\theta_1^C(\boldsymbol{e_1}, \boldsymbol{e_2}, \varepsilon)$, $\theta_2^C(\boldsymbol{e_1}, \boldsymbol{e_2}, \varepsilon)$, $\theta_1^{NC} = \gamma(\boldsymbol{e_1}, \varepsilon; k)$, $\theta_2^{NC} = \lambda(\boldsymbol{e_2}, \varepsilon; k)$, $\varphi(\boldsymbol{e_1}, \boldsymbol{e_2}, \varepsilon; k) = ½\{\theta_1^C(\cdot) + \theta_2^C(\cdot) + \gamma(\cdot) - \mu(\cdot)\}$ and $\psi(\boldsymbol{e_1}, \boldsymbol{e_2}, \varepsilon; k) = \frac{1}{2}\{\theta_1^C(\cdot) + \theta_2^C(\cdot) + \mu(\cdot) - \gamma(\cdot)\}$, where ε is a vector of uncertain variables and $\boldsymbol{e_1}$ and $\boldsymbol{e_2}$ are vectors of tasks. The relational contract introduced in the next section must then depend on all four observable variables: θ_1^C, θ_2^C, θ_1^{NC} and θ_2^{NC}. The main results are unchanged, and the proofs are straightforward extensions of the current ones, but the bonus payment rule will be more complicated to relate to.

where $\omega(\theta_1^C, \theta_2^C)$ and t (a fixed transfer) are positive when they specify payments *from* Manager 2 *to* Manager 1. The index for ownership structure, k, is omitted to simplify notation. The sum inside the first square brackets is what the manager would get in a spot mode. With balancing budgets, Manager 2's share is given by[2]

$$W_2(\theta_1^C, \theta_2^C) = [\, \psi(\theta_2^C) + \theta_1^C - \varphi(\theta_1^C) \,] - [\, \omega(\theta_1^C, \theta_2^C) + t \,]. \qquad (3b)$$

Since these payments are not enforced by an outside court, a manager could be tempted to renege on them. The division of surplus in that period would then be decided by the parties' respective bargaining positions (as in the spot mode). Note that there is no risk of one of the parties honouring the relational contract while the other does not, since the two parties can write a verifiable contract on transactions in a given period once the uncertainty is resolved.

Then there is the question of what will happen after a contract violation. There are many possible scenarios, and no general consensus has been reached in the literature. One can for example imagine that the managers use grim-trigger strategies and continue in a spot mode - with or without an ownership transfer. They can play some kind of tit-for-tat strategy. Or they can require retributions before re-establishing the relational contract. It turns out that the form of the optimal relational contract is independent of which of these assumptions that are made, while the choice of the ownership structure is not. I will at this stage therefore use a general formulation that allows for all scenarios and come back to the different punishment alternatives when they become relevant (in section 4).

For the managers to honour the relational contract after uncertainty is resolved, the following conditions must hold

$$-\,\omega(\theta_1^C, \theta_2^C) - t \;\le\; R_1 - S_1 \qquad (4a)$$

$$\omega(\theta_1^C, \theta_2^C) + t \;\le\; R_2 - S_2, \qquad (4b)$$

where R_j is the net expected discounted value of all future transactions to manager j, if the relational contract is honoured by both parties, and S_j is the net value she can expect from future periods if she chooses to renege. To find a subgame-perfect equilibrium of the repeated game (MacLeod and Malcomson, 1989) there are also some ex-ante constraints that must be satisfied. In particular, both managers must be better off under the relational contract than in a spot mode, so the right-hand sides of (4a) and (4b) must be positive. With the optimal contract derived in the next section, that will be a problem only in very extreme cases. But in those extreme cases one

[2] Unlike in Holmstrom (1982), a relaxation of the budget-balancing constraint does not improve incentives, because contracts on the observed signals cannot be enforced by a third party. See Che and Yoo (2001) for a discussion of optimal incentives for teams in a repeated setting when signals are verifiable. Payment schemes where the managers 'burn money' are not renegotiation proof.

must exchange either (4a) or (4b) with the appropriate ex-ante constraint. In this paper we restrict our attention to settings where that is not necessary.[3]

Definition 1 A relational contract is *self-enforcing* if the strategies it specifies (investment levels, payments and punishment strategies) describe a sub-game perfect equilibrium of the repeated game.

PROPOSITION 1 *For a self-enforcing relational contract to implement (e_1^R, e_2^R), the following three conditions must be satisfied* [4]

$$e_1^R = \underset{e_1}{\text{Argmax}} \{ E[\varphi(\theta_1^C) + \omega(\theta_1^C, \theta_2^C) \mid (e_1, e_2)] - c_1(e_1) \} \qquad (IC_1)$$

$$e_2^R = \underset{e_2}{\text{Argmax}} \{ E[\psi(\theta_2^C) - \omega(\theta_1^C, \theta_2^C) \mid (e_1, e_2)] - c_2(e_2) \} \qquad (IC_2)$$

$$\sup_{(\theta_1^C, \theta_2^C)} \omega(\theta_1^C, \theta_2^C) - \inf_{(\theta_1^C, \theta_2^C)} \omega(\theta_1^C, \theta_2^C) \le R - S. \qquad (DE)$$

Proof The incentive constraints, (IC_1) and (IC_2), are the maximisation problems that the two managers solve for a given relational contract. The dynamic-enforcement constraint (DE) is found by taking supremums in (4a) and (4b), so that they hold for all possible realisations of ε_1 and ε_2, and then summing the two inequalities, with $R \equiv R_1 + R_2$ and $S \equiv S_1 + S_2$.

3. The Optimal Relational Contract

Proposition 1 listed constraints a self-enforcing relational contract must satisfy. Under some settings (for example when the parties are very patient) many different classes of relational contracts may perform equally well in terms of expected joint surplus (achieving first-best), but in this section we are looking for the relational contract that is the most effective under more marginal settings.

PROPOSITION 2 *No self-enforcing relational contract can generate a higher joint surplus for a given interest rate than one paying what a manager would get in a spot mode, a fixed transfer, and a one-step bonus.*

[3] Assuming punishment strategies 1 or 3 as defined in section 4, it can be shown that for $r < ½$, the ex-ante constraints are always satisfied, or no relational contract can be sustained. But, an ex-ante constraint could be binding if the spot incentives for one manager are extremely bad while they are close to first-best for the other, the probability distribution is highly peaked (so that the one-step bonus is very effective), and the interest rate is very high.

[4] Proposition 1 can be seen as an extension of Levin's (2002) theorem 3. Levin studies a setting where only one party invests, the outside options are invariant to investments and uncertain environmental variables, and the parties cannot renegotiate after a relational contract violation to capture gains from trade in that period. Again, note that the conditions in proposition 1 are necessary, but not always sufficient, as under some extreme conditions an ex-ante constraint may bind.

Proof An optimal self-enforcing relational contract maximises the expected joint surplus, subject to (IC_1), (IC_2) and (DE). Consider the first-order conditions for the two incentive constraints

$$\frac{\partial}{\partial e_1}\left\{\mathrm{E}\left[\varphi(\theta_1^C)+\omega(\theta_1^C,\theta_2^C)\,|\,(e_1,e_2)\right]-c_1(e_1)\right\} = 0 \qquad (\mathrm{FOC}_1)$$

$$\frac{\partial}{\partial e_2}\left\{\mathrm{E}\left[\psi(\theta_2^C)-\omega(\theta_1^C,\theta_2^C)\,|\,(e_1,e_2)\right]-c_2(e_2)\right\} = 0\,. \qquad (\mathrm{FOC}_2)$$

Let λ_1 and λ_2 be the Lagrange multipliers on (FOC_1) and (FOC_2) respectively and $f((\theta_1^C, \theta_2^C)|(e_1, e_2))$ be the (quasiconcave) probability density function of the outcome, given the two managers' investments. Ignoring (DE), the marginal returns to increasing $\omega(\theta_1^C, \theta_2^C)$ are $m(\theta_1^C, \theta_2^C) \equiv \lambda_1 f_{e_1}(\cdot)/f(\cdot) - \lambda_2 f_{e_2}(\cdot)/f(\cdot)$. For $m(\cdot) > 0$, $\omega(\cdot)$ should be chosen as large as possible, while for $m(\cdot) < 0$, $\omega(\cdot)$ should be chosen as small as possible. When (DE) binds, the range of values $\omega(\cdot)$ can take is limited. This bang-bang solution can be interpreted as a bonus payment, which is paid by Manager 2 to Manager 1 when $m(\cdot) > 0$, and vice versa. According to the set-up of the problem, see (3a) and (3b), the relational contract includes then payments identical to what the managers would get after renegotiations. With (DE) satisfied, some fixed transfer t must be chosen so that (4a) and (4b) hold. Each manager's maximisation problem is concave under the relational contract, so the solutions to (FOC_1) and (FOC_2) are solutions to the maximisation problems in (IC_1) and (IC_2).

Proposition 2 is based on Levin's (2002) theorem 6. In Levin's model, the optimal relational contract is simply a fixed transfer and a one-step bonus payment. Here it includes payments identical to what the managers would get in a spot mode. Such payments must be included when outside options depend on investments and uncertain variables that affect also the cooperative outcome. They would also have to be included if that was not the case, as long as the parties are allowed to renegotiate after a relational contract violation to capture gains from trade in that period. Furthermore, the bonus payment depends now on the realisation of two variables, since there are two indicators of value added, while in Levin's paper there is only one (as only one party invests). Note that it is straightforward to show that proposition 2 holds also in a multi-task environment (see footnote 1).

The expected payments specified by the relational contract can be written as

$$\mathrm{E}[W_1(\cdot)] = \mathrm{E}[\varphi(\theta_1^C) + \theta_2^C - \psi(\theta_2^C)] - \tfrac{1}{2}\beta + t + p(e_1, e_2)\beta \qquad (5a)$$

$$\mathrm{E}[W_2(\cdot)] = \mathrm{E}[\psi(\theta_2^C) + \theta_1^C - \varphi(\theta_1^C)] - \tfrac{1}{2}\beta - t + \{1 - p(e_1, e_2)\}\beta, \qquad (5b)$$

where $p(e_1, e_2)$ is the probability that Manager 1 receives the bonus, β, implied by the optimal rule for bonus payment. In other words, the starting point is that each manager receives what she would get in the spot mode. Then some amount is deducted, ($\tfrac{1}{2}\beta - t$) for Manager 1 and ($\tfrac{1}{2}\beta + t$) for Manager 2. The net total of these deductions, β, is given to the manager who is entitled to the bonus. The dynamic-enforcement constraint (DE) is then simply given by $\beta \leq R - S$.

To help the reader understand how the actual payment of the one-step bonus is determined, imagine an environment where the error terms, ε_1 and ε_2, have a bivariate normal distribution. Bonus payment is then decided by a straight line through (e_1^R, e_2^R) in a diagram with (θ_1^C, θ_2^C) on the axes, where e_1^R and e_2^R are the investment levels chosen under the relational contract, see figure 1. When both manager would have underinvested in the spot mode, the line goes from south-west to north-east. If the outcome (θ_1^C, θ_2^C) is to the north-west of this line (where $m(\cdot) < 0$), the bonus is paid to Manager 2, while Manager 1 receives the bonus if the outcome (θ_1^C, θ_2^C) is to the south-east of the line (where $m(\cdot) > 0$).

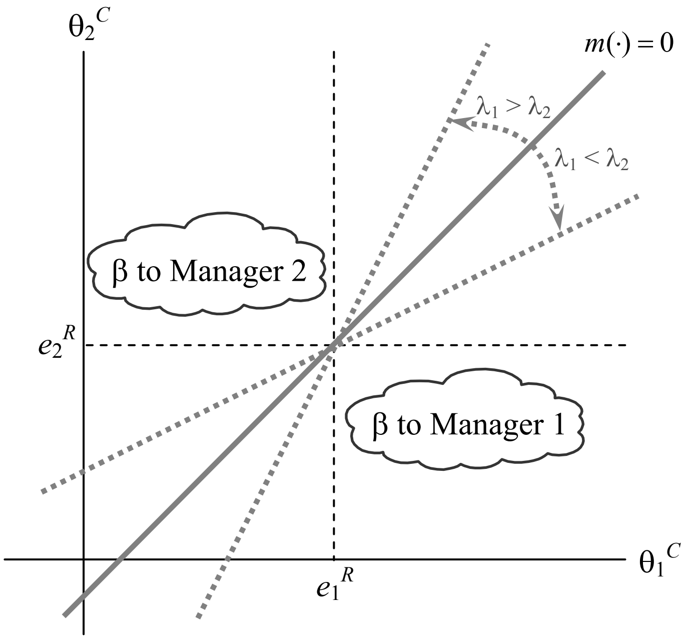

Figure 1. *Examples of rules determining payment of one-step bonus*

Start with a line that is 45° on the axes (so that $\partial p(e_1, e_2)/\partial e_1 = -\partial p(e_1, e_2)/\partial e_2$). When the incentive constraints for the two managers then are equally strict, so that $\lambda_1 = \lambda_2$, this line is in fact the optimal bonus payment rule. When $\lambda_1 > \lambda_2$ (Manager 1's incentive constraint is the most costly) more can be gained in terms of joint surplus by strengthening Manager 1's incentives, and the line should be steeper. For $\lambda_2 = 0$ (when Manager 2's investments are first-best anyway) the line is vertical.

Definition 2 The production technologies are symmetrical if the cost functions are identical, $c_1(e) = c_2(e)$, and the probability density function for the error terms is symmetrical, $g(\varepsilon_1, \varepsilon_2) = g(\varepsilon_2, \varepsilon_1) = g(-\varepsilon_1, -\varepsilon_2)$.

Definition 3 The investment specificities of the two managers are identical for a given ownership structure when $\varphi(x) = \psi(x)$ for all x.

With symmetrical production technologies and identical investment specificities, bonus payments are decided by a 45° line going through the origin:

PROPOSITION 3 *With symmetrical production technologies and identical investment specificities, the bonus is paid to the manager who had the best (worst) results in that period, when the problem is one of underinvestment (overinvestment).*

The bonus part of the relational contract is here simply a rank-order tournament (Lazear and Rosen, 1981). But note that while it is usually risk aversion that limits the size of the prize in the literature on tournaments, here the temptation to renege plays that role.

PROPOSITION 4 *With symmetrical production technologies, the fixed transfer, t, in the optimal relational contract is paid to the manager with the weakest (strongest) spot incentives, when the problem is one of underinvestment (overinvestment).*

Proof With the relational contract given by proposition 2, the left hand sides of (4a) and (4b), after taking supremums, are given by $\frac{1}{2}\beta - t$ and $\frac{1}{2}\beta + t$ respectively. Assume they bind, and subtract the one from the other to get

$$2t = (R_2 - S_2) - (R_1 - S_1). \qquad (6)$$

For the rest of the proof a punishment strategy must be specified, and the full proof is omitted. It does hold for all the scenarios listed in section 2. Assuming a specific scenario, set in the proper expressions for R_j and S_j, and use the fact that the investment level a manager would have chosen in the spot mode must give her a higher payoff in that mode than the investment level under a relational contract.

The intuition behind proposition 4 in the underinvestment case is as follows. With identical cost functions, the manager with the weakest spot incentives will invest the least in the spot mode. But under the relational contract we want the investment levels of the two parties to be equal (if possible), due to the identical convex cost functions. The bonus scheme will thus be designed to provide the weakest manager (in terms of bargaining positions) with the strongest incentives. If Manager 2 is the weakest, this is achieved by having a relatively flat line in figure 1 determine who is going to receive the bonus. But the probability of getting the bonus will be the same, ½. The bonus does not provide any of the managers with higher expected payments, it works only at the margin. And since the payments a manager may expect from the increased value added of the other manager will be the largest for the manager with the strongest spot incentives, the fixed payment must be paid to the manager with the weakest spot incentives for her not to want to renege on the contract.

(7) shows further that it is the manager who gains the least from a relational contract that gets the fixed transfer. This is the manager with the weakest spot incentives. But, she will still gain the least. The relational contract is socially desirable in the sense that both managers gain from it, but it is not ‘social democratic’ in nature, as it amplifies any differences in payoff between the managers caused by hold-up in the first place.

4. The Choice of Ownership Structure and Technology

If the managers agree to use the relational contract derived above, they should choose the ownership structure ($k \in K$) as part of the following maximisation problem:

$$\underset{\beta,\, p(\cdot), k}{\text{Max}} \left\{ e_1 + e_2 - c_1(e_1) - c_2(e_2) \right\}$$

$$\text{s.t.} \quad e_1 = \underset{e_1}{\text{Argmax}} \{ \text{E}[\varphi(\theta_1^C(e_1+\varepsilon_1; k))] + p(e_1, e_2)\beta - c_1(e_1) \}, \qquad (\text{IC}_1)$$

$$e_2 = \underset{e_2}{\text{Argmax}} \{ \text{E}[\psi(\theta_2^C(e_2+\varepsilon_2; k))] + (1\text{-}p(e_1, e_2))\beta - c_2(e_2) \}, \qquad (\text{IC}_2)$$

$$\beta \le R - S, \qquad (\text{DE})$$

and the $p(\cdot)$-function satisfying constraints given by the underlying joint probability distribution on $(\varepsilon_1, \varepsilon_2)$.

The key research question is to investigate under what circumstances the ownership structure supporting the relational contract should be different from the one that would have been optimal in a spot mode. The choice of ownership structure changes the spot incentives, given by $\text{E}[\varphi'(e_1 + \varepsilon_1; k)]$ and $\text{E}[\psi'(e_2 + \varepsilon_2; k)]$. This impacts the incentive constraints, IC_1 and IC_2. And it may or may not impact the dynamic-enforcement constraint, DE, depending on what punishment strategies we assume the managers play.

In table 1, I list six alternative punishment strategies, of which, to my knowledge, four have been used in other papers on relational contracts and asset ownership. In 1A, used by Halonen (2002), the managers would simply continue in a spot bargaining mode after a contract violation, but due to high costs associated with the transfer of ownership rights, they are stuck in the ownership structure used under the relational contract. 1B is similar, but in this alternative, used by Baker, Gibbons and Murphy (2002), there are no costs associated with ownership transfers (as there are no costs associated with spot bargaining or the initial choice of ownership structure).

Kvaloy (2002) suggests a carrot-and-stick (tit-for-tat) strategy, 2A, where there is no transaction at all for one period following a violation, after which the relational contract is re-established. 2B is a modification of that strategy, where an ownership transfer is allowed before (and after) the punishment period (as that can improve both mangers' surplus in the punishment period but does not require any trust in the form of a relational contract).

1A. Spot bargaining, but no bargaining on ownership rights after violation	1B. As 1A, but allow ownership transfers in punishment path
2A. No transactions in one period, and relational contract is re-established	2B. As 2A, but allow ownership transfers in punishment path
3A. Retribution is paid, and relational contract is re-established (spot bargaining if no retribution)	3B. As 3A, but allow ownership transfers in punishment path

Table 1. *Punishment strategies* [5]

Blonski and Spagnalo (2002) suggest a retribution strategy, 3A, where a manager requires a payment to re-establish the relational contract that equals (almost) what the manager who has reneged otherwise would gain (R_j - S_j if manager j is the violator). If retribution is not paid, they continue transacting in a spot mode. But, the manager who has been cheated refuses to transfer ownership rights, even when that would have increased joint surplus in the punishment path. It is questionable, however, whether such a threat is credible. A violator can argue that she is not willing to pay the retribution and instead go for spot transactions in the future. And then she can offer to bargain over an ownership transfer when that increases the joint surplus (Blonski and Spagnolo do allow renegotiations of strategies). Following this logic, the maximum retribution payment must be based on a S_j that allows a transfer of ownership rights in the punishment path. This alternative is denoted 3B.

As the reader will have noted by now, I am partial to strategies that allow the transfer of ownership rights (the B alternatives), but I accept that no agreement has been reached and will therefore consider all alternatives. Fortunately, it turns out that for the results I derive, the important distinction is whether the punishment strategy is of type A or B, and not whether they are of type 1, 2 or 3.

4.1. *No transfer of ownership rights in the punishment path*

Assumption A The punishment strategies do not allow a transfer of ownership rights, or such a transfer is prohibitively costly.

[5] One could also imagine that a manager would become so angry with the other after a contract violation that she would not do any transaction at all in future periods (although she might accept a one-time transfer of ownership rights). This alternative is theoretically identical to alternative 1 in the table, except that $\gamma(\theta_1^C; k)$ and $\mu(\theta_2^C; k)$ replace $\varphi(\theta_1^C; k)$ and $\psi(\theta_2^C; k)$ in S, so that a relational contract is self-sustaining for a higher discount rate.

PROPOSITION 5 *Under assumption A, an ownership structure with weaker (stronger) spot incentives can sometimes sustain a better relational contract in the underinvestment (overinvestment) case. This is only the case when the increased temptation to renege in a given period is dominated by the increased punishment in future periods, which becomes more likely with*

(a) *a more sharply peaked probability distribution (making the bonus more effective),*
(b) *a greater incentive problem in the spot mode due to hold-up,*
(c) *more patient managers, and/or*
(d) *less convex cost functions (making managers more responsive to incentives).*

Proof Assume for the sake of the proof that ownership can be chosen in a marginal way, that the managers underinvest, and that they follow the strategies defined by 1A. Consider weakening Manager 1's spot incentives, $E[\varphi'(e_1 + \varepsilon_1;\, k)]$, while keeping Manager 2's incentives constant. To simplify exposition, the weakening of the spot incentives is assumed to be independent of investment levels. Due to the envelope theorem, we can use the partial derivative of the Lagrangian ($\mathcal{L}$) of the maximisation problem with respect to $E[\varphi'(\cdot)]$ to establish the result. To find the derivative of $S = \{e_1^S + e_2^S - c_1(e_1^S) - c_2(e_2^S)\}/r$, use the first-order condition for Manager 1 in the spot mode, $E[\varphi'(\cdot)] = c'(e_1^S)$. Differentiating, we may write $\partial e_1/\partial E[\varphi'(\cdot)] = 1/c''(e_1^S)$ by the inverse function theorem, and we have

$$\partial\mathcal{L} / \partial E[\varphi'(\cdot)] = \lambda_1 - \lambda_3 \frac{1 - c'(e_1^S)}{rc''(e_1^S)},$$

where λ_1, λ_2 and λ_3 are Lagrangian multiplicators for constraints IC_1, IC_2 and DE. For the optimal relational contract we know that $\partial\mathcal{L} / \partial\beta = 0$. Use this to find an expression for λ_3. Substitute and rearrange to get

$$\partial\mathcal{L} / \partial E[\varphi'(e_1 + \varepsilon_1;\, k)] < 0 \;\Leftrightarrow\; \left(\frac{\partial p(\cdot)}{\partial e_1^R} - \frac{\lambda_2}{\lambda_1}\frac{\partial p(\cdot)}{\partial e_2^R}\right)^{-1} < \frac{1 - c'(e_1^S)}{rc''(e_1^S)}. \qquad (7)$$

The left-hand side of the inequality is the change in bonus, β, necessary for the relational contract to generate the same joint surplus as before and can be interpreted as the increased temptation to renege. The right-hand side is the decrease in the discounted value of joint surplus in the spot mode, S; the increased punishment. When the inequality is satisfied, β can be set even higher, so that it generates more joint surplus (unless investments are already first best). Results (a)-(d) follow from (7). For (b), remember that $c'(\cdot) = E[\varphi'(\cdot)]$ under spot governance. The proof is identical for the 3A case, since S_1 and S_2 add up to the joint surplus under spot governance also then. And, the proof is similar with strategies of type 2A. r in (7) is then replaced by ½.

In the spot governance mode one would never change to an ownership structure with worse spot incentives for one manager unless the incentives of the other manager improve. Proposition 5 shows therefore that under assumption A, one may choose a different ownership structure with a relational contract. This insight was first established by Halonen (2002).

The predictions in proposition 5 of when we would expect to observe other ownership structures differ, however, from those found in Halonen's article. Prediction (a) was not relevant for Halonen, since she assumes away uncertainty. The unambiguous prediction in (b) could not be made in Halonen's model, as a worsening of the incentive problem due to hold-up affects both the temptation to renege and the punishment, while here only the punishment effect is relevant. And, while Halonen (in her propositions 3-5) claims that a manager's investments must be inelastic to her (marginal) surplus share for a different ownership structure to be chosen under the relational contract, I show in (d) that a different structure is more likely for a large $\partial e_1^S/\partial \mathrm{E}[\varphi'(\cdot)]$. These predictions are in direct conflict for large ranges of parametric settings.[6] Again that is because elasticity is only important for the punishment here, while it also affects the temptation to renege in Halonen's set-up.

In other words, predictions are critically dependent on whether or not one allows for imperfect observation of investments (as the nature of the relational contract then changes). In the real world one can, of course, hardly expect investments in human capital and competences to be perfectly observable.

4.2. *Allow transfers of ownership rights in the punishment path at no cost*

Assumption B The punishment strategies allow transfers of ownership rights along the punishment path at no cost. The parties share the extra surplus generated by such transfers 50:50.

PROPOSITION 6 *Under assumption B, if there is a general problem of underinvestment (overinvestment), the parties should never switch to an ownership structure that weakens (strengthens) one of the parties' spot incentives, unless the spot incentives of the other party then are strengthened (weakened).*

Proof Consider the underinvestment case. Weakening Manager 1's spot incentives, $\mathrm{E}[\varphi'(e_1 + \varepsilon_1; k)]$, while holding bonus payments and $\mathrm{E}[\psi'(e_2 + \varepsilon_2; k)]$ constant, will induce her to invest less (IC_1). This will in turn make the dynamic-enforcement constraint (DE) stricter, since the expected joint surplus R decreases, while S is unchanged. Similar for overinvestment.

[6] For a given cost function, e.g. $c(e) = e^{\nu}$, elasticity may decrease in a parameter (ν), while $\partial e_1^S/\partial \mathrm{E}[\varphi'(\cdot)]$ first increases and then decreases in the same parameter (when e_1^S is allowed to change). In this example $\partial e_1^S/\partial \mathrm{E}[\varphi'(\cdot)]$ is at its maximum for $\nu = 1.32$ when $\mathrm{E}[\varphi'(\cdot)] = 0.75$, and it can be shown that $\partial e_1^S/\partial \mathrm{E}[\varphi'(\cdot)]$ has always its maximum for some $\nu < 2$. A different ownership structure will under certain circumstances therefore be chosen only when investments are elastic in my set-up, while they must be inelastic ($\nu > 2$) in Halonen's world.

When ownership can change hands in the punishment path, strong spot incentives are good under both relational and spot contracting if underinvestment is the general problem, while weak spot incentives are good in the overinvestment case. This does not mean that one will always choose the same ownership structures for spot governance and relational contracting (see subsection 4.5), but there is a *tendency* in this direction. The result is easily extended to a multi-task setting, where there is one incentive constraint for each task (see footnote 1):

COROLLARY *Assume scenario B in a multi-task setting. The parties should then never switch to an ownership structure that worsens the incentives a manager would have had for a task in the spot mode, unless her spot incentives, or the spot incentives of the other manager, are improved for some other task(s).*

If the problem is one of overinvestment for one task and underinvestment for another, a change in ownership should only be considered when it in the spot mode would have lead to less investments in the first task and/or more investments in the second.

With our general model, proposition 6 does not rule out any ownership structure, because all structures (also joint ownership) are candidates for being the optimal one in the spot mode. But if we were to assume more restrictively that marginal and absolute values move together, as in Hart and Moore (1990), joint ownership can never be optimal in the underinvestment case. Proposition 5, on the other hand, showed that joint ownership could be optimal also then, when ownership cannot change hands after violations.

4.3. *Asymmetrical bargaining powers after a contract violation*

It may seem unsatisfactory that assumptions A and B lead to so different results. One way to bridge the gap between the conflicting predictions could be to allow asymmetrical bargaining powers in the negotiations over ownership rights after contract violations. One might argue (although we lack a rational explanation for this) that the (regretful or humble) violator would accept less than 50 percent of the extra surplus from an ownership transfer, while the other (angry) manager would require more. Some support for such punishment behaviour can be found in experiments on ultimatum games (e.g. Roth et al., 1991) and power-to-take games (Bosman and Winden, 2002).

Assumption C The punishment strategies allow a cost-free transfer of ownership rights along the punishment path. After bargaining, $b \in [0, 1]$ of the extra surplus goes to the manager who has reneged.[7]

[7] Note that we still assume symmetrical bargaining power in future years, when the parties expect to cooperate again. The extra payment for ownership transfers (or the discount if the cheater is the seller

PROPOSITION 7 *When b is sufficiently large, one should never choose an ownership structure with worse spot incentives under assumption C (as in proposition 6). But, with b sufficiently small, an ownership structure with worse spot incentives can be good for the relational contract (as in proposition 5).*

Proof With assumption C and punishment scenario 1 or 3, $S = [(1\text{-}2b)\Omega(k{=}\rho) + 2b\Omega(k{=}\sigma)] / r$, where Ω is the joint surplus in the spot mode and ρ and σ are the ownership structures under relational contracting and spot mode respectively. It is then straightforward to show (using the same approach as in proposition 5) that a marginal worsening of the spot incentives cannot be good when

$$b > Max\left(0,\ \frac{1}{2}\left(1-\left(\frac{\partial p(\cdot)}{\partial e_1^R}-\frac{\lambda_2}{\lambda_1}\frac{\partial p(\cdot)}{\partial e_2^R}\right)^{-1} \Big/ \frac{1-c'(e_1^S)}{rc''(e_1^S)}\right)\right). \tag{8}$$

But, if (8) is not satisfied, a change in ownership could be optimal. With punishment strategy 2, r in (8) is replaced by ½.

With b = ½, assumptions B and C are identical, while assumptions A and C generate identical results when b = 0. Allowing for asymmetrical bargaining powers after contract violations, we can thus replicate Halonen's main result that bad ownership structures in the one-shot game is sometimes good for the relational contract, also in an environment where ownership transfers are allowed in the punishment path at no cost.

4.4. *The choice of technology*

Propositions 5 and 7 show that when transfers of ownership rights are costly, or bargaining powers are asymmetrical in the punishment path, the choice of ownership can impact the performance of a relational contract. But the managers can do more than that. When they begin their relationship by acquiring assets, they can sometimes choose between technologies with different degrees of specificity to influence spot incentives. Assuming that later technology changes are prohibitively costly (or at least more costly than ownership transfers), this can add value:

PROPOSITION 8 *A technology with stronger (weaker) spot incentives can sometimes sustain a better relational contract in the underinvestment (overinvestment) case. That is only the case when the increased temptation to renege is dominated by the increased punishment (as in proposition 5).*

of the asset) should therefore be seen as a retribution. After this retribution is paid, the parties are willing to trade with each other on equal terms again. To assume that also future bargaining powers are affected is unproblematic, but does not lead to any interesting new insights (except that of course a relational contract then will be self-enforcing for a higher discount rate).

The choice of technology is probably mainly driven by its direct effect on productivity. But the indirect incentive effect discussed here may still be important. And it can, in fact, provide a theoretical justification for the result found in many empirical studies that mutual dependence between exchange partners seems to promote trust (Bradach and Eccles, 1989).

4.5. *The form of the joint probability distribution*

Consider the three uniform joint probability distributions for ε_1 and ε_2 drawn in figure 2. Assume that the value of the probability density function is one for all combinations that are inside the square, diamond and circle respectively, and zero otherwise. In case A the variables are independent of each other, and $|\varepsilon_1| \leq 1$ and $|\varepsilon_2| \leq 1$. In case B, $|\varepsilon_1| + |\varepsilon_2| \leq \sqrt{½}$. And in case C, $\varepsilon_1^2 + \varepsilon_2^2 \leq 1/\pi$. The form of the joint probability distribution affects the possible combinations of $\partial p(\cdot)/\partial e_1$ and $-\partial p(\cdot)/\partial e_2$. In the underinvestment case we want these derivatives to be as large as possible, to strengthen the incentives to invest. In case A, the restrictions are simply $\partial p(\cdot)/\partial e_1 \leq 1$ and $-\partial p(\cdot)/\partial e_2 \leq 1$. In case B they are $\partial p(\cdot)/\partial e_1 - \partial p(\cdot)/\partial e_2 \leq \sqrt{2}$. And in case C, $(\partial p(\cdot)/\partial e_1)^2 + (\partial p(\cdot)/\partial e_2)^2 \leq 4/\pi$.

To further facilitate the discussion, assume a simple linear technology, where $\varphi(\theta_1^C) = \varphi_k\theta_1^C$ and $\psi(\theta_2^C) = \psi_k\theta_2^C$, where $\varphi_k, \psi_k \in (½, 1)$. There are two assets. Consider three ownership structures, I1 where Manager 1 owns both assets (integration), I2 where Manager 2 owns the assets and NI where each manager owns one asset (non-integration). Assume some symmetry, so that spot incentives are given by $\varphi_{I1} = \psi_{I2} = \bar{\kappa}$, $\varphi_{I2} = \psi_{I1} = \underline{\kappa}$, and $\varphi_{NI} = \psi_{NI} = \kappa$; where $\bar{\kappa} > \kappa > \underline{\kappa}$. Further, assume quadratic cost functions, $c(e_j) = ½e_j^2$. In the spot mode, the managers are then indifferent between the three ownership structures when $2(\kappa - ½\kappa^2) = \bar{\kappa} - ½\bar{\kappa}^2 + \underline{\kappa} - ½\underline{\kappa}^2$. Denote the κ that solves this equation $\tilde{\kappa}$.

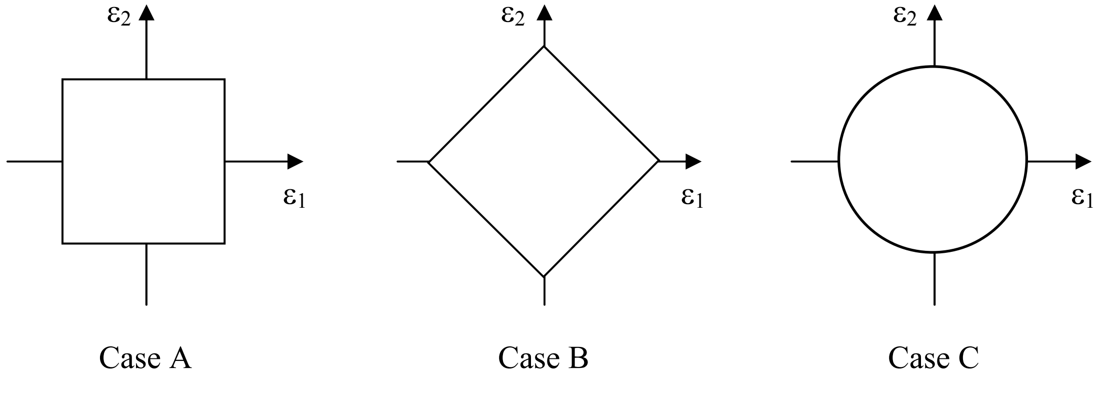

Figure 2. *Probability distributions for* $(\varepsilon_1, \varepsilon_2)$

But, that does not mean that the managers then are indifferent to the choice of ownership structure under relational contracting. When $\kappa = \tilde{\kappa}$, the managers would in case A strictly prefer non-integration, because that ownership structure can sustain a better relational contract. There is no way to use the bonus payment rule to transfer incentives from one manager to the other, and due to the convexity of the identical cost functions, the extra incentive strength is worth more when they start with the same spot incentives.[8]

In case B one can shift the incentives over to the manager who does not own any assets one-to-one, by adjusting the bonus payment rule. Symmetry is no longer important for the relational contract, and the managers should simply choose the ownership structure that maximises $\varphi + \psi$ (for the range of parameters where such shifting of incentives is possible). When $\kappa = \tilde{\kappa}$, the managers strictly prefer integration.[9] Finally, in case C the managers are indifferent between non-integration and integration for $\kappa = \tilde{\kappa}$ (as in the spot mode), because both the probability distribution and the cost functions are quadratic.

The trade-off of providing one manager with very strong incentives at the cost of weakening the incentive strength for the other manager is illustrated in figure 3 for the three cases (with the maximum $|\partial p(\cdot)/\partial e_j|$ normalised to one in each case). It is indicated that case C represents the threshold probability distribution in this example, so that the result from case A holds for all probability distributions with trade-off curves outside case C in the diagram (when technologies otherwise are symmetrical).

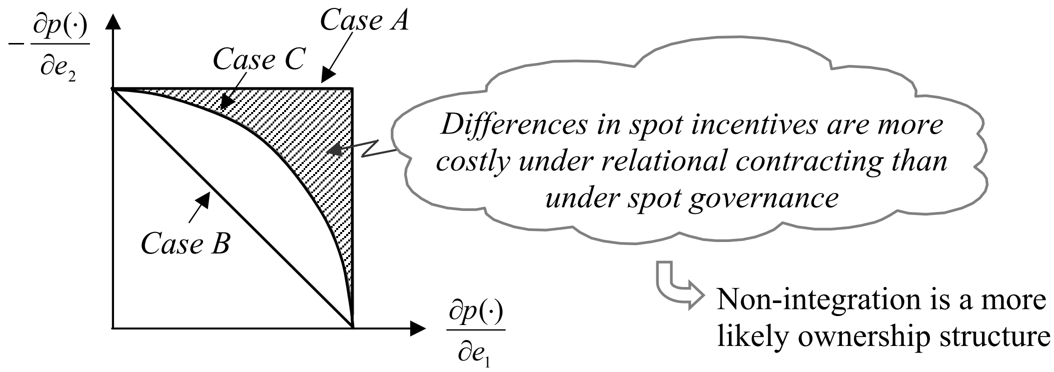

Figure 3. *Trade-offs between $\partial p(\cdot)/\partial e_1$ and $-\partial p(\cdot)/\partial e_2$*

Next we investigate how correlation between ε_1 and ε_2 will impact the results. In figure 4, case C is taken as the starting point, and the probability distribution is then stretched to capture correlation. With positive correlation, a 45° bonus payment rule implies that $\partial p(\cdot)/\partial e_1$ and $-\partial p(\cdot)/\partial e_2$ both are equal to the distance between a and d;

[8] With $\bar{\kappa} = 0.90$, $\underline{\kappa} = 0.60$ and $r = 0.25$, Non-Integration dominates Integration for $\kappa > 0.71$ under spot governance and for $\kappa > 0.62$ under relational contracting in case A (given punishment scenario 1B). Non-Integration is thus almost always optimal when a relational contract is used in this example.

[9] In the general model, they should maximise $E[\varphi'(e_1 + \varepsilon_1; k)] + E[\psi'(e_2 + \varepsilon_2; k)]$ in case B, when the problem is one of underinvestment (given that a further shifting of incentives is possible). For the example given in footnote 8, Non-Integration now dominates Integration only for $\kappa > 0.75$.

while with a flat bonus payment rule, $\partial p(\cdot)/\partial e_1$ is only equal to the distance between b and c, and $\partial p(\cdot)/\partial e_2 = 0$. In other words, the 45° bonus payment rule strengthens the incentives of both managers, compared to the flat one. That is, however, not the case for negative correlation, where the trade-offs are closer to those of case B. The differences are illustrated in the diagram to the right in figure 4 (where again the maximum $|\partial p(\cdot)/\partial e_j|$ is normalised to one).

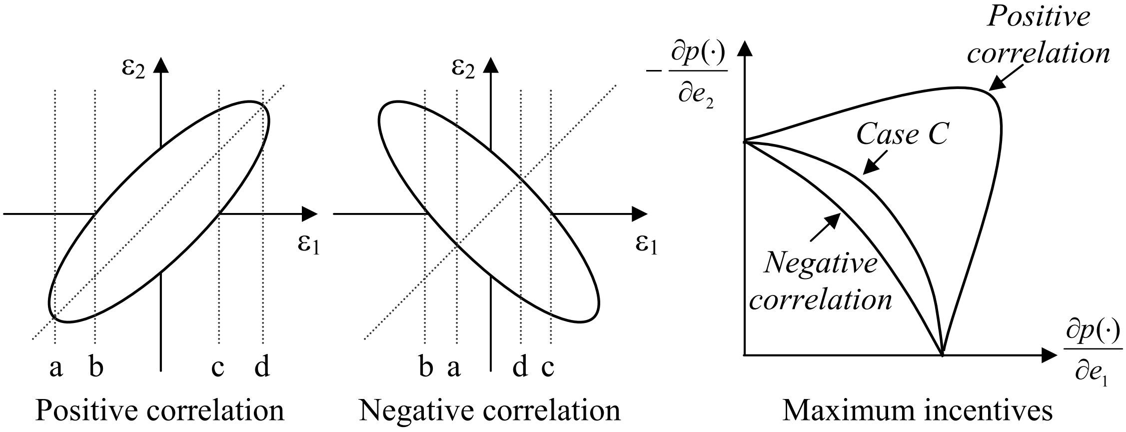

Figure 4. *Probability distributions and trade-offs between* $\partial p(\cdot)/\partial e_1$ *and* - $\partial p(\cdot)/\partial e_2$

As large differences in spot incentives become more costly the further away the trade-off curves are from case C in the north-west direction, we can state the following proposition:

PROPOSITION 9 *With strong positive correlation between the performance variables of the two managers, but otherwise symmetrical technologies, we would expect to observe ownership structures with relatively equal bargaining positions (non-integration) more often under a relational contract. With strong negative correlation, incentive strength can be shifted to another manager through the relational contract at a smaller cost, and we would expect to see asymmetrical ownership structures (integration) more often.*

As shown in footnotes 8 and 9, the effects of correlation on the predictions of ownership can be quite dramatic.

In the examples we considered underinvestment problems, but proposition 8 is valid also when the problem is one of overinvestment. Overinvestment is more typically the problem, however, in a multi-task setting where some tasks increase outside value but are unimportant for the value of transactions inside the relationship. As pointed out earlier, the model is easily extended to such an environment, although space does not permit an exhaustive discussion here. The results in Baker, Gibbons and Murphy (2002) can thus be replicated.[10]

In BGM, by construction, one can always shift incentives from one task to another on a one-to-one basis, so their model is equivalent to case B here. My set-up allows a more general treatment, and it is a straightforward extension of proposition 9 that positive correlation makes it costly to choose an ownership structure with a large difference between tasks in how distant spot incentives are from first-best. Introducing positive correlation in BGM's example (see their figure II on page 64) would make integration a less likely ownership structure (as was the case in the example here).

5. Concluding Remarks

The optimal relational contract was derived and implications on the choice of ownership structure were discussed. It was demonstrated that predictions depend critically on the punishment strategies and the nature of the uncertainty.

Real-world managers may resort to simpler relational contracts than the one specified here, if they can be sustained. This will impact the choice of ownership. It can for instance be shown that the simplest contract imaginable, specifying that each manager is to receive her observed value added, favours ownership structures where the managers have similar bargaining positions (typically non-integration or joint ownership).

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[10] In BGM only one manager is allowed to invest, but she has two tasks (a_1 and a_2). To replicate their results, assume for example $\theta^C = \chi + \tau_1 a_1 + \tau_2 a_2 + \varepsilon_1$ and $\theta^{NC} = \upsilon_1(k)a_1 + \upsilon_2(k)a_2 + \varepsilon_2$, where χ is sufficiently large so that $\theta^C > \theta^{NC}$ always holds. Note that when BGM claim that payoff levels can influence the optimal integration decision in their result 4, it is actually a change in the variance that drives the result. The parallel in this setting would be to show that the effect of an increase in the variance of ε_2 on the performance of the relational contract depends on ownership, while such a change is of no significance in the spot mode. It is straightforward to show that this, in fact, can be the case.

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