CORPORATE COORDINATION AND THE THEORY OF THE FIRM

- Four essays –

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Abstract

This thesis aims to increase our understanding of the mechanisms that govern business activities, whether these are organised within a single corporation or are performed in part by other independent companies. First, I suggest an analytical framework on corporate coordination, where I define authoritative, economic and social coordination mechanisms and discuss their motivational bases, the organisational requirements, what coordination objectives the mechanisms can support, the costs and their interactive nature.

Then I develop a model where authority over assets and an explicit profit-sharing contract combine to govern the activities of two parties who have joint business interests (organised for example in a joint venture). The model is used to show how the parties' respective levels of risk aversion and investment specificity jointly influence the optimal allocation of ownership rights (and the design of the profit-sharing agreement).

I have also developed a model where ownership rights can be combined with a simple implicit contract. With two-sided investments the model is sufficiently rich to have room for firms, spot employment, relational contracting, spot markets, partnerships and mutual hostage taking. I show, for example, that long-term relational contracting and partnerships are attractive when the parties have similar technologies, because symmetrical *ex-post* bargaining positions tend to support effective implicit contracts.

Finally, I suggest a model to study decentralisation, where I include management activities such as information search and processing, communication, bargaining, decision-making and control in an environment where local managers maximise sub-unit profits. In extensions I allow alternative behavioural assumptions, for example by incorporating the self-enhancement bias. I also compare an integrated hierarchy (where centralised authority is owner-given) with a market organisation.

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CHAPTER 0

Introduction

In this introductory chapter I bring the main ideas of my dissertation together. In section 1 I introduce the reader to the research questions and indicate how the following essays will deal with different aspects of those questions. In section 2 I reflect on the theoretical foundations for my work. Then, in section 3, I discuss in some more detail the theoretical foundations of incomplete contracts, as such contracts are central to all the three formal models of the thesis. Finally, I give the outline of the dissertation in section 4, with a summary of each essay.

1. The main research questions

We are living in a time of private companies. During the last two hundred years they have grown to dominate our economy and our lives, whether they play the role of employer, manufacturer, service provider or as a resource allocation mechanism. Some are small in size, while others are huge organisations, with many business units controlled by the same central management. Considering their importance to the economy, it is of tremendous interest to society how the leaders of these corporations choose to coordinate and control the underlying business activities, whether these are organised fully within one firm or are performed in part by other independent entities.

The business firm being a young institution, corporate managers have been seen to experiment a great deal. The divisionalised, multibusiness firm emerged after World War I, and the organisation form spread rapidly after World War II, as it became increasingly difficult to manage the operations of the growing corporations (Chandler 1962). Diversification, Portfolio Planning, Restructuring and Core Competencies were buzz words of the 60s, 70s, 80s and 90s respectively (Goold, Campbell and Alexander 1994). New systems to influence, measure and control performance are steadily being introduced, based for example on a Balanced Scorecard (Kaplan and Norton 1996) or an Economic Value Added approach (EVA is a registered trademark of Stern Stewart & Company).

Although we have certainly learnt from past experimentation, a lot of uncertainty seems to remain with respect to how to best govern business activities. To what extent should the central managers rely on economic coordination, with the use of the price system also inside the company? What management activities and responsibilities should be decentralised? Should activities be wholly organised within the one firm, or should one rely on cooperation with other firms? Should the management base the cooperation on long-term expectations or short-term objectives? And, how should they govern joint operations organised outside the original firms' boundaries (as in a joint venture)?

The list of difficult questions could go on and on. Practitioners and scholars have some experience and theories to draw on. But we have still a lot to learn. Organisation theory is a young science (with its breakthrough in the 60s), and much of it is not efficiency oriented, focusing instead on other dimensions, such as the legitimacy of practices (in new institutional theory) and the development and survival over time (in evolutionary theory). And economic theory on organisations is still in its infancy. While incentive contracts have been extensively studied over the last thirty or so years, other important mechanisms, such as the use of authority, have been explored only sporadically.

Even so, the starting point for this thesis is a fundamental belief that economic theory with its precision, logical consistency and normative nature can further our understanding of some of the mechanisms that govern business activities. In particular, I believe in the power of economics when it is combined with insights and ideas from organisation theory, which have been developed without the sometimes very restrictive mathematical language of economics.

My research objective can, in its most general form, be stated as follows:

The research objective is to better understand the mechanisms that govern business activities, both within an integrated company and across independent entities.

Based on that objective I have formulated three research questions, where the broad first question can be seen as incorporating the more specific questions B and C.

A. What are the key qualities and requirements of the main coordination mechanisms?
B. How to govern joint business activities with other independent companies – and when should the activities instead be organised within an integrated structure?
C. What role should the central management play in large organisations – and what responsibilities should be decentralised?

The research questions are ambitiously formulated, opening up for both broad discussions and deeper analyses. They can be addressed using a variety of theoretical approaches from the academic fields of economics, organisation theory and finance.

I aspire in this thesis only to touch on *some* aspects that are of relevance to the questions. I have chosen to focus on how economic mechanisms work in parallel with and interact with mechanisms based on authority or social processes. In particular, I emphasise the role of authority.

In *Essay I*, I develop a general analytical framework on what I have called corporate coordination, where I define and discuss authoritative, economic and social coordination mechanisms. With corporate coordination I think of the coordination of employees and units in a broad sense. The problem is to align the business activities so that the total surplus is maximised in an environment with conflicts of interest. Aspects of motivation and control are therefore integral parts of the coordination mechanisms.

The discussion is held on a general level, with a focus on the organisational requirements of each coordination mechanism, what coordination objectives the mechanisms can support, their costs and their interactive nature. The essay is thus a direct response to the general research question A. To ease the exposition, I have limited the discussion to coordination *within* a single corporation (with many sub-units), although it is also relevant to coordination across independent units (as in research question B). The three broad categories of coordination mechanisms (authoritative, economic and social) differ with respect to their level of decentralisation. The essay does therefore address research question C as well, albeit in a rather general way.

In the next two essays I turn my attention to research question B. First, in *Essay II*, I discuss how authority should be allocated, in the form of ownership rights, when the parties can also write a (court-enforced) explicit contract to divide the profits. The optimal ownership structure is then driven by the parties' respective levels of investment specificity and risk aversion. The results are relevant to the classical vertical integration question. In the essay, however, I emphasise an interpretation with a joint venture owned by two independent companies (with complementary competencies).

Then, in *Essay III*, I investigate how implicit contracts (which are not enforced by a court) can help govern relationships both within an integrated hierarchy and across independent firms. The model generates predictions on when one can expect to see firms, spot employment, relational contracting, spot markets, partnerships and mutual hostage taking.

In both these two essays the setting is decentralised, with economic maximising managers who are free to decide their own investment levels but must bargain with the other managers on cooperative moves. These are key characteristics of economic coordination. In the one essay, the economic coordination is strengthened with an explicit incentive contract. Aspects of authoritative coordination are captured throughout, since the ownership structure determines decision rights over assets (in case negotiations break down). And, an implicit contract, which captures aspects of trust in the latter essay, can be interpreted as a social coordination mechanism.

In other words, essays II and III can be seen as modelling aspects of the coordination (and control) mechanisms of essay I and are as such deeper probes into some of the specifics that are not captured in the general discussion. They can also, however, be seen as extensions, in the sense that they emphasise how coordination across independent units is different from coordination inside an integrated firm. The ownership structure will impact the choice and performance of an explicit or implicit incentive contract.

The two essays on ownership miss one important aspect of authority, though. While they do consider the decision rights over business assets, they ignore the top management's right to direct business activities, which is a principal defining characteristic of a business firm (Milgrom and Roberts 1988). In *Essay IV*, I capture that aspect, by developing a model with room for a central management function. A central manger performs information search and processing activities, communicates with subordinates, and makes decisions or delegates decision authority according to the optimal level of decentralisation.

The main part of this final essay has, as the first essay, its focus on the coordination and control of a single corporation (with many sub-units). Analysing the optimal decentralisation of management activities, it addresses directly research question C. But, with the introduction of a centralised authority, the model can also add to our understanding of when two otherwise independent units should be integrated (research question B). I argue that owner-given authority (in an integrated hierarchy) can better support central information processing and decision-making than bargaining-based authority (from independent firms under a market organisation).

2. Theoretical foundations

In my work with this dissertation I have drawn on a broad range of economic theories with relevance to organisations. In this section I reflect on their properties, and I comment on what theories I use in each essay, and why I have chosen to combine insights from several theories within the same framework or model. For a

more detailed discussion on the relevant theories, see each of the following essays. In particular, see essay I on corporate coordination, which could be seen as a review of theory on economic, authoritative and social coordination mechanisms.

The *neoclassical theory*, where the firm is represented by a production function, is the point of departure for the economic theory on organisations. The internal organisation of the firm is not modelled explicitly. The unit is simply assumed to be acting on input and output prices in a profit-maximising way. But, as we tend to model the behaviour of individual managers in much the same way as firms are modelled in the neoclassical theory, we can draw on many neoclassical insights in our new, more elaborate theories of the firm. Including the game theoretic ideas on non-cooperative equilibria and cooperative bargaining solutions.

The *agency theory* has allowed economists to study incentive problems in contractual relations between two (or more) parties with asymmetric information. As a firm can be seen as a nexus for a set of contracting relationships among individuals (Jensen and Meckling 1976), the theory is a step on the way to opening up the "black box" of the firm. Throughout this dissertation agency problems are considered important to the problem of coordination both within and across firms.[1]

However, while much of the formal economic literature on organisations over the last thirty years has highlighted contracts as a means to alleviate incentive problems, I allow in my models also other instruments to have an impact, such as asset ownership (in essays II and II) and the direct use of authority (in essay IV). That is not to say that I deny the importance of incentive contracts. In essays II and III I include explicit and implicit incentive contracts respectively.

But, I do not believe that incentive contracts alone are sufficiently empirically important to base a theory of the firm entirely on this concept. In particular, I think that we need to incorporate aspects of authority, as it is a key characteristic of firms. The following essays are all attempts to do that, either informally (as in essay I) or formally (as in the rest of the dissertation).

I also take issue with the emphasis on individual shirking (moral hazard) and untruthful communication (adverse selection) of employees that is found in much of the agency theory. These do not seem to constitute the main problems of modern corporations. I focus instead on the more legitimate strive of a manager to maximise the profits of the unit she leads. This is a form of an agency problem, seen from the central authorities of a firm, as it leads to sub-optimising behaviour. But, at the same time, it can be efficient for a manager to focus on own performance, rather than the

[1] Jensen and Meckling (1976) include as agency costs the monitoring expenditures by the principal, the bonding expenditures by the agent and the residual loss.

activities of all the other units, due to management overload effects (as I argue in essay IV).

Another weakness of the agency theory is its assumption of hyperrational actors. *Transaction cost theory*, championed by Oliver Williamson, is an attempt to introduce bounded rationality to the study of institutions, while at the same time stressing the hazards of opportunism. The theory does suggest interesting hypotheses on governance, in particular on the role of asset- or relationship-specific investments. All the three formal models that I present in this dissertation do include such specific investments (although I have disguised them as the research of global projects in essay IV). In this sense, my work is certainly inspired by the ideas of Williamson (and others within this school of thought). Since Williamson has been surprisingly silent on the underlying mechanisms that are to drive his hypotheses, this thesis can be seen as one step on the way to fill out the lacking substance.

In this respect, my work builds on the *incomplete contracts theory* – also called the property-rights approach (developed by Sanford Grossman, Oliver Hart and John Moore), where the actors can typically contract on decision rights (often in the form of ownership rights) only. Specific investments that lead to hold-up problems are central to the theory. *Ex-post* bargaining on cooperative moves is then influenced by the initial allocation of decision rights. In this way, the theory incorporates aspects of authority. Essays II and III are direct extensions of the incomplete contracts theory, as found in Hart and Moore (1990).

Albeit undoubtedly a valuable theoretical contribution to the study of managerial behaviour, the incomplete contracts theory has been criticised for not capturing important human behavioural aspects of the transaction cost economics (Kreps 1996), for focusing too much on ownership of assets by individuals - while assets tend to be owned by firms (Holmstrom 1999), and for a lack of theoretical rigourism (Maskin and Tirole 1999a). I address the first two issues in this section. The last issue will be discussed in the next.

Essays I and IV can be seen as direct responses to the first two points of criticism. In essay I, I develop a broad analytical framework, with economic, authoritative and social mechanisms. And, in the formal model of essay IV, I assume that the assets are owned by firms, and I explicitly include bounded rationality aspects such as information processing and communication. Further, I allow the direct use of hierarchical authority, so that the actions of employees can be decided directly by a superior manager (as discussed by Williamson but ignored by Grossman, Hart and Moore, who assume that the actors must always negotiate also within firms).

Also essay III is in some sense closer to the ideas of transaction cost theory than the basic Grossman-Hart-Moore models, since it allows for long-term relational contracting, which is central to Williamson's (1985) framework on governance. To capture the dynamic effects, following the example of Baker, Gibbons and Murphy (1997), I use a repeated game (with reputation effects), as Kreps (1990) did in his discussion on corporate culture.

And, in essay II, I suggest a setting where the actors of the model are companies who decide to do a joint venture. Ownership is then interpreted as control over assets (including non-physical assets such as brand names) when the joint venture is dissolved. The model in essay III could be interpreted in the same way. With such an interpretation, the critique by Bengt Holmstrom on individual ownership of assets does not apply.

Further, there are many settings where individuals (entrepreneurs), in fact, own (or could own) assets directly. Theories that apply to such settings should therefore not offhandedly be dismissed as irrelevant. My model in essay III shows, for example, that partnerships (with joint ownership) tend to be robust under conditions that are satisfied for many law and management consulting firms. In this respect, the theory is certainly empirically relevant.

Another approach to the problems of bounded rationality is found in the (rather small) literature on optimal design of organisations under observation, information processing and communication costs. It is sometimes called the *theory of teams*, after Marschak and Radner's (1972) book, since agency problems are suppressed. Important recent contributions include Radner (1992) and Bolton and Dewatripont (1994). My discussions on the information structure requirements of coordination mechanisms in essay I, and my model structure in essay IV, are inspired by their focus on information networks.

Because the economic analysis of organisations is still in a very rudimentary state (Hart 1995), I have also taken inspiration from *organisation theory*. And maybe because of economic theory's immatureness in this field, and the apparently rather slow growth of fundamentally new ideas in organisation theory, I have found the early contributions particularly useful, as those by Herbert Simon, James March and Richard Cyert (which again build on Chester Barnard's work). But I have also been inspired by more recent work, as found in the balanced account of organisation theory by Scott (1998) and the more provocative review by Pfeffer (1997). The reading of organisation theory has, in particular, influenced my thinking on corporate coordination (in essay I) and the decentralisation of management activities (in essay IV).

I should also mention that essays I and IV have been inspired by the focus on central authorities found in the *strategy literature* (see Porter 1987 and Goold, Campbell and Alexander 1994). And I incorporate well-documented judgement biases from the *psychology literature* in two extensions of the model in essay IV (Bazerman 1998).

Economic theory on organisations has been criticised by organisation theorists, for example Perrow (1986) and Pfeffer (1997), on many accounts. As the reader who is familiar with their critique will have noted, I do agree with some of their points. For example, I do consider authority relations and cooperative arrangements (or relational contracting) important (while these are ignored in the agency theory). Further, I acknowledge that the costs of a market (as discussed in the transaction cost theory) can also be present inside a firm - because there are strong elements of markets within hierarchies - while also markets have strong elements of hierarchies within them. And, I do not believe that individual shirking and untruthful communication should be the core drivers of a theory of the firm.

However, these points of critique do not really attack the basic ideas of economic theory. On the contrary, I find (as opposed to Perrow and Pfeffer) its two main characteristics very useful - comparing mechanisms based on efficiency considerations, and modelling individual or group behaviour (under certain settings) in a maximising way. Then we are able to use the strength of economics - its logical structure - to develop alternative or complementary hypotheses on organisations, spelling in detail out the underlying mechanisms. These should be tested empirically, alongside the theories that are based on sociological or psychological arguments.

3. Foundations of incomplete contracts

Coase (1937) discussed how the costs of transactions are different, depending on whether they are organised within a firm or in a market place. Around forty years later Klein, Crawford and Alchian (1978) and Williamson (1975, 1985) picked up on these ideas. They focused on the costs of opportunistic behaviour under market organisation, when there is a large surplus to be divided *ex post* among cooperating parties - compared to if they must seek out new partners. The hold-up problems arise when the actors cannot, *ex ante,* write complete contracts, securing a party fair compensation for her relationship- and asset-specific investments.

These distinguished scholars point to integration as a solution to high transaction costs in the market place, but they are vague about how integration changes the characteristics of the transaction. Common ownership (where authority replaces market negotiations) is simply assumed to reduce the transaction costs.

Unhappy with this one-sided explanation, Grossman and Hart (1986) emphasise that a transfer of ownership rights is not only associated with benefits but also with costs. In particular, while the incentives of those who get more (residual) control rights are strengthened, those managers who lose control will have weaker incentives to make specific investments. Integration is then typically optimal when the control rights are very important to one player only or other players' investments are relatively unimportant compared to the would-be owner's. Non-integration, on the other hand, can be optimal when a large surplus requires moderate investments by all the parties.

Hart and Moore (1990) develop what has become known as the property-rights approach further - with a more specific model of asset ownership and investments in human capital (see also Hart 1995). The ownership of an asset is defined as the right to exclude others from the use of that asset. *Ex-post* access to assets and the participation of other managers determine the benefits from *ex-ante* investments. With this framework Hart and Moore are able to develop more specific propositions on the optimal ownership structure, for example that integration seems favourable when assets are complementary in nature.

The Grossman-Hart-Moore models are characterised by an inability to contract on all future contingencies. The parties must instead rely on an incomplete contract that only specifies control rights. Future activities are agreed on later - through negotiations. In this bargaining process the sunk investments are seen as irrelevant. The division of surplus is determined by a comparison of the cooperative outcome and the actors' outside options, which again are influenced by the initial allocation of control rights. The expectations of the *ex-post* bargaining process decide the incentives to invest *ex ante*.[2]

These are the basic features of the incomplete contracts theory - a theory which has proven very useful to organise thoughts about economic issues (Tirole 1999), such as the boundaries of the firm (as analysed by Grossman, Hart and Moore), financial structure (Aghion and Bolton 1992, Hart 1995) and authority relations (Aghion and Tirole 1997). As indicated in the preceding section, however, the theory has been criticised for its lack of rigorous foundations.[3] Receiving the most attention is the argument by Maskin and Tirole (1999a) that there is a tension between the postulation of significant transaction costs, which prohibit complete contracts, and

[2] The structure of the *ex-post* bargaining process can for example be a 50:50 split of the extra surplus - as in a symmetric Nash bargaining solution (Grossman and Hart 1986), a use of the Shapley value (Hart and Moore 1990), a take-it-or-leave-it offer where one of the parties has all the bargaining power (Aghion and Bolton 1992) or some kind of alternating-offer bargaining game (Bolton and Whinston 1993). One can also assume that there is no *ex-post* bargaining (for instance because of an extremely risk averse agent), and that one of the parties ends up with the right to pick the action (Aghion and Tirole 1997).

[3] In the preceding section I also discussed other points of criticism.

the unboundedly rational dynamic programming that the parties are expected to perform.

The arguments by Grossman and Hart (1986), Hart and Moore (1990) and Hart (1995) for why the contracts must be incomplete in their models can be summed up as follows: The world and the production or trade decisions are thought to be complex and highly unpredictable, making it hard to think about, to describe in negotiations (partly due to a lack of common language) and to write long-term contracts that are contingent on every possible eventuality. In particular so that the contracts can be enforced by an outside authority (who may have little knowledge of the specific environment in which the contracting parties operate). At the same time the managers in the models are able to perfectly calculate expectations on how their investment decisions will influence the *ex-post* surplus under modes of both co-operation and dispute.

Maskin and Tirole (1999a, p.84), on the other hand, argue that "the rationality needed to perform dynamic programming is in standard models strong enough to ensure that transaction costs are irrelevant." Specifically, they show that the problem of foreseeing physical contingencies *ex ante* does not restrict the set of payoffs that can be reached through contracting (see also Tirole 1999). To derive at this "irrelevance theorem" they use techniques of the implementation literature (with complex message games), and assume that the parties can commit not to renegotiate (even if that would increase the surplus of all the active parties *ex post*). The contract must also be "welfare neutral" (in the sense that whenever two states are payoff-equivalent, it gives rise to the same utilities in both states).[4]

Hart and Moore (1999), building on Segal (1999), counter the critique by arguing that the nondescribability of future states is not critical for the foundations of incomplete contracts. Rather, the crucial assumption is the lack of commitment (not to renegotiate a prior agreement). Then, in a setting where the variables are not verifiable, it can be shown that as the contracting environment becomes increasingly complex (as the number of potentially relevant future trade opportunities go up), the outcome under any message-contingent long-term contract converges to the outcome under an incomplete contract (where the parties cannot contract on trade *ex ante* – only *ex post*).[5] Under these circumstances, Maskin and Tirole's "irrelevance

[4] With more restrictive assumptions, Maskin and Tirole (1999a) establish a similar irrelevance theorem in a setting *with* renegotiations, provided that the agents are risk averse. Hart and Moore (1999) argue that there are important situations where this theorem does not hold (because the restrictive assumptions are not satisfied).

[5] A critical assumption for this result is that the potential trades cannot be ordered *ex ante* in any natural way (there is no quality or quantity dimension). All trades must *ex ante* be equally likely to be the appropriate one *ex post*.

theorems" are satisfied, since the ability to describe the nature of trade in advance does not matter. The important insight, however, is that under sufficient complexity no mechanism can do better than the null contract – which is incomplete.

Therefore, in such a complex setting, the fundamental question becomes why the parties cannot commit not to renegotiate an *ex-ante* contract. Maskin and Tirole (1999a) suggest that the parties could register their first contract publicly and then instruct a court to ignore any revised contract. The initial contract could include a large penalty from the other party if one was able to produce evidence of a second contract, so that even if there are more than one enforcement authority, the parties would not dear to enter a new contract undoing the first. Hart and Moore (1999), on the other hand, point out the possibility of writing side-contracts with third parties. Then it could be very difficult for a court to establish whether, in fact, renegotiations had taken place or the middleman had been used for legitimate business purposes only.

Maskin and Tirole (1999b) also come up with a second set of critique, with particular relevance to the literature on property rights. First, they suggest that more complex ownership arrangements can strengthen the incentives to invest. In particular, they argue that a contract where a party, drawn at random, may receive a right to sell her share in a jointly owned asset at a pre-specified price can do better than a one-sided classical ownership structure. In fact, if the other party (who must buy the asset) then must also pay a tax to a third party (the community of citizens), the contract can achieve first-best. Second, Maskin and Tirole question the predictive power of the property-rights-literature, as they argue that there is potentially a range of contracts, e.g. specifying randomised ownership or options to sell or buy assets, that can implement the same level of joint surplus.

Hart and Moore (1999), on the other hand, are sceptical to contracts that specify large taxes to third parties, as these contracts are vulnerable to collusion. They also argue that the joint ownership contract with options-to-sell suggested by Maskin and Tirole seems fragile. The contract critically depends on the assumption that first-best investment levels will guarantee that the other party does not exercise the option. But the strike price must be set in advance. Therefore, if there is enough uncertainty, there will be a positive probability for tax payments even at first-best investment levels. Then the contract does not seem so attractive, since it reduces the expected joint surplus for the team. In fact, Hart and Moore (p.134) conjecture that "the indeterminacy in optimal ownership structure will be much reduced, and may disappear, in a world of uncertainty."

Maskin and Tirole (1999b) point to bounded rationality and robustness considerations as explanations for why their somewhat more complex contracts are

rare. Tirole (1999) claims that incomplete contracts can be more robust to players' mistakes or to misspecification, and that institutions such as authority, property rights and patents have good learning properties, as they are used in various contexts throughout a person's life. Segal (1999) argues that bounded rationality can explain why people will not want to bind themselves not to renegotiate. In a complex environment, where the contracting parties may even possess private information about trade opportunities, a contractual message game will require a lot of formal communication. If the costs of such communication are high, the parties may prefer to write incomplete contracts – with an expectation of renegotiations.

These thoughts indicate that we can see the behavioural assumptions of the incomplete contract models in an evolutionary perspective (Nelson and Winter 1982). The players may (either through learning or natural selection) develop (unconscious) behavioural rules that are (almost) consistent with rational dynamic programming. In particular they can develop a feeling or intuition for how much they should receive of the surplus that is generated by their investments in a simple cooperative arrangement. Social norms of fairness can help to coordinate those expectations or predictions across the cooperating parties.

Bounded rationality will be much more limiting when the parties must document their behaviour, as in an explicit contract (with or without message mechanisms). First, to improve incentives, that contract will tend to be more complex, and therefore more difficult to think about for the contracting parties. And, second, a language is required that can translate the thoughts into a written contract. The writing and enforcement costs can also be significant.

Until we have a better understanding of how to model transaction costs and bounded rationality, it seems to me that some pragmatism is warranted. Looking around us, we certainly observe a widespread use of incomplete contracts governing business transactions. In fact, incomplete or simple contracts are rather the rule than the exception. It therefore boils down to a question of whether the simple models that the theory of incomplete contracting suggests can help us derive insights about empirical phenomena or not. If we believe that they can, as I do, and hopefully this dissertation will show, then such models should be welcomed!

4. Outline of the dissertation

The dissertation consists of four essays (in addition to this introductory chapter). Each of the following chapters is thus independent in nature, and there are few cross-references, although, as I have established above, they are certainly related. Below I

provide brief summaries of the essays. A short abstract is also included at the beginning of each essay.

ESSAY I - Corporate coordination: Authoritative, economic and social mechanisms

Drawing on both economic and organisation theory I suggest an analytical framework on corporate coordination. The role of a coordination mechanism is to align business activities so that the total surplus is maximised, in an environment with conflicts of interests. The coordination is thus also a matter of control and motivation.

I distinguish between authoritative, economic and social coordination mechanisms, according to whether decision-making is centralised or decentralised, and whether the decisions are based on economic calculations or norms and values. Allowing for standardisation of behaviour, the framework is extended to six categories: Formal rules and routines, Direct supervision, Piece-rate schemes, Internal markets, Informal rules and routines and Goals.

Basing the framework on three orthogonal dimensions, it proves to constitute a robust foundation for comparing the requirements and qualities of each coordination mechanism, which is the objective of the essay. My focus is thus different from that of Mintzberg (1983), whose coordination mechanisms are designed to fit ideal organisational types. I stress instead that coordination mechanisms tend to work in parallel and that they interact to guide actual behaviour.

Economic, social and individual motivational factors can be important for all the coordination mechanisms. Economic (together with social) factors can explain some authoritative and social coordination – while social (together with economic) factors can lead individuals to maximise economic variables.

The coordination mechanisms have different requirements with respect to management capacity, information structure, social structure and frequency. While authoritative mechanisms require central management capacity, local management capacity is important for decentralised mechanisms. Further, while the information structure is critical for authoritative and economic mechanisms, a certain social structure must be in place for the social mechanisms to work. Finally, effective standardisation requires a certain level of frequency.

The information characteristics of a particular class of business activities determine how a coordination mechanism (with its specific information structure requirements) can support the associated coordination objective. I argue that all the coordination

mechanisms can be used for production activities (to achieve operational efficiency), while economic and social mechanisms are typically best suited to coordinate sales and marketing activities (to attain a competitive market position). Authoritative and economic coordination mechanisms are difficult to use directly for competence-building activities (to develop capabilities), since actions and outcomes are hard to observe, while social coordination can work well, due to its indirect nature.

The coordination mechanisms will also differ with respect to design, implementation and coordination failure costs. Authoritative coordination is typically the easiest to understand and to predict the outcome of, while its implementation is relatively costly. Economic coordination is particularly vulnerable to coordination failure problems, but also social coordination can have high such costs, since it too is a decentralised mechanism.

Finally, I reflect on how coordination mechanisms interact to guide business activities and decision-making. A particular use of one mechanism will often influence how another mechanism can be expected to work. For example can the use of authority change the norms and values of the organisation, and it may limit the action space or change expectations under economic coordination. I also stress the path dependent nature of coordination mechanisms, as they are the accumulated result of social inter-actions over time and the actors need time to learn how a mechanism might work.

ESSAY II - Asset ownership and risk aversion

In this essay I suggest a model where the business activities result in both verifiable and non-contractible benefits. The *ex-post* division of surplus is determined by, first, a contract on how to share the verifiable profits and, second, the bargaining power of each party as they negotiate over the non-contractible benefits. The *ex-post* bargaining power is again determined by the *ex-ante* allocation of ownership rights. The aim of the essay is to analyse in detail how the risk aversion of the respective parties, jointly with the specificity of their investments, should influence the optimal ownership structure (and the design of the profit-sharing contract).

Counter to intuition, I show that it can be optimal for the *most* risk averse manager to own all the assets, if the risk-bearing costs associated with the non-contractible benefits are moderate compared to those associated with the verifiable benefits. The most risk averse manager receives then a large share of the not so risky non-contractible benefits, while the other manager is motivated by a larger share of the more risky verifiable profit stream through an explicit contract. This way, both managers can enjoy a reasonable incentive strength, while the total risk-bearing costs are minimised.

Further, I show that integration is more likely to dominate non-integration when the managers have very different risk preferences. Then the risk-bearing costs of the most risk averse manager are very sensitive to transfers of ownership rights. Therefore, if it is good for her to own assets, she should own them all. But if it is very costly for her to own assets, she should not own any.

I also investigate how a third party can break the budget-balancing constraint. If she plays the role of a traditional investor, she buys a right to a certain percentage of the verifiable profits. Then the total risk-bearing costs are reduced, but so are the incentives. The third party could instead be paid *ex ante* to gear up the investments of the two managers. The resulting improved incentives from the verifiable profits must be weighed against the increased total risk-bearing costs.

Although the model can be given a more traditional vertical integration interpretation, I suggest a setting where two companies with complementary competencies do a joint project. In addition to the work done by the project organisation (a joint venture), the project requires substantial effort by managers and experts within the two parent companies. The model can then be used to study how the parent companies can be motivated by verifiable project profits and future benefits from new opportunities that they expect to discover. The latter (non-contractible) benefits are to some degree relationship- and asset-specific.

ESSAY III - Asset ownership and implicit contracts

The aim of this essay is to develop a richer logical framework for a theory of the firm that combines asset ownership and implicit contracts (while it ignores the possibility of a court-enforced contract on profits, which is studied in essay II). In a dynamic model with two-sided investments there is room for firms, spot employment, relational contracting, spot markets, partnerships and mutual hostage taking. The model is shown to generate predictions on ownership structures and the qualities of the implicit contract (if it is viable) that seem more realistic than the predictions of other comparable models.

While Halonen (1994) argues that the worst ownership structure of the one-shot game can be good in a repeated setting, I show that the parties should instead aim for strong *ex-post* bargaining positions when choosing the ownership structure (with a given technology). Choosing between technologies, however, strong mutual inter-dependencies can be good to provide strong punishments after cheating.

And, while Baker, Gibbons and Murphy (1997) study a setting with one-sided investments, I allow both managers to invest, opening up for more balanced relationships. In particular I show that a partnership (joint ownership) is viable also

in a model where the parties invest in human capital only. A partnership is likely to be the preferred structure in a setting where two (or more) parties have similar technologies, they take a long-term perspective, and there is for all practical purposes only one asset to own (e.g. the company name). These conditions are satisfied for many law and management-consulting firms, where partnerships are prevalent.

The implicit contract that I propose is simple, focusing on each manager's realised contribution to the joint surplus. I argue against the inclusion of a fixed payment in the implicit contract (although I do analyse also that case). That payment would have to be paid by the party with the weakest bargaining position (typically the employee - if one of the parties own all the assets), and it must thus be interpreted as a "bribe" and not a "salary". Risk aversion or wealth constraints would limit the attractiveness of such an arrangement. It could conflict with social norms (such as equity). And it would make the implicit contract much more difficult to understand for managers of bounded rationality. (Note that I do not claim that fixed transfers are not important in business relations, but my impression is that a fixed transfer is usually part of a verifiable contract and is paid *to* the weaker party.)

When the implicit contract cannot include a fixed transfer, I show that symmetry between the *ex-post* bargaining positions of the parties can be good to support an effective implicit contract. In other words, the parties may choose an ownership structure under an implicit contract where they end up with more symmetrical bargaining positions than they would under a spot mode. I also show that ownership then matters even when the parties are infinitely patient. A first-best contract can only be sustained when the bargaining positions are relatively symmetrical.

ESSAY IV - The delegation of management activities: Towards a management-based theory of the firm

In the final essay I argue that it is important to understand a broad spectre of management activities to develop an empirically relevant theory on organisation design. In a model to study decentralisation I include management activities such as information search and processing, communication, bargaining, decision-making and control in an environment where local managers maximise sub-unit profits. I suppress any individual temptation to shirk (moral hazard) or provide untruthful information (adverse selection), as these phenomena are unlikely to account for the observed diversity among companies with respect to their degree of decentralisation.

The model is used to show how the incentive problems, communication flows and control activities shift when decision authority on project research and project implementation is delegated. These factors then impact the nature and level of information search and processing centrally and locally. Local managers will do more

research on local projects, while central managers will focus more on the global projects (which affect several sub-units), when the project research decision is delegated. And, the local managers will do more and the central managers will do less of the overall information search and processing when the project implementation decision is delegated. Under a decentralised organisation design local projects are favoured, and fewer global projects are implemented.

The delegation of authority involves a trade-off between incentive problems and information processing, communication and control costs. But these costs are not necessarily monotonic in nature. The delegation of more decision authority can, in fact, under some circumstances reduce the incentive problems. The local managers will then no longer want to skew her other decisions (that were already delegated) to influence the outcome of the now decentralised decisions (as she would if they were centralised). And, while vertical communications are reduced, lateral communications increase, as local managers must engage in costly bargaining to reach an agreement on global projects.

In four extensions I relax some of the behavioural assumptions of the model. First, I allow a local manager to also have some interest in the corporate profits (and not only in the profits of the local unit). In another extension I assume that a manager can base her decisions on incomplete information (in the sense that not all the processed information is communicated to her) and analyse how that affects the organisation design decision. Finally, I let decision-makers suffer from the self-enhancement bias, which is a well-established empirical phenomenon. I discuss its effect on the project selection decision (leading to fewer – or smaller – global projects under decentralised structures) and the way central managers may disturb the local managers (insisting on the evaluation of centrally generated project ideas).

Although the main focus of the essay is confined to the decentralisation of management activities within a firm's boundaries, the model is also useful to understand under what circumstances two otherwise independent units should be integrated. The introduction of a centralised authority (with information-processing and decision-making capabilities) explains why and how integration can reduce the hold-up problem. Comparing an integrated hierarchy and a market organisation, I argue that the owner-given authority of a central manager in an integrated hierarchy may better support central information processing and decision-making than bargaining-based authority under market organisation.

ESSAY I

Corporate Coordination

- Authoritative, Economic and Social Mechanisms -

Economic models tend to deal with only very narrow aspects of corporate coordination. In an attempt to flesh out the broadness and the complexity, I suggest an analytical framework, where I define authoritative, economic and social coordination mechanisms and distinguish between those mechanisms that standardise behaviour and those that do not. Economic, social and individual motivational factors are important for all the mechanisms. They have different requirements with respect to management capacity, information structure, social structure and frequency. Not all the mechanisms can support every coordination objective. The information characteristics of the underlying business activities are critical. The mechanisms differ with respect to design, implementation and coordination failure costs. Mechanisms interact to guide actual behaviour.

1. Introduction

While economists have been able to build comprehensive theories on market trading and are on the way to do the same for contractual transactions, the economic analysis of organisations is still in a very rudimentary state (Hart 1995). In particular, economic models deal with only very narrow aspects of what I call *corporate coordination*. I then think of the coordination of employees and units in a broad sense. The problem is to align activities throughout the business firm so that the total surplus is maximised in an environment where conflicts of interest can also exist within the organisation's boundaries. Aspects of motivation and control are therefore integral parts of a corporate coordination mechanism. The fact that individuals in the organisation only possess a limited capacity for observation, information processing and communication adds to the problem.

In the traditional *neoclassical theory* the firm is represented by a production function. This is useful to discuss how the production choice of a profit-maximising unit can depend on input and output prices (see for example Milgrom and Roberts 1990b),

but it does not further our understanding of how those production choices are decided and implemented in the organisation. It can, however, be used in game theoretic analyses of how such units interact strategically with other units inside or outside the company (Tirole 1988).

In *agency theory*, opportunistic hyperrational actors with asymmetrical information search for optimal incentive schemes to regulate their transactions. In the more advanced parts of the vast literature, agency theorists have included many agents, many principals or multiple tasks, and some have interpreted the models to illustrate implicit rather than explicit contracts (see surveys by Hart and Holmstrom 1987 and Gibbons 1996). The theory does touch on important aspects of corporate coordination, and I do draw on many of its insights in the remainder of the essay. But, real-world problems of performance measurement and the partial nature of most of the theory limit its usefulness.

Transaction cost economics, championed by Williamson (1975, 1985, 1996), is the result of an attempt to introduce bounded rationality to the study of institutions, while at the same time focusing on the hazards of opportunism. The theory does suggest interesting hypotheses on governance, in particular on the role of asset-specific investments, but it does not spell out the underlying mechanisms, neither formally nor verbally. It is therefore only of limited value in the study of corporate coordination, where the objective is an in-depth understanding of the coordination mechanisms as such.

Although bounded rationality is difficult to model formally, a small strand of literature has been developed to understand how efficiency considerations affect the *optimal design* of organisations under observation, information processing and communication costs, in the absence of agency problems (Marschak and Radner 1972, Sah and Stiglitz 1986, Radner 1992, Bolton and Dewatripont 1994). The theory shows that design is important even when there is no conflict of interests in the organisation.

The *incomplete contracts* approach seems to be a promising avenue to take bounded rationality into account in an environment with conflicts of interest, even if it does so in an indirect way (Grossman and Hart 1986). The actors are assumed to be able to contract on decision rights only, due to transaction costs or high uncertainty (Segal 1999, Hart and Moore 1999). But within this constraint they act in accordance to full rationality, usually without observation, information processing and communication costs. The theory enables economists to discuss important issues such as ownership structure (Hart and Moore 1990), organisation design (Aghion and Tirole 1995), and transfer pricing policies (Holmstrom and Tirole 1991) within a formal (mathematical) theoretic framework.

Repeated games and *implicit contracts* capture aspects of trust in long-term cooperative relationships. Both hierarchical relationships (Kreps 1990, Baker, Gibbons and Murphy 1997) and lateral cooperation (Cremer 1986) can be analysed within such a framework. In both settings, the parties can be disciplined by reputation effects (future punishment after cheating) and thus sustain a higher surplus than in a spot mode.

In other words, although economic theory has generated some important insights that are relevant for corporate coordination, it has so far only touched on very partial and limited issues. Liberating myself from the economic language of mathematics, but supported by insights from the existing economic theory, I try in this essay to flesh out the broadness and complexity of corporate coordination. To do that I also draw on organisation theory.

Consider the coordination of a large company seen through the eyes of the CEO or the top management team. There are many coordination mechanisms at play, of which some are easily manipulated, while others are difficult both to understand and even more so to influence (at least in the short run). The picture is further complicated by the fact that even though decisions and activities can clearly be guided by one mechanism in a particular situation, a different mechanism can dominate in another, although the decision-makers are the same. And, in many situations several coordination mechanisms interact, so that no single mechanism alone can explain the actual behaviour.

To simplify this complex picture, I suggest an *analytical framework*. I distinguish between authoritative, economic and social coordination mechanisms, according to whether decision-making is centralised or decentralised and whether the decisions are based on economic calculations or norms and values. Allowing for standardisation of behaviour, the framework can be extended to six categories: Formal rules and routines, Direct supervision, Piece-rate schemes, Internal markets, Informal rules and routines and Goals.

Being based on three orthogonal dimensions the framework is qualitatively different from earlier coordination frameworks that I am aware of. The approach makes it a robust foundation for comparing the requirements and qualities of each coordination mechanism, which is the objective of this essay. My focus is thus different from that of Mintzberg (1983), whose coordination mechanisms are designed to fit ideal organisational types. I stress instead that coordination mechanisms tend to work in parallel and that they interact to guide actual behaviour.

Although I also discuss the motivation of employees and units to act in accordance with a mechanism, the framework was designed to be a starting point for discussions

on what organisational requirements each mechanism has, what coordination objectives it can support, what coordination costs it will incur and how the mechanisms relate to each other in a system of coordination mechanisms. A thorough treatment of each of these questions would require the format of a book. In this essay I will only indicate some factors that are of importance to each question.

With respect to the *motivational bases* for corporate coordination, I argue that economic, social and individual factors are important to explain all the three main categories of coordination mechanisms. In other words, economic (together with social) factors can explain some authoritative and social coordination – while social (together with economic) factors can lead individuals to maximise economic variables.

The coordination mechanisms have different *requirements* with respect to management capacity, information structure, social structure and frequency. While authoritative mechanisms require central management capacity, local management capacity is important for decentralised mechanisms. Further, while the information structure is critical for authoritative and economic mechanisms, a certain social structure must be in place for the social mechanisms to work. Finally, effective standardisation requires a certain level of frequency.

The information characteristics of a certain class of business activities determine how a coordination mechanism (with its specific information structure requirements) can support the associated *coordination objective*. I argue that all the coordination mechanisms can be used for production activities (to achieve operational efficiency), while economic and social mechanisms are typically best suited to coordinate sales and marketing activities (to attain a competitive market position). Authoritative and economic coordination is difficult to use directly for competence-building activities (to develop capabilities), since actions and outcomes are hard to observe, while social coordination can work well, due to its indirect nature.

The coordination mechanisms will differ with respect to design, implementation and coordination failure *costs*. Authoritative coordination mechanisms may be the easiest to understand and to predict the outcome of, but they are costly to implement. Economic coordination is particularly vulnerable to coordination failure problems, but also social coordination can have high such costs, since it too is a decentralised mechanism.

To set the reader's expectations right I should stress that I will not provide specific management tools for corporate coordination (as that would also require the format of a book). I do not discuss the properties of practical solutions such as plans, budgets, transfer-pricing policies, incentive schemes, information systems, communi-

cation modes, strategy processes and the use of symbols and storytelling for purposes of socialisation. Instead I keep my discussion on a more fundamental level. A deep understanding of the basic characteristics of the coordination mechanisms is in my opinion necessary before we go on to discuss the more practical aspects of corporate coordination, whether such a discussion has research or management objectives. However, this essay should help the reader to judge himself on the qualities of a specific solution or management tool in a real-world organisation.

The essay proceeds as follows. The analytical framework is developed in section 2. In section 3 I discuss the motivational bases for coordination. Then, in section 4, I point out the requirements of the coordination mechanisms with respect to management capacity, information structure, social structure and frequency. In section 5 I study how the various coordination mechanisms can support certain coordination objectives (targeting specific classes of business activities). In section 6 I suggest how the coordination mechanisms differ with respect to design, implementation and coordination failure costs. In section 7 I discuss the interactive and path dependent nature of the coordination mechanisms. Finally, in section 8, I make some concluding remarks.

2. The framework

Consider two important dimensions along which coordination mechanisms differ. Decision-making can be *centralised* or *decentralised*, and it can be based on *economic calculations* or *social mechanisms*.

A decision is centralised on the corporate level if it is made by the top management and then communicated to or imposed on the units, while it is decentralised if it is left to the units alone to make (Milgrom and Roberts 1992). Formal rules and routines are part of a centralised structure, since although they may have been developed locally, the top management sanction them. So are formal guidelines that limit the autonomy of the units in a clear way. But as guidelines become vaguer, they tend to work only indirectly – in a decentralised way – through their influence on the norms and values in the organisation (if they have any effect at all).

For the purpose of this essay, decision-making and activities are based on economic calculations if the decision-maker consciously tries to maximise a function of some economic variables that are observed (possibly in an aggregate form) by the central authorities, who thus can control performance. Production volumes, sales, costs, profits and return on capital are typical examples of economic variables that are controlled centrally. The actors do not need to be hyperrational in the traditional economic sense. Information processing capabilities (Galbraith 1973), affective and

cognitive processes (March and Simon 1958) or rationalised myths (March and Olsen 1976, Meyer and Rowan 1977) can affect actual behaviour. The distinction I make is whether or not the actors *try* to optimise in an economic sense, weighing the costs of their actions against the expected positive effect on the economic indicator. The benefits and costs must then be of the same denomination or transformed to the same denomination by some formula (for instance in an incentive contract).

If the decision-making is not based on economic calculations, social mechanisms may influence it. Following Scott (1998) I distinguish between norms and values. Norms are social (informal) rules that specify appropriate actions directly. Values are criteria used to select a desired outcome (or goal). There can also be roles that signify expectations (of actions) or evaluative standards (with respect to outcome) for occupants of specific social positions. A decision-maker's adherence to social norms and values is not controlled directly by the central authorities. Instead an individual conforms due to social pressure (from peers or other social groups), or she has internalised the norms and values, so that no outside pressure is necessary.

Combining the two dimensions generates a framework of four categories, see figure 1. Under centralised decision-making, the top management make the decisions and issue formal rules, routines and guidelines according to what they think is best, and it is (at least from their perspective) less interesting whether they base their decisions on economic calculations or not. Hence, I combine these two categories of *authoritative coordination*. Call the category where the decision-making and the activities are guided locally by the maximisation of some economic variables for *economic coordination*. The decision-making is also under *social coordination* left to the units, but it is then guided by social norms and values.

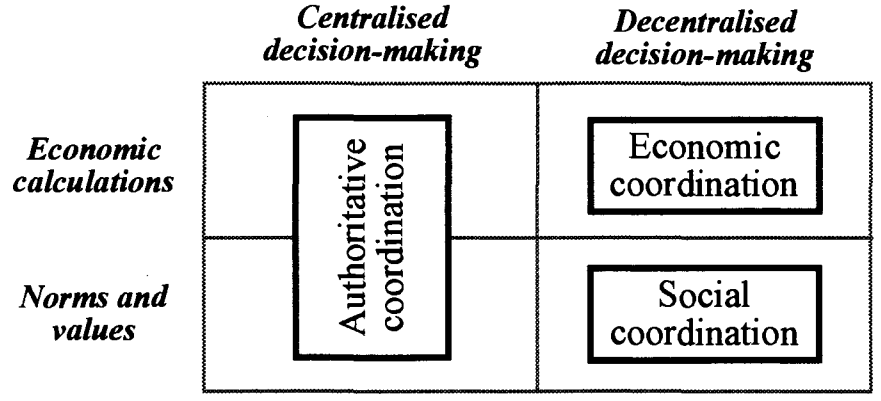

Figure 1.

To illustrate how authoritative, economic and social coordination mechanisms work, consider that a vector of actions $\mathbf{x} = (x_1, x_2, \cdots, x_n)$ is chosen that leads to an uncertain actual outcome $\Gamma(\mathbf{x})$. There is also an uncertain set of signals $\Phi(\mathbf{x})$, which all the relevant parties can observe. With this terminology, authoritative coordination tends to be directed at the actions $\mathbf{x}$. Economic coordination operates with the signals $\Phi(\mathbf{x})$ as the most important coordination variables. And, social coordination is directed both at the actions $\mathbf{x}$ and at the objectives regarding the outcome $\Gamma(\mathbf{x})$ in an indirect way through the norms, values and roles. See figure 2.

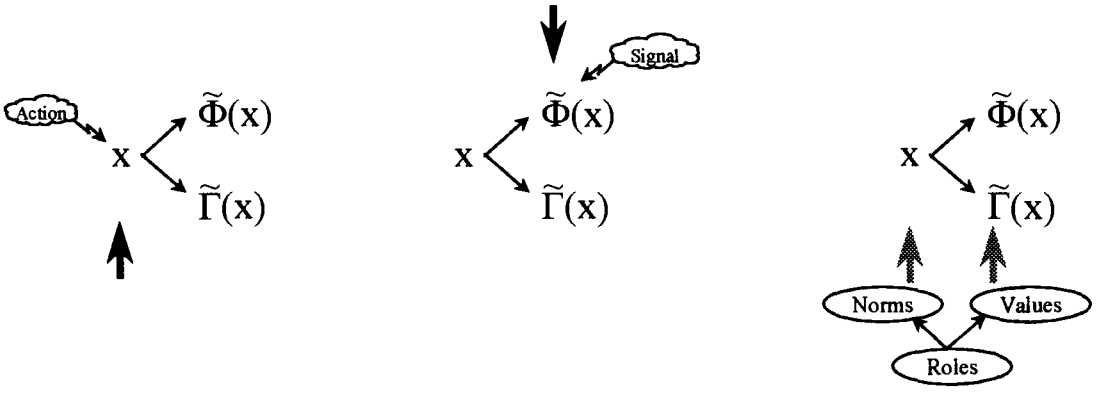

Figure 2.

These differences are important when we are to understand the requirements of each coordination mechanism with respect to management capacity, information structure and social structure (which I discuss in section 4). In particular, figure 2 illustrates that while the central authorities must be in a position to observe actions and some signal on the outcome under authoritative and economic coordination respectively, such information is not needed for the more indirect social coordination (at least not to the same degree). The control is then internal or by the social environment.

The level of *standardisation* is another important coordination dimension (Cyert and March 1963). Focus on the standardisation of behaviour. The framework can then be extended from three to six categories. See figure 3, where I have indicated archetypical mechanisms for each category.[1]

[1] The standardisation of language (March and Simon 1958) and the standardisation of skills (Mintzberg 1983) are not captured directly in this framework, but they can be seen as the result of informal rules. Newcomers will be socialised into the company way of using specific (technical) terms. And there can be a tradition (or a formal rule) for accepting candidates with a specific educational background.

	Authoritative coordination	*Economic coordination*	*Social coordination*
Standardised behaviour	① **Formal rules and routines**	③ **Piece-rate schemes**	⑤ **Informal rules and routines**
Non-standardised behaviour	② **Direct supervision**	④ **Internal markets**	⑥ **Goals**

Figure 3.

Formal rules and routines standardise behaviour under authoritative coordination. If no standardisation takes place, the top management can influence the actions of the units through *direct supervision*. Under economic coordination *piece-rate schemes* can standardise behaviour. Then the output characteristics are decided centrally, and the units (or employees) are compensated with a fixed amount per unit of output they deliver. If the units can decide what products and services to produce and then sell these to internal (or external) customers, the company has created *internal markets*. *Informal rules and routines* are not sanctioned by the top management. Instead they are enforced by peers as social norms or are internalised. When actions are not standardised, *goals* can communicate values that the units and employees are expected to base their decision-making on.

The distinction between standardised and non-standardised behaviour is not always as marked as figure 3 may indicate. Take for instance economic coordination. If the top management through transfer-pricing policies and mandatory deliveries strictly regulate internal markets, the level of standardisation can be very high. And it could instead be appropriate to speak of piece-rate schemes, although aspects of a market are present.

The two coordination mechanisms with internal markets and goals respectively allow a local manager the most freedom. She is then free to choose whatever action she deems best to attain some target. The difference between the two is that under the former she is expected to let the maximisation of some economic variable that is controlled by the central authorities guide her decision, while under the latter she is expected to strive to attain some non-economic goal without any conscious consideration of the economic consequences. The non-economic goal, for instance product quality, customer satisfaction or employee development, is an end in itself, even if it is not monitored closely by the top managers.

Note that if the central authorities do track an individual's or a unit's contribution to the attainment of a goal, they can use the information for authoritative coordination.

And, if they monitor the goal attainment, or some signal on goal attainment (but not necessarily the actions leading to that outcome), they can turn it into a *quasi-economic variable*, even if it is not a natural part of a traditional accounting system. The central authorities must then signal what emphasis they want the goal to have relative to the financial performance, to enable the local decision-makers to consciously weigh the benefits of pursuing the goal (as judged by the central authorities) against the (opportunity) costs. The signalling can take place during the company's performance appraisal process, for example under management practices such as Management by Objectives (Drucker 1954) and Balanced Scorecard (Kaplan and Norton 1996).

To help the reader get a feel of how the six (pure) coordination mechanisms work, I have in figure 4 constructed one (imaginary) statement for each mechanism in the context of a company that manufactures cars. The statements refer to a unit in the company that produces engines. While statements 1 to 4 can be seen as being made by some manager at the headquarters, statements 5 and 6 can be seen as remarks made by a colleague (in the same or in another company unit).

(1) "The production process must meet the requirements in the company handbooks for safety and quality control..."	(3) "The unit will be compensated by X dollars for each engine it produces with the following characteristics..."	(5) "Here at XYZ Inc. we have always used the following engineering technique..."
(2) "In the upcoming period the unit is to prepare for the production of a new engine with the following characteristics..."	(4) "The unit is free to negotiate price, volume and product characteristics with any internal or external customer..."	(6) "Here at XYZ Inc. we strive to build engines that run more quietly than any engine built by a competitor..."

Figure 4.

Observe that the six categories in my framework are related to – but distinctly different from – Mintzberg's (1983) five coordination mechanisms: Direct supervision, Standardisation of work processes, Standardisation of output, Standardisation of skills and Mutual adjustment.[2] The differences between the two approaches reflect Mintzberg's ambition to link coordination mechanisms to ideal organisational types, while I focus on how the coordination mechanisms as such work.

[2] Mintzberg (1998) has later added a sixth coordination mechanism to his framework: "The standardisation of norms."

The framework is consistent with Bradach and Eccles' (1989) observation that price, authority and trust mechanisms are found both in markets and in firms. Although the three mechanisms are not clearly defined in their article, they do seem to roughly correspond to the economic, authoritative and social coordination mechanisms that I have defined here.

3. Motivational bases

In this section I discuss why the actors may choose to behave as expected under the authoritative, economic and social coordination mechanisms. I argue that economic, social and individual factors are important for all the mechanisms, see the overview in figure 5.

	Authoritative coordination	***Economic coordination***	***Social coordination***
Economic factors	• Contracted decision and ownership rights • Laws and legal tradition • Reputation effects • Compensation and promotion policies • Information and expertise	• Incentive contracts • Residual income rights • Compensation and promotion policies	• Reputation effects • Compensation and promotion policies
Social factors	• Norms and role expectations	• Values and role expectations	• Personal relationships and social networks • Corporate culture
Individual factors	• Moral obligations • Identification processes	• Personal recognition • Group pride	• Moral obligations • Identification processes

Rewards

Loyalty/ Identification

Figure 5.

Some of these factors are related to rewards (or punishment), while others are more related to loyalty and identification mechanisms (Simon 1991). As can be seen from the bullet points, some factors are important for several mechanisms. Note that although I discuss a broad range of motivational factors, I do not claim to have covered all the relevant issues.

a) Authoritative coordination

Economic theory often assumes that if an agent is indifferent between two alternative actions, she will choose the alternative favoured by the principal, since she has no incentive to do otherwise. There are, however, much stronger bases for authoritative coordination than that, such as contracted decision rights, ownership rights, laws and

legal traditions, reputation effects, compensation and promotion policies, information asymmetries, expertise, norms, role expectations, moral obligations, and identification processes.

If the parties are able to specify how decisions are to be made, they can contract on *decision rights*. It could be a requirement for unanimity, a voting procedure (if there are more than two parties), or one of the parties could be given unilateral residual control (Grossman and Hart 1986). An employment contract can typically be seen as an example of the latter. Although some rough job description is possible, it is left to the employer to decide the particular tasks an employee is to perform in a given period of time. Detailed planning before hiring is impossible (or too costly), due to uncertainty and long-lasting employment relations.

The right of an employer to decide the tasks of an employee is institutionalised, in the sense that it is regulated by *laws and legal tradition* to protect both the employee and the employer. *Ownership rights* for physical assets are also institutionalised. The owner can control the use of the asset, and, in particular, she can deny other people access to it (Hart and Moore 1990). The government can in general only intervene if the asset is used to harm other people or it affects the environment in a very negative way.

Similarly, owners of a firm have an institutionalised right to make any decision they like with respect to the activities of that firm, as long as contracts, laws and governmental regulations are honoured. Since it is not practical for the owners to make all the decisions in a large company, authority is delegated to managers who again delegate to other managers and employees. However, top management (and ultimately the owners) retain the right to intervene. This is a key distinction between hierarchies and markets, where only a court (or in some special cases the government) can intervene (Williamson 1985).

Simon (1951) argues that for an employee to surrender authority to an employer, she must have some kind of faith or trust that the authority will be used fairly. *Reputation effects* can discipline the employer in two ways. An individual may punish the employer in future periods if she is not treated fairly, for example by resigning. And other employees use publicly known information of such incidents to form their expectations on the company's future behaviour. As unforeseen contingencies tend to follow patterns, the employer can build up a reputation for meeting the contingencies in a certain way (Kreps 1990).

The *compensation and promotion policies* can motivate employees to follow instructions from the top management (Simon 1947). The power of the top management to influence the decisions and the activities of units and employees

depends on their ability and willingness to reward observed behaviour that is consistent with the central decisions and guidelines (and punish other behaviour).

Information asymmetries and *expertise* can both strengthen and weaken the real authority. It is rational for an employee to follow decisions and guidelines from the top management if they are perceived to have richer information (better overview or sources) or stronger data-analysis and decision-making capabilities, as long as the resulting actions are expected to be mutually beneficial. On the other hand, centralised formal authority has little value if the units have better information and expertise (Aghion and Tirole 1997).

Norms and *role expectations* formed through social interaction are important social bases (and constraints) of authority (Scott 1998). When it is socially accepted and expected that a person or unit should follow central decisions, such behaviour is enforced locally by peers.

A sense of duty or internalised *moral obligation* to follow (or not follow) commands can be important on a more personal level. The employee can also *identity* herself with the superior or the organisation and its goals (Simon 1991). The employee may want to be like the superior, or sees herself as the same type of person. If she even takes on the values and interests of the superior (or the organisation), then there is no reason why she should not follow the superior's directions, if the coordination achieved thereby is believed to further those interests (Coleman 1990).[3]

Finally, note that the existence of authority will lead to power-seeking behaviour and influence activities (Milgrom and Roberts 1988). Individuals spend resources to position themselves politically and influence decision-makers to choose alternatives that are favourable to them. It can be rational to introduce inflexible bureaucratic rules and restrictions to reduce the costs of influence activities.

b) Economic coordination

Ever since Adam Smith discussed the invisible hand of markets more than two hundred years ago, economists have praised the virtues of the price system to coordinate activities and allocate resources. As firms in the 20th century have grown larger and more complex, it has become increasingly popular to use aspects of the price system for coordination purposes also within a company. The decentralised decision-making is then guided by the maximisation of some economic variable, for

[3] Barnard (1938) discussed aspects of social norms, moral responsibilities and identity processes with respect to authority in organisations. French and Raven (1959) argued that internalised norms or values are important for legitimate power and that identification is a basis for so-called referent power.

example a unit's profits, which is observed centrally. Many factors can be important for why managers and other employees choose to maximise a particular function of economic variables. In this section I discuss the role of incentive contracts, residual income rights, compensation and promotion policies, values, role expectations, personal recognition and group pride.

To offer an explicit *incentive contract* is the most direct way to encourage economic maximisation. The contract must be based on signals that are observed by both the principal and the agent. For the contract to be enforced by for example a court, the variable must be verifiable also to this third party. A large portion of the economic theory on organisations over the last 30 years has focused on how such incentive contracts should be structured under information asymmetry.

In the adverse selection part of the literature – where information about an agent's type is hidden from the principal – the principal typically trades off production efficiency (so that a not so efficient type does not produce first-best quantities) against information rents (that are obtained by the efficient type). Under moral hazard – when the agent's actions are hidden – the principal trades off risk-bearing costs against incentive strength. In the real world one must also trade off costly monitoring on the one hand against the aggregate information rents, production inefficiencies and risk-bearing costs on the other.

If a unit has the right to control a (large) share of it's residual income, it can use that money to for example increase salaries and wages, improve work environment, arrange grander Christmas parties and invest in the unit's future, to secure jobs and more interesting work in years to come. *Residual income rights* can thus induce strong incentives for both managers and employees to maximise the unit's profits, even though these rights are not in the traditional individualised sense (as for an entrepreneur in the market place), and there is a certain risk that the top management may intervene to take (some of) the residual income away from the unit.

While incentive contracts link compensation directly to economic variables, there are also more indirect (or subtle) mechanisms to the same effect associated with the company's *compensation and promotion policies*. In some organisations an increase in profits is expected to raise the level of (non-contracted) bonuses, wages and salaries. Such expectations can be based on company traditions or promises from executives.

And, a unit's relative performance can be expected to affect promotion decisions. A successful unit manager is likely to be promoted upwards in the organisation, leaving room for other promotions within the unit. And lower-level managers and experts are promoted to positions in other units to boost the performance there too. The link

between performance and promotions can be formally established in company policy papers, but expectations are most likely to be based on how previous promotions are perceived to reflect the relative success in terms of the relevant economic variable. Aspects of these more indirect motivation mechanisms have been captured in the economic tournament literature (Lazear and Rosen 1981).

There can also be social pressures to maximise economic variables, when it is socially accepted that those are the right *values* to pursue for the company and its employees. In particular there can be the expectation that an individual who occupies a management position (as a *role*) has a special responsibility to maximise the economic result of the unit she leads. These social pressures for economic maximisation stem then not only from superiors, but also from peers and subordinates in the organisation (or even from people outside the firm).

The social mechanisms are linked to the fundamental need of human beings for *personal recognition* (Barnard 1938). This recognition can of course be accompanied by (or signalled through) monetary rewards, but it can also be purely social or psychological in nature. If it is perceived that the recognition (or prestige) is linked to the performance of an economic variable, then this will in itself motivate the individual to contribute to the maximisation of that variable.

Even if an individual does not profit in any of the above ways when the unit's economic performance is improved, there is a certain satisfaction associated with being a member of a successful group (due to identification mechanisms). As in sports, an individual takes pride in the group's performance (Simon 1991). In fact, *group pride* can be important for an individual even if she herself does not contribute to the result, but it should be even more important if she feels that her actions have a positive impact.

In other words, an individual can be motivated to maximise an economic variable not only by economic incentives – but also by social or internal pressure. In either case, the central authorities can predict the local behaviour and observe the result (although the information may be in aggregated form). And, if the results are not satisfactory, a central manager can intervene; for example by changing the rules of the games under which the economic maximisation is performed or by investigating the matter in more detail to enable authoritative coordination.

c) Social coordination

Finally, consider social coordination, which takes place through norms and values. Since Barnard (1938), these social mechanisms are generally accepted to be very important for actual human behaviour in organisations (although they have been

ignored in most economic literature). Some of the factors that influence how social coordination works are reputation effects, compensation and promotion policies, personal relationships, social networks, corporate culture, moral obligations and identification processes.

First, note that individuals sometimes follow norms (or pursue certain values) simply because that saves them spending time evaluating the options at hand in a more thorough way (March and Olsen 1976). Or [illegible] and then they may not even think that there are any other alternatives, as the norms (or values) are the only alternatives that come to mind at the time of decision.

Next, consider a situation where the individual more consciously evaluates alternative options for actions, in a setting with a given set of norms, values and role expectations. Economic theory can then help explain why the individual may choose to adhere to these "regulations," instead of pursuing activities which may seem more tempting from a personal perspective, at least in the short run. As Coleman (1990) points out, a person will take into account potential accompanying rewards or punishments as elements when she decides which action it will be in her interest to carry out. The rewards and punishments can be economic or more social in nature (for example in the form of social acceptance). Economic models of *reputation effects* can then illuminate some of the trade-offs involved.

Because the central authorities tend not to observe directly whether a manager follows a certain norm or value, she cannot use rewards (or punishments) extensively to motivate (or discourage) such behaviour. However, a salary raise or a promotion will sometimes be contingent on how well you are liked by your colleagues, which in itself may be an indicator of how closely you conform to (positive) norms and values. So, indirectly, the *compensation and promotion policies* may, in fact, have an impact also on an individual's attitudes to the norms and values that are communicated to her by her colleagues.

Financial rewards and promotions can further be used to develop values and norms that are considered important by the top management. If a central manager happens to learn of an incidence that can be used as an example of a norm that should be encouraged, she can reward the person to signal that the behaviour should be considered socially desirable.

Recent developments in evolutionary economics can cast some light on aspects of the process by which functional social norms (and values) develop. But norms, values

and role expectations that do not appear to be efficient in an economic sense do develop as well (Elster 1989).[4]

If an individual truly believes that the norms, values and role expectations are right, there is no need for external pressure. *Moral obligations* are such internalised beliefs that can support norms and values. An individual may feel compelled to do the right thing (as seen by the group) on moral grounds, although she is tempted to do otherwise out of personal interest or pleasure-seeking (Etzioni 1988). Such thinking can either be a form of true altruism or a question of inner personal satisfaction from acting in the interest of others.[5] Moral obligations can on the other hand limit the potential for coordination, if individuals have strong opinions on what they should aim for or do and those do not correspond to the group's values and norms.

An individual's behaviour can also be strongly influenced by *identification* mechanisms. If a manager or employee identify with the top management or the organisation's objectives (or its survival), she will try to act in their interest, which she perceives as being in her interest as well (Simon 1947). Then no coordination is necessary, if the individual has the necessary information and expertise to make the right decisions.

Similarly, *personal relationships* lead to behaviour consistent with the interests of the friend without a need of monitoring, but it does on the other hand also lead to forgiving behaviour in a discrete sense (Williamson 1993). That is, in such a relationship you either fully trust and believe in your friend or you give her up completely.

More extended *social networks* are also important. Because an individual is usually a member of several social groups within and across organisational boundaries (e.g. work groups, unions, professional associations, political and humanitarian organisations and friends) and identify herself with these (March and Simon 1958), her behaviour is likely to reflect a patchwork of norms and values. It can hence be very difficult to predict.

Some organisations are, however, characterised by strong *corporate cultures* (Deal and Kennedy 1982, Peters and Waterman 1982). The norms, values and role expectations within the organisation are then significantly different from those in the outside society, and the actual behaviour is easier to predict. But there can also be

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[4] In fact, norms and values may develop to justify and defend a certain pattern of behaviour that is already established by some individuals in the group, although that behaviour does not appear to be (rationally) desirable from a social point of view.

[5] Coleman (1990) argues that an individual will feel internally generated rewards (or punishments) as a result of conforming to (or not conforming to) an internalised norm.

pockets of very different cultures within the same corporation. The marketing and manufacturing departments have, for instance, difficulties communicating in many companies, due to the backgrounds of the employees and the differing interests of the departments.

Norms and values are formed through complex and unpredictable social processes, which scholars and practitioners have not been very successful at understanding and describing. But it seems clear that values, norms and role expectations can be influenced by the top management and used for coordination purposes (Barnard 1938, Peters and Waterman 1982), although the central control of these mechanisms is limited. For example can strategy formulations, storytelling, the hailing of heroes and other types of formal and informal communications support the development of common goals as social values in an organisation.

4. Coordination mechanisms requirements

Consider the six coordination mechanisms I have suggested: Formal rules and routines, Direct supervision, Piece-rate schemes, Internal markets, Informal rules and routines and Goals. In this section I argue that these mechanisms have different requirements with respect to management capacity, information structure, social structure and frequency.

Central *management capacity* (including information processing capabilities and expertise) is important under the centralised coordination mechanisms, in particular under direct supervision because each decision may then demand some new knowledge and understanding. But central management capacity is also important for the design of formal rules and routines. Certainly, local resources can be used, but the central authorities must nevertheless understand the rules and routines and their consequences before they are approved or modified. Otherwise, centralisation has no value. Decentralised mechanisms, on the other hand, require more local management capacity, so that the local managers are capable of successfully making decisions without the direct guidance from central authorities.

Economic coordination mechanisms require a certain *information structure*. Both parties must be able to observe some output measure for piece-rate schemes to make sense. The closer this measure is related to the actual actions of the employees, the better. Piece-rate schemes are less attractive when uncertain outside variables are expected to impact the signal on output to such a degree that it becomes more a question of luck than a result of the unit's effort and abilities. Similarly, internal markets require relevant signals on the outcome, e.g. the unit's profits. It must be

possible to price transfers between the units, so that the signals reflect the actual performance of each unit.

The information structure is also important for authoritative coordination mechanisms. The central authorities cannot effectively direct activities throughout the organisation unless they can observe actions and outcome. This is necessary for a central manager to develop an understanding of the causal relations, issue the right instructions and control local behaviour.

Social mechanisms, on the other hand, require a *social structure*. There has to be an appropriate social network in place that facilitates social interactions, where values and norms are developed, communicated and enforced. This social structure can to some degree be supported and regulated by the top management through personal participation and more impersonal communication channels. It is, however, a kind of social capital (Coleman 1990) that takes time to develop. The choice of coordination mechanisms in the short run is, therefore, constrained by the existing social structure.

Finally, standardisation can only be of value if the activities have a certain regularity or *frequency*. Otherwise, the costs of establishing rules, routines or piece-rate schemes become too high compared to the efficiency gains. The costs include both the actual process costs and the opportunity costs from inflexibility that automatically follows standardised behaviour.

These requirements are summarised in figure 6 for the six coordination mechanisms.

Coordination mechanism	**Critical management capacity**	**Critical structure**	**Required frequency**
1. Formal rules and routines	Central	Information	High
2. Direct supervision	Central	Information	
3. Piece-rate schemes	Local	Information	High
4. Internal markets	Local	Information	
5. Informal rules and routines	Local	Social	High
6. Goals	Local	Social	

Figure 6.

Note that although only central management capacity is listed as critical for authoritative mechanisms, some local capacity is also necessary, as employees must be capable of informing the central authorities before decisions are made and then be able to carry out the instructions according to the intentions. Similarly, some central

management capacity is needed to guide decentralised coordination mechanisms. Further, a favourable information structure will help the central authorities to understand how the social mechanisms work, while a strong social structure can support authoritative and economic coordination mechanisms.

5. Corporate coordination objectives

In section 4 I argued that the information structure is very important for some coordination mechanisms. It is therefore interesting to search for classes of business activities with different information characteristics. I distinguish between production activities (to achieve operational efficiency), sales and marketing activities (to attain a competitive market position) and competence-building activities (to develop capabilities).

Production activities are in many organisations relatively easy to monitor and to understand for the management. Authoritative coordination mechanisms can then be used. Often there are also good measurements (signals) available for outcome, where outcome is understood in production terms (output). Economic mechanisms can therefore be attractive, unless important tasks are not captured in the measurements and hence will be ignored (Holmstrom and Milgrom 1991). Norms, values and role expectations (for instance in the form of informal rules and routines) can also be (cost) effective, taking advantage of peer enforcement and little need of direct involvement from the (top) management.

Sales and marketing activities are less suitable for an extensive use of authoritative coordination, if the activities are difficult to monitor directly (as they take place outside the organisation's premises) or the causal effects between actions and wanted outcome are hard to judge for management who lack local knowledge. It may then be very difficult (or costly) for central managers to specify the right responses to specific situations. On the other hand, many important dimensions of outcome are often easily observable (e.g. sales figures), favouring economic coordination. Social mechanisms are of course also important, as can be seen from the way companies run training programmes and conferences for sales and marketing employees.

Competence-building activities are the most difficult to manage, because the actions, such as investments in human and social capital, are not easily observable, and there are few reliable signals on outcome. The causal effects are complex and difficult to understand, and the effects are long-term in nature. Social coordination mechanisms tend therefore to be more important for how capabilities are developed in an organisation than authoritative and economic coordination mechanisms.

We then have the following structure. Authoritative, economic and social mechanisms are used to coordinate the production activities, the sales and marketing activities and the competence-building activities. These three categories of activities correspond to coordination objectives of operational efficiency, market position and capabilities respectively. See figure 7. The links drawn with a solid line indicate what coordination mechanisms that, following the above discussion, seem best suited for the relevant coordination objective.

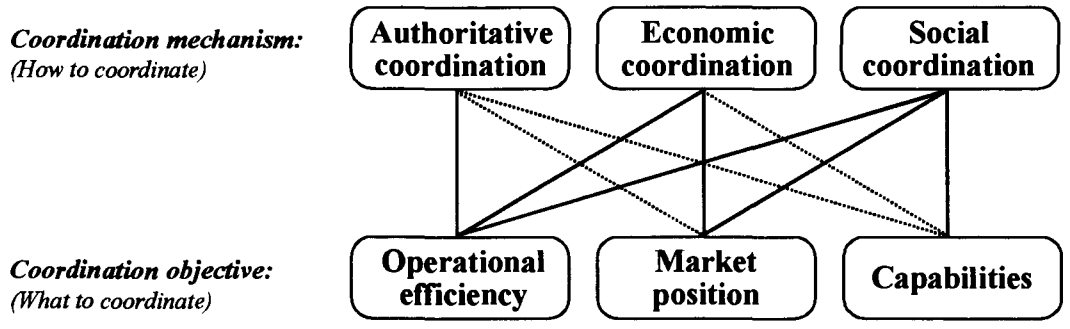

Figure 7.

Major strategic decisions tend to fall outside the framework, since they usually affect all the three coordination objectives at the same time. The decision to develop and introduce a new product is a good example. Such a move can improve the utilisation of (existing) production capacity, change market shares and other market position criteria, and develop competencies that can help similar processes in the future.

Strategic decisions may have significant impact across organisational units and they can often be formulated as discrete alternatives. A centralised decision process (authority) is therefore attractive. Some strategic decisions are even so left to the units, to take advantage of local knowledge and resulting motivational effects. They can then either be guided by economic mechanisms (if also long-term effects are taken into account) or by social mechanisms (if there is a general agreement on what the overall objectives are in the organisation).

6. Corporate coordination costs

The above discussion indicates that the coordination mechanisms differ with respect to costs. In this section I define three classes of corporate coordination costs: Design costs, Implementation costs and Coordination failure costs.

Design costs include the resources needed to understand and design a mechanism and then to predict the actual outcome of it. Since authoritative mechanisms are direct in nature, they seem to have lower such costs than economic mechanisms, where

coordination takes place through signals on outcome (which seldom fully reflect the actual actions). Social mechanisms are generally even more difficult to understand, since norms, values and roles are formed through complex social interactions, where the top managers are only a few of many actors and there are many interactions of importance where they do not take part.

Implementation costs are the resources needed to actually run the coordination mechanism, including the costs of motivating the employees. While authoritative coordination may imply the lowest design costs, it seems to imply the highest top management costs in the implementation process. Due to its centralised nature there is a strong need for top management information search, processing and communication. To ensure expected behaviour the management may have to also engage in extensive activities to monitor subordinates and to set punishments and rewards that correspond to how units and employees have adhered to central decisions and guidelines.

The top management can usually maintain economic mechanisms with less ongoing effort, since they are more decentralised in nature. Communication and duplicate information processing costs are saved. But there are also certain kinds of activities where economic mechanisms would demand more information exchange than authority. Activities that must be synchronised or can be assigned to only one individual or unit are examples where delays and duplications of effort make economic mechanisms unattractive (Milgrom and Roberts 1992).

Economic coordination requires highly skilled unit employees, as they must understand the causal effects between actions and signals. The local responsibilities are greater, and compensations may therefore need to be higher than under authority. Risk aversion can strengthen this effect, if monetary incentives are necessary to motivate economic optimisation.

At surface value social mechanisms may appear to have the lowest implementation costs, as the top management no longer need to follow up economic signals and manage incentive systems. However, this is not necessarily the case. The management must continuously communicate and reinforce norms, values and roles if they are to influence how these develop over time. Mechanism-maintenance costs can therefore be significant, although peer enforcement reduces the direct control costs. As for economic mechanisms, there is a need of highly competent individuals in the units, due to the decentralised decision-making.

Coordination failure costs are the opportunity costs associated with the consequences of failed coordination. Sub-optimisation, multitask problems and a

lack of information, knowledge and expertise (centrally or locally) are relevant problems.

Problems of sub-optimisation and multitasking can theoretically be avoided with centralised decision-making (authority), with the central authorities taking all the relevant issues into account. But, if the central authorities lack important knowledge or understanding of local affairs, centralisation can lead to very inefficient decisions and guidelines. Remember also the constraints set by the high top-management implementation costs of authoritative coordination mechanisms.

Under economic coordination a manager will usually have a special interest in the profits of the unit she leads. Economic mechanisms tend therefore to encourage some degree of sub-optimisation, leading a manager to ignore the interests of other units. On the other hand, a unit manager may very well have much richer information about the impact of decisions and actions across unit borders than the top management in a setting where the sub-units cooperate or trade extensively. Then the units may be in a good position to negotiate joint-surplus-maximising agreements (at some costs).

Multitask problems (within a unit) will also limit the usefulness of economic mechanisms (Holmstrom and Milgrom 1991). When important dimensions of the outcome (for instance maintenance standards and customer loyalty) are not included in the signals, economic mechanisms can do more harm (taking the focus of the employee away from important tasks) than good (motivating the employee to a high effort level on certain tasks). But even if the signals do incorporate all the important dimensions of the outcome, the local managers and employees may not have a sufficient understanding of the causal relations to find the right actions.

Due to their decentralised nature social mechanisms have many of the same problems as economic mechanisms with respect to sub-optimisation, as values may take into account local interests only. Multitask problems arise if norms do not imply work on important tasks or values lack focus on important dimensions. And, even if the values do incorporate the desired dimensions, the causal effects are not always known by the local decision-makers.

The respective magnitudes of design, implementation and coordination failure costs depend crucially on the organisation's properties (including its human and social capital) and the coordination demands of the organisation with respect to the coordination objectives (which again depend on the environment).

7. Systems of coordination mechanisms

Coordination mechanisms interact to guide activities and decision-making. The use of authority can change the norms and values of an organisation, so that activities not directly affected by the instructions are influenced as well, albeit in an indirect way. The use of authority will further limit the freedom of the units to maximise the economic variables, and it may change behaviour when units anticipate interventions. Focus on economic variables can similarly affect the norms and values, influencing decisions that are not expected to have an economic impact. It may also affect how enthusiastic and wholehearted units and employees are in fulfilling central guidelines and decisions.[6] Finally, norms and values will influence how individuals react to economic and authoritative coordination, supporting or limiting the effectiveness depending on whether they are aligned or not.

Due to this interactive nature of the coordination mechanisms, and the fact that all the three coordination mechanisms tend to be used in any given organisation (Bradach and Eccles 1989), it seems appropriate to speak of *systems of coordination mechanisms*. When we try to explain actual behaviour, we must take into account that a specific action can be the result of several coordination mechanisms. And, even though a particular action is decided entirely by one mechanism, the way that mechanism actually operates can have been influenced by how other mechanisms have worked in the past.

Path-dependence is another important characteristic of coordination mechanisms. Social bases of authoritative, economic and social coordination tend to develop slowly, as they are the accumulated result of social interactions over time. But also economic bases of the coordination mechanisms need time to develop. Reputation effects are by nature the result of historic events, and individuals need time to understand how for instance incentive contracts, promotion policies and sanction processes work to adapt to them.

Social mechanisms are particularly path-dependent, since the coordination takes place indirectly through norms, values and role expectations that in general need a long time to develop. A specific episode can occasionally have a large impact, however, especially if it challenges norms or values that previously were taken for granted.

The interactive and path-dependent nature of coordination mechanisms has important implications for the design of the system of coordination mechanisms. The special

[6] The trade-off between intrinsic and extrinsic motivation is a related discussion. Several studies show that extrinsic rewards and surveillance can damage the intrinsic motivation and commitment, due to altered self-perception and rationalisation of behaviour (Pfeffer 1997).

needs of one coordination objective may dominate the needs of other objectives at a particular point in time. And the use of coordination mechanisms tends to change over time as the coordination needs and the characteristics of an organisation and its environment develop.

8. Concluding remarks

In this essay I have suggested a framework for corporate coordination. Although I have tried to structure the most important issues along some simple dimensions, I have also demonstrated how complex corporate coordination really is. Economic and social mechanisms interact to influence the actual behaviour both under centralised and decentralised coordination mechanisms. Existing economic theory can only to a very limited degree describe and explain what is going on. To achieve empirical relevance, it is necessary to relate future research of corporate coordination to a more holistic view.

Throughout my discussion I have conveyed a view that conscious corporate coordination is possible. With that I do not mean that the top management can fully control the decision processes throughout the organisation, but I do believe that they can actively *influence* them.[7] I do acknowledge, however, that decision processes are ambiguous (March and Olsen 1976), that social norms can arise by accident (Elster 1989) and that survival (Nelson and Winter 1982), legitimacy (Parsons 1960) and power struggles (Pfeffer 1981) are important motivational factors for actual organisational behaviour.

I have deliberately not tried to link the coordination mechanisms to ideal organisational types. As I see it, in the same way that elements of structure are often decoupled from the organisation's activities (Meyer and Rowan 1977), the formal structure of a modern corporation is only loosely linked to what coordination mechanisms that, in fact, influence the actual behaviour. Therefore, I find it more useful to focus directly on the coordination mechanisms, with the freedom such an approach gives to define the mechanisms in a logically consistent way that is well suited to discuss their characteristics, requirements and costs.

However, that is not to say that structure and other organisation design parameters do not interact with the different coordination mechanisms. For instance will the number of management levels in the organisation affect the actual level of decentralisation, and the grouping of activities and people will influence how norms

[7] This view is also reflected in the strategy literature, with its focus on the active role of central authorities in large corporations, see for example Porter (1987) and Goold, Campbell and Alexander (1994).

and values develop and how economic variables are calculated and aggregated. The top management can deliberately use design strategies to improve the organisation's ability to coordinate its activities (Galbraith 1973) or reduce its coordination costs (Thompson 1967).

I have in this essay focused on coordination inside a single corporation. Significant coordination activities take place also between independent firms. Most of my discussions, and the framework as such, are relevant also for these activities. My limited focus was motivated by the way it would ease the exposition.[8]

[8] Grandori and Soda (1995) and Grandori (1997) discuss some special characteristics of inter-firm coordination.

ESSAY II

Asset ownership and risk aversion

I suggest a model for two managers/owners and two assets, where the optimal allocation of ownership rights is jointly determined by the parties' risk aversion and the specificity of their investments. The managers are motivated by both verifiable and non-contractible benefits. The most risk averse manager should own at least one of the two assets, if the risk-bearing costs associated with the non-contractible benefits are low compared to the risk-bearing costs associated with the verifiable benefits. There is a tendency for integration to dominate non-integration when the two managers have very different risk preferences. Third-party participation can reduce the total risk-bearing costs or can strengthen the incentives to invest. In one interpretation of the model, the two managers are seen as two companies with complementary competencies who do a joint venture.

1. Introduction

Williamson (1975, 1985) and Klein, Crawford and Alchian (1978) observed that specific investments can play an important role to determine optimal asset ownership. Building on this idea, Grossman and Hart (1986) and Hart and Moore (1990) have suggested formal models to show the benefits and costs of integration with respect to the hold-up problem. Risk aversion was ignored in these and in most other papers on property rights.

The classical trade-off found in the moral hazard literature between incentives and risk sharing can, however, also add insights to the ownership question. If the investments are one-sided, the trade-off is straightforward. The party who makes the specific investment should be the sole owner of the asset, unless the risk-bearing costs then are prohibitive high (Holmstrom and Milgrom 1991, Hanson 1995).[1]

[1] Holmstrom and Milgrom (1991) consider a classical principal-agent relationship, where the risk averse agent (e.g. a sales representative) invests in a relationship-specific asset (e.g. goodwill). Hanson (1995) studies manufacturers in a developing country (Mexico) who divide asset ownership

Following Grossman-Hart-Moore I assume that there are two parties who *both* make asset- and relationship-specific investments. I let these investments result in non-contractible and verifiable benefits, which often is the case when companies do joint projects. The formal model combines a linear form of the asset-specificity technology found in Hart (1995) with a linear moral hazard model (Holmstrom and Milgrom 1987). Multitask effects are suppressed.[2] In this setting it is not obvious who should own the assets, since both the relative investment specificity and the relative risk aversion of the two managers must be considered.

In fact, counter to intuition, I show that it can be optimal for the *most* risk averse manager to own all the assets, if the risk-bearing costs associated with the non-contractible benefits are moderate compared to those associated with the verifiable benefits. The most risk averse manager then receives a large share of the not so risky non-contractible benefits, while the other manager is motivated by a larger share of the more risky verifiable profit stream through an explicit contract. This way, both managers can enjoy a reasonable incentive strength, while the total risk-bearing costs are minimised.

Further, I show that integration is more likely to dominate non-integration when the managers have very different risk preferences. Then the risk-bearing costs of the most risk averse manager are very sensitive to transfers of ownership rights. Therefore, if it is good for her to own assets, she should own them all. But if it is very costly for her to own assets, she should not own any.

I also investigate how a third party can break the budget-balancing constraint. If she plays the role of a traditional investor, she buys a right to a certain percentage of the verifiable profits. Then the total risk-bearing costs are reduced, but so are the incentives. The third party could instead be paid *ex ante* to gear up the investments of the two managers. The resulting improved incentives from the verifiable profits must be weighed against the increased total risk-bearing costs.

Although the model can be given a more traditional vertical integration interpretation, I suggest that it can be seen as reflecting two companies with complementary competencies doing a joint project. In addition to the work done by the project organisation (a joint venture), the project requires substantial effort by managers and experts within the two parent companies. The model can then be used to study how

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between themselves and subcontractors to share natural risk (although only the manufacturers make specific investments).

[2] Holmstrom and Milgrom (1991, 1994) also include both verifiable and private benefits, but they only model one-sided investments. Further, they do not explicitly include an asset-specificity technology. Finally, they study a multitask environment, while I let the parties perform only one task each. Another interesting model that combines a linear moral hazard approach and the allocation of decision rights is found in Holmstrom and Tirole's (1991) article on transfer pricing.

the parent companies can be motivated by verifiable project profits and future benefits from new opportunities that they expect to discover. The latter (non-contractible) benefits are to some degree relationship- and asset-specific.

The essay proceeds as follows. I develop the model in section 2. In section 3 I discuss the interpretation of the model. Then, in section 4, the different ownership structures are compared. In section 5 I illustrate the results with a numerical example. The role of a third party is examined in section 6. Finally, in section 7 I make some concluding remarks.

2. The model

There are two assets and two productive parties, manager 1 and manager 2. At $t = 0$ the managers make unverifiable investments in human capital (e_1 and e_2). The effort levels determine two types of benefits at $t = 1$.

First, each productive manager has an uncertain non-contractible benefit, which is observable to manager 1 and 2 at $t = 1$ but not verifiable to third parties. This benefit is dependent upon whether the two parties choose to cooperate or not at $t = 1$. Cooperation cannot be verified. In the case of no cooperation, the benefit will further depend on the ownership structure.

Define asset ownership as the right to deny others access to the asset (Hart and Moore 1990). Consider three ownership structures. Either manager 1 owns both assets (which, following Hart (1995), I call Type 1 integration - T1), manager 2 owns both assets (Type 2 integration - T2), or each manager owns the asset most specific to her own investments (Non-integration - NI).

Assume independent technologies that are linear in an agent's effort e_i ($i \in \{1,2\}$). If the two managers choose to cooperate, their non-contractible benefits are given by

$$\Gamma_1 = e_1 + \varepsilon_1$$

$$\Gamma_2 = e_2 + \varepsilon_2$$

where $e_i \geq 0$, $E[\varepsilon_i] = 0$, $Var[\varepsilon_i] = \sigma_i^2$ Manager 1's benefits depend only on manager 1's effort and an uncertain error term (which may be correlated with the error term of the other manager's benefit function).[3] In the more general case, Γ_i could be a function of both the two managers' effort levels.

[3] Observe that the variances are not affected by the effort levels of the two managers. Choate and Maser (1992) have shown (in a setting without explicit contracts) that risk aversion tends to augment the importance of asset specificity when risk-bearing costs increase with effort levels.

Second, there is an uncertain verifiable profit stream that the managers can contract on. Both the productive managers are risk averse, so the optimal contract must trade off incentives and risk-sharing considerations. In the tradition of Holmstrom and Milgrom (1987, 1991) I assume that contracts are restricted to be linear in profits.

The managers' shares of the profit stream Π are

$$\pi_1 = a\Pi + t_1$$

$$\pi_2 = b\Pi + t_2,$$

where a, b, t_1 and t_2 are constants. Assume for now that there is no third party to break the budget balancing constraint, so that $b = 1 - a$ and $t_1 + t_2 = 0$.

The verifiable benefits are assumed to have similar technologies as the non-contractible.

$$\Pi = \zeta_1 e_1 + \zeta_2 e_2 + \varepsilon_3$$

where ζ_1 and ζ_2 are positive constants, $E[\varepsilon_3] = 0$ and $Var[\varepsilon_3] = \sigma_3^2$. In other words, there is a linear relation between the verifiable profits and the non-contractible benefits. This is obviously a special case, but it is not clear whether the relation should be convex or concave, if it was not to be linear in nature. Note that although the value added of each manager can be technologically separated, the managers can contract on an aggregated measure only.[4]

Assume that the benefits enter a manager's utility function in an additive way, and define $\theta_i^C \equiv \Gamma_i + \pi_i$ as a manager's total benefits at $t = 1$ when cooperation takes place. If the two parties choose not to cooperate, their total benefits are reduced to

$$\theta_1^{NC} \equiv \gamma_k \Gamma_1 + \pi_1$$

$$\theta_2^{NC} \equiv \lambda_k \Gamma_2 + \pi_2$$

where γ_k, $\lambda_k \in [0,1)$ are constants that depend on the ownership structure $k \in K \equiv \{T1, T2, NI\}$. This assumption is fairly strong in the sense that total and marginal benefits move together. That does not necessarily need to be the case, but it is consistent with Hart and Moore (1990) and Hart (1995).[5]

The formulation of investment specificity is valid only for non-negative non-contractible benefits. I restrict my attention to that case. With the quadratic cost

[4] The results do not change qualitatively when there are two profit streams (or signals) available for contracting.

[5] The verifiable profits could also depend on whether cooperation takes place or not, but this complication would not add any significant new insights.

function that I will use, $\varepsilon_1, \varepsilon_2 \geq -\frac{1}{2}$ is a sufficient condition for non-negative benefits, as the investments (e_1 and e_2) then always will be larger than ½.[6]

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.[7] The two managers are assumed to have mean-variance preferences, maximising utility functions of the following additive form[8]

$$U_1 = E\left[\tfrac{1}{2}(\theta_1^{C}+\theta_2^{C}) + \tfrac{1}{2}(\theta_1^{NC}-\theta_2^{NC})\right] - \tfrac{1}{2} r_1 \operatorname{Var}\left[\tfrac{1}{2}(\theta_1^{C}+\theta_2^{C}) + \tfrac{1}{2}(\theta_1^{NC}-\theta_2^{NC})\right] - c_1(e_1)$$

$$U_2 = E\left[\tfrac{1}{2}(\theta_2^{C}+\theta_1^{C}) + \tfrac{1}{2}(\theta_2^{NC}-\theta_1^{NC})\right] - \tfrac{1}{2} r_2 \operatorname{Var}\left[\tfrac{1}{2}(\theta_2^{C}+\theta_1^{C}) + \tfrac{1}{2}(\theta_2^{NC}-\theta_1^{NC})\right] - c_2(e_2)$$

where $r_i > 0$ denotes manager i's risk aversion and $c_i(e_i)$ her private costs. Assume $c_i'(e_i) > 0$ and $c_i''(e_i) > 0$.

Define $\varphi_k \equiv \frac{1}{2}(1+\gamma_k)$ and $\psi_k \equiv \frac{1}{2}(1+\lambda_k)$, which can be interpreted as the two managers' respective bargaining positions. Leaving out the index k and the terms that are unaffected by e_1 and e_2 respectively, the maximisation problems of the two managers (for a given ownership structure and profit sharing contract) then simplify to

$$e_1 = \underset{e_1}{\operatorname{Argmax}}\, U_1 = \underset{e_1}{\operatorname{Argmax}} \{ \varphi e_1 + a \zeta_1 e_1 - c_1(e_1) \}$$

$$e_2 = \underset{e_2}{\operatorname{Argmax}}\, U_2 = \underset{e_2}{\operatorname{Argmax}} \{ \psi e_2 + (1-a) \zeta_2 e_2 - c_2(e_2) \}$$

with first-order conditions

(1a) $c_1'(e_1) = \varphi + a \zeta_1$

(1b) $c_2'(e_2) = \psi + (1-a) \zeta_2$

The managers' reaction functions $e_1(a)$ and $e_2(a)$ are implied by these conditions. Differentiate both sides of equations (1a) and (1b) with respect to a to find the marginal reaction functions

(2a) $$\frac{d e_1}{d a} = \frac{\zeta_1}{c_1''(e_1)}$$

---

[6] The bounds on the error terms can be made less restrictive by including positive fixed terms in the functions for Γ_1 and Γ_2. These fixed terms could then be interpreted as benefits generated by the project organisation without the aid of the parent companies.

[7] Assume that the managers cannot commit not to renegotiate, so that a message game cannot improve the incentives when there is a high degree of uncertainty with respect to the *ex-post* choice of activity or product (Hart and Moore 1999).

[8] When the error terms are close to have a normal distribution (although the lower tail is cut off), the preferences approximate negative exponential utility functions.

$$(2b)\quad \frac{de_2}{da} = -\frac{\zeta_2}{c_2''(e_2)}$$

For a given ownership structure, optimal incentives are found by maximising the expected joint surplus Ω, which, allowing for correlation between all the three error terms, is given by

$$(3)\ \Omega(a) = (1+\zeta_1)\,e_1(a) + (1+\zeta_2)\,e_2(a) - c_1(e_1(a)) - c_2(e_2(a))$$
$$- \tfrac{1}{2} r_1 [\varphi^2\sigma_1^2 + (1-\psi)^2\sigma_2^2 + a^2\sigma_3^2 + 2\varphi(1-\psi)\sigma_{12} + 2\varphi a\sigma_{13} + 2(1-\psi)a\sigma_{23}]$$
$$- \tfrac{1}{2} r_2 [(1-\varphi)^2\sigma_1^2 + \psi^2\sigma_2^2 + (1-a)^2\sigma_3^2 + 2(1-\varphi)\psi\sigma_{12} + 2(1-\varphi)(1-a)\sigma_{13} + 2\psi(1-a)\sigma_{23}]$$

where σ_{ij} denotes the covariance between two error terms ($i, j \in \{1, 2, 3\}$, $i \neq j$). After finding the first-order condition with respect to a, use (1) and (2) to solve for the optimal incentives

$$(4)\quad a^* = \frac{\frac{\zeta_1}{c_1''}(\zeta_1 + 1 - \varphi) - \frac{\zeta_2}{c_2''}(1-\psi) + r_2\left(\sigma_3^2 + (1-\varphi)\sigma_{13} + \psi\sigma_{23}\right) - r_1(\varphi\sigma_{13} + (1-\psi)\sigma_{23})}{\frac{\zeta_1^2}{c_1''} + \frac{\zeta_2^2}{c_2''} + (r_1 + r_2)\sigma_3^2}$$

where c_i'' is short for $c_i''(e_i)$. Observe that the incentives for manager 1 from the verifiable profit stream decrease in r_1 and increase in r_2, as is usual for moral hazard models. More interestingly, they decrease in φ and increase in ψ, since a manager who has strong incentives from her private benefits does not need strong incentives from the profit stream. This means that the incentive coefficient for a manager is reduced when ownership of assets is transferred to her (although total incentives for her are strengthened). This is the opposite of what Holmstrom and Milgrom (1994) hypothesise, and reflects a single task (per manager) versus a multitask setting (where the tasks are substitutes in an agent's cost function).

If $\sigma_{13} = \sigma_{23} = 0$, $\zeta_1 = \zeta_2 = 1$ and $c_1'' = c_2'' = 1$, a^* simplifies to

$$a^* = \frac{1 + \psi - \varphi + r_2\sigma_3^2}{2 + (r_1 + r_2)\sigma_3^2}$$

Of course, $a^* = \tfrac{1}{2}$ when $\varphi = \psi$ and $r_1 = r_2$, since the two managers then are equal in every respect.

3. An interpretation of the model

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). But the model can also represent two companies that decide to do a joint project, with the use of a separate project organisation. When this is set up as an independent legal entity, project revenues are verifiable. The costs of project employees and the investments in physical assets are deducted before the profits are calculated and can therefore also be contracted upon in advance.

However, the project requires substantial effort by managers and experts within the two parent companies. Since these resources are not part of the joint venture as such, and the managers may also have other duties to perform, it can be difficult to verify the costs of their efforts. In fact, the investments might even be unobservable to the other party. The costs are therefore not part of the contract. The model in this essay is meant to provide insights into how the project contract can be designed to generate the best possible incentives for the parent companies to make such investments anyway. How individual employees are motivated is not included in the model.

The parent companies have two types of incentives. They get a certain share of the (verifiable) profits of the project, and there are some non-contractible benefits that to some degree depend on the parties' continued cooperation after (or outside) the contracted project. First, consider the verifiable profits. Usually it is difficult for third parties to verify the value added each manager contributes to these profits. Therefore I have assumed that there is only one profit stream to be contracted on.

Second, as the project evolves, the two parent companies and the project organisation may discover new opportunities related to the project at hand. At the project start, the nature of these opportunities is unknown, so they cannot be contracted upon. The opportunities could be pursued by each of the two companies independently. However, larger benefits can be realised if they choose to cooperate. Then the human capital of both parent organisations, the project's assets and the project organisation can again be combined in a fruitful pursuit of the opportunities in a new project.

If negotiations break down, a company will do better if it continues to have access to some of the assets (e.g. production facilities and distribution networks). Access to these assets at the end of the initial project is determined in an *ex-ante* contract. Either one parent company takes over the entire project organisation with assets, or

the two companies split the assets according to their existing competencies. In the latter case, a company keeps assets that are close to its existing products and markets, and the overlying project organisation is dissolved.

An important driver of the results in this essay is that the activities of the parent companies at the same time contribute to the present project's verifiable profits and to the value of a future project. In other words, the parent companies cannot shift their focus away from the contracted project and over to investing in future opportunities, if their incentives to do the latter are strengthened. This may seem as a strong assumption, but in my setting that is not necessarily so. The value of the future project depends crucially on the investments in the present project, as the same assets will be used and hence the same competencies will be needed. Furthermore, a parent company does not know what the future opportunities will be at the project start and can thus not direct its employees towards working with these only. Finally, many possible opportunities can materialise during the project, but an evaluation of these opportunities may not be possible before the project end, for instance because feedback from the market on the existing project is needed. Then it would not make sense to channel investments to a particular opportunity before the evaluation is performed.

4. Comparative analysis

Assume the value of a manager's outside option is given by

$$1 > \gamma_{T1} > \gamma_{NI} > \gamma_{T2} \geq 0$$

$$1 > \lambda_{T2} > \lambda_{NI} > \lambda_{T1} \geq 0$$

Then, it follows directly from the definitions of φ and ψ that

(5a) $1 > \varphi_{T1} > \varphi_{NI} > \varphi_{T2} \geq \frac{1}{2}$

(5b) $1 > \psi_{T2} > \psi_{NI} > \psi_{T1} \geq \frac{1}{2}$

With these assumptions, the value of the outside option increases with the number of assets the manager controls. If we defined a discrete function f for a specific technology, so that $f(\varphi) = \psi$, then this function would decrease in φ, since a strengthening of one manager's bargaining position (through a transfer of ownership rights) results in a weakening of the other manager's position.

However, to gain insights into how risk aversion can affect optimal asset ownership, it proves useful to first analyse how the expected joint surplus is affected by *one-sided* changes in the parties' bargaining positions (even though φ in reality can be

increased only if ψ is reduced and vice versa). To simplify the analysis, assume quadratic cost functions

$$c_i(e_i) = \tfrac{1}{2} e_i^2, \; i \in \{1, 2\}$$

so that optimal incentives are constant over effort levels (since c_i'' is a constant). Fixed cost elements are ignored. (1a) and (1b) then imply

$$e_1 = \varphi + a\,\zeta_1$$
$$e_2 = \psi + (1\text{-}a)\,\zeta_2$$

Due to the envelope theorem, the partial derivatives of the maximum expected joint surplus (Ω^*) with respect to φ and ψ are given by

$$\frac{\partial \Omega^*}{\partial \varphi} = 1 - \varphi + \zeta_1(1 - a^*) - r_1\left(\varphi\sigma_1^2 + (1-\psi)\sigma_{12} + a^*\sigma_{13}\right) + r_2\left((1-\varphi)\sigma_1^2 + \psi\sigma_{12} + (1-a^*)\sigma_{13}\right)$$

$$\frac{\partial \Omega^*}{\partial \psi} = 1 - \psi + \zeta_2 a^* + r_1\left((1-\psi)\sigma_2^2 + \varphi\sigma_{12} + a^*\sigma_{23}\right) - r_2\left(\psi\sigma_2^2 + (1-\varphi)\sigma_{12} + (1-a^*)\sigma_{23}\right)$$

where a^* denotes the optimal incentive coefficient found in (4). These derivatives can be negative, since an increase in φ or ψ does not only strengthen a manager's incentives. It also increases her risk-bearing costs.[9]

To focus on risk aversion and asset specificity, assume otherwise symmetrical technologies.

DEFINITION 1: The production technologies are symmetrical if $\zeta_1 = \zeta_2 \equiv \zeta$, $\sigma_1^2 = \sigma_2^2 \equiv \sigma_\Gamma^2$, $\sigma_{13} = \sigma_{23} \equiv \sigma_{\Gamma\Pi}$ and the managers' cost functions are identical.

Assume such symmetry, define $\sigma_3^2 \equiv \sigma_\Pi^2$, and use the expression for a^* from (4) to find the following relation

(5)
$$\frac{\partial \Omega^*}{\partial \varphi} > \frac{\partial \Omega^*}{\partial \psi}$$

$$\Updownarrow$$

$$(\psi - \varphi)(r_1 + r_2)[\sigma_\Pi^2 + (\sigma_\Gamma^2 + \sigma_{12})\{2\zeta^2 + (r_1 + r_2)\sigma_\Pi^2\} - 4\zeta\sigma_{\Gamma\Pi} - 2(r_1 + r_2)\sigma_{\Gamma\Pi}^2]$$
$$+ (r_1 - r_2)[\zeta(\sigma_\Pi^2 + 2\sigma_{\Gamma\Pi}) - 2\zeta^2(\sigma_\Gamma^2 + \sigma_{12} + \sigma_{\Gamma\Pi}) - (r_1 + r_2)\{\sigma_\Pi^2(\sigma_\Gamma^2 + \sigma_{12}) - 2\sigma_{\Gamma\Pi}^2\}] > 0$$

[9] With a risk averse agent employed by a risk neutral principal in a setting where there are only non-contractible benefits, the optimal investment specificity would be given by $\varphi = 1/(1 + r\sigma^2) < 1$. In other words, in order to share risks the parties may want to choose a technology that leads to a hold-up problem, even if another technology is available that could yield the same output, for the same effort, without any investment specificity.

For most parametric settings, the expression in the upper square brackets is positive, so that $\varphi < \psi$ and $r_1 = r_2 \Leftrightarrow \partial\Omega^*/\partial\varphi > \partial\Omega^*/\partial\psi$.

It can be shown that the second-order derivatives are negative constants (since Ω^* is quadratic in φ and ψ). Hence, $\Omega^*(\varphi, \psi)$ is (separately) concave in both φ and ψ. Furthermore, with symmetrical production technologies, $\partial^2\Omega^*/\partial\varphi^2 = \partial^2\Omega^*/\partial\psi^2$.

a) Type 1 versus Type 2 integration

Consider type 1 integration versus type 2 integration. Remember that the results of this section do not rule out non-integration as the optimal ownership structure.

In general, type 1 integration is more likely to dominate type 2 integration if $(\varphi_{T1} - \varphi_{T2})$ is large compared to $(\psi_{T2} - \psi_{T1})$. Further, when $\varphi_{T1} - \varphi_{T2} \approx \psi_{T2} - \psi_{T1}$, the manager with the worst bargaining positions (in absolute terms) is more likely to own the assets, since the expected joint surplus is concave in φ and ψ. To focus on risk aversion, assume symmetrical asset-specificity technologies.

DEFINITION 2: The asset-specificity technologies are symmetrical if $\varphi_{T1} = \psi_{T2}$, $\varphi_{NI} = \psi_{NI}$ and $\varphi_{T2} = \psi_{T1}$.

DEFINITION 3: Manager 1's (2's) bargaining position is on the margin more *important* for the joint surplus than manager 2's (1's) bargaining position, if $\partial\Omega^*/\partial\varphi > \partial\Omega^*/\partial\psi$ $(\partial\Omega^*/\partial\psi > \partial\Omega^*/\partial\varphi)$ for all $\varphi = \psi \in [½, 1)$.

LEMMA 1: A manager should own at least one of the two assets, if her bargaining position (on the margin) is more important for the joint surplus than the other manager's bargaining position, and the production and asset-specificity technologies are symmetrical in nature.

PROOF: Due to the symmetrical asset-specificity technologies, define $k_1 \equiv \varphi_{T1} = \psi_{T2}$ and $k_2 \equiv \varphi_{T2} = \psi_{T1}$, where $k_1 > k_2$. For notational purposes also define $\Omega^*_1(\varphi, \psi) \equiv \partial\Omega^*/\partial\varphi$ and $\Omega^*_2(\varphi, \psi) \equiv \partial\Omega^*/\partial\psi$. Type 1 integration then dominates type 2 integration if and only if

$$\int_{k_2}^{k_1} \Omega_1(k, k_2)dk > \int_{k_2}^{k_1} \Omega_2(k_2, k)dk$$

If manager 1's bargaining position (on the margin) is the most important for the joint surplus, then $\Omega^*_1(k_2, k_2) > \Omega^*_2(k_2, k_2)$.[10] The inequality is then trivially satisfied, since Ω^* is equally concave in both arguments under symmetrical production

[10] $\varphi = \psi = k_2$ can be interpreted as a joint ownership structure.

technologies. Similar if manager 2's bargaining position (on the margin) is the most important for the joint surplus. QED.

For lemma 1 to be of value, we must understand under what settings a manager's bargaining position is expected to be the most important.

Define $M \equiv \zeta(\sigma_\Pi^2 + 2\sigma_{\Gamma\Pi}) - 2\zeta^2(\sigma_\Gamma^2 + \sigma_{12} + \sigma_{\Gamma\Pi}) - (r_1 + r_2)\{\sigma_\Pi^2(\sigma_\Gamma^2 + \sigma_{12}) - 2\sigma_{\Gamma\Pi}^2\}$.

In a situation with symmetrical production and asset-specificity technologies, we know from (5) and lemma 1 that the most risk averse managers should own at least one of the assets if $M > 0$. M is positive when σ_Γ is small compared to σ_Π.

DEFINITION 4: The risk-bearing costs associated with the non-contractible benefits are unimportant if $\sigma_\Gamma \to 0$.

PROPOSITION 1: The most risk averse manager should own at least one asset, if the risk-bearing costs associated with the non-contractible benefits are unimportant, and the production and asset-specificity technologies are symmetrical in nature.

PROOF: $\sigma_{12}, \sigma_{\Gamma\Pi} \to 0$, if $\sigma_\Gamma \to 0$. Then (5) simplifies to

$$(6) \quad \frac{\partial \Omega^*}{\partial \varphi} > \frac{\partial \Omega^*}{\partial \psi} \quad \Leftrightarrow \quad (\psi - \varphi)(r_1 + r_2) + (r_1 - r_2)\zeta > 0$$

According to definition 3, the most risk averse manager's bargaining position is then (on the margin) the most important for the joint surplus, and the proposition follows directly from lemma 1. QED.

The intuition behind this perhaps somewhat surprising result is simple. If one of the managers is very risk averse, then it is costly to motivate her through the explicit contract on the uncertain verifiable profit stream. Instead it is better to give her ownership rights, so that she is highly motivated by the less risky non-contractible benefits. The two managers can thus be given balanced total incentives at a lower cost.

With the interpretation of the model suggested in section 3, it does seem realistic to consider situations where the non-contractible benefits are less risky than the verifiable profit stream. The downside risk is limited, since the parties do not commit to any costs to pursue the new opportunities before $t = 1$. And, the parties could very well be able (at $t = 0$) to relatively accurately predict the valuation (at $t = 1$) of the new opportunities, even if they do not sufficiently understand the nature of these opportunities to contract upon them. However, we should also consider the other case, where the non-contractible benefits are more risky.

DEFINITION 5: The risk-bearing costs associated with the verifiable benefits are unimportant if $\sigma_{\Pi} \rightarrow 0$.

PROPOSITION 2: The least risk averse manager should own at least one asset, if the risk-bearing costs associated with the verifiable benefits are unimportant, and the production and asset-specificity technologies are symmetrical in nature.

PROOF: $\sigma_{\Gamma\Pi} \rightarrow 0$, if $\sigma_{\Pi} \rightarrow 0$. Then (5) simplifies to

$$(7) \quad \frac{\partial \Omega^*}{\partial \varphi} > \frac{\partial \Omega^*}{\partial \psi} \quad \Leftrightarrow \quad (\psi - \varphi)(r_1 + r_2) - (r_1 - r_2) > 0$$

According to definition 3, the least risk averse manager's bargaining position is then (on the margin) the most important for the joint surplus, and the proposition follows directly from lemma 1. QED.

Now the least risk averse manager should own assets, since ownership does have an impact on the risk-bearing costs, while the explicit contract does not. So the most risk averse manager can instead be motivated by the risk-free explicit contract.

Finally, consider the less extreme case, where there are risk-bearing costs associated with both the non-contractible benefits and the verifiable profit stream. From the definition of M, note that M is negatively related to $(r_1 + r_2)$, if $\sigma_{\Pi}^2(\sigma_{\Gamma}^2 + \sigma_{12}) - 2\sigma_{\Gamma\Pi}^2 = \sigma_{\Pi}^2\sigma_{\Gamma}^2(1 + \rho_{1,2} - 2\rho_{\Gamma,\Pi}) > 0$. That is typically the case, since it is unlikely that the correlation between the private benefits and the verifiable profit stream is much higher than the correlation between the two private benefits. In other words, the most risk averse manager is more likely to own assets if the *total* risk aversion $(r_1 + r_2)$ is small.

To better illustrate the trade-offs between the ownership structures under this more ambiguous setting, consider two special cases. First, assume that all the error terms are perfectly correlated and that the verifiable and the non-contractible benefits are equally important ($\rho_{1,2} = \rho_{\Gamma,\Pi} = 1$ and $\zeta = 1$). For $\varphi = \psi$, (5) then simplifies to

$$(8) \quad \frac{\partial \Omega^*}{\partial \varphi} > \frac{\partial \Omega^*}{\partial \psi} \quad \Leftrightarrow \quad (r_1 - r_2)(\sigma_{\Pi} - 2\sigma_{\Gamma}) > 0$$

That is, the most risk averse manager should own at least one of the two assets if $\sigma_{\Pi} > 2\sigma_{\Gamma}$ (and the production and asset-specificity technologies are symmetrical in nature). Note that $\sigma_{\Pi} = 2\sigma_{\Gamma}$ if the non-contractible benefits in total are as risky as the profit stream. In other words, the most risk averse manager tends to own assets, if the total non-contractible benefits are less uncertain than the verifiable profit stream.

Second, assume that there is no correlation between the error terms, while, as before, the verifiable and the non-contractible benefits are equally important. That is, $\rho_{1,2} = \rho_{\Gamma,\Pi} = 0$ and $\zeta = 1$. For $\varphi = \psi$, (5) then simplifies to

$$(9) \quad \frac{\partial \Omega^*}{\partial \varphi} > \frac{\partial \Omega^*}{\partial \psi} \quad \Leftrightarrow \quad (r_1 - r_2)\,[\,\sigma_\Pi^2 - 2\sigma_\Gamma^2 - (r_1 + r_2)\sigma_\Pi^2\sigma_\Gamma^2\,] > 0$$

In other words, unlike in (8), the total level of risk aversion is again relevant. The most risk averse manager will now own assets when $\sigma_\Pi = 2\sigma_\Gamma$ only if $(r_1 + r_2)\sigma_\Gamma^2 \leq \frac{1}{2}$.

Seen together, (8) and (9) indicate that if all the three error terms are equally correlated, the most risk averse manager is more likely to own assets for high levels of correlation. When the verifiable profit stream is more risky than the total private benefits ($\sigma_\Pi > 2\sigma_\Gamma$), a stronger overall correlation will increase the risk bearing costs of using the profit stream more than it increases the costs of using the private benefits.

b) Integration versus Non-integration

In general, type 1 integration is more likely to dominate non-integration if $(\varphi_{T1} - \varphi_{NI})$ is large compared to $(\psi_{NI} - \psi_{T1})$, and type 2 integration is more likely to dominate non-integration if $(\psi_{T2} - \psi_{NI})$ is large compared to $(\varphi_{NI} - \varphi_{T2})$.

Assume for simplicity that the asset-specificity technologies are symmetrical ($\varphi_{T1} = \psi_{T2} \equiv k_1$, $\varphi_{NI} = \psi_{NI} \equiv k_{NI}$ and $\varphi_{T2} = \psi_{T1} \equiv k_2$). Take $\varphi = \psi = k_2$ as a starting point. This can be interpreted as a joint ownership structure. Figure 1 shows how the expected joint surplus, $\Omega^*(\varphi, \psi)$, then increases in its two arguments.[11] I have assumed that manager 1's bargaining position (on the margin) is the most important, so that type 1 integration dominates type 2 integration.

Starting at $\varphi = \psi = k_2$ (joint ownership), the managers can choose between three (other) ownership structures. One of the managers can give up her claims to both assets. If manager 1 remains the sole owner (type 1 integration), then φ is increased from k_2 to k_1, while ψ still equals k_2. And, if manager 2 remains the sole owner (type 2 integration), ψ is increased from k_2 to k_1, while φ still equals k_2. The managers can also choose to give up ownership rights to one asset each, so that each manager becomes the sole owner of the asset most specific to her investments. Then both φ and ψ are strengthened from k_2 to k_{NI}.

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[11] The diagram is generated using $\zeta_1 = \zeta_2 = 1$, $\sigma_1 = \sigma_2 = 0.25$, $\sigma_3 = 1.00$, $\sigma_{12} = \sigma_{13} = \sigma_{23} = 0$, $r_1 = 4.5$, $r_2 = 1.5$ and $k_2 = 0.5$.

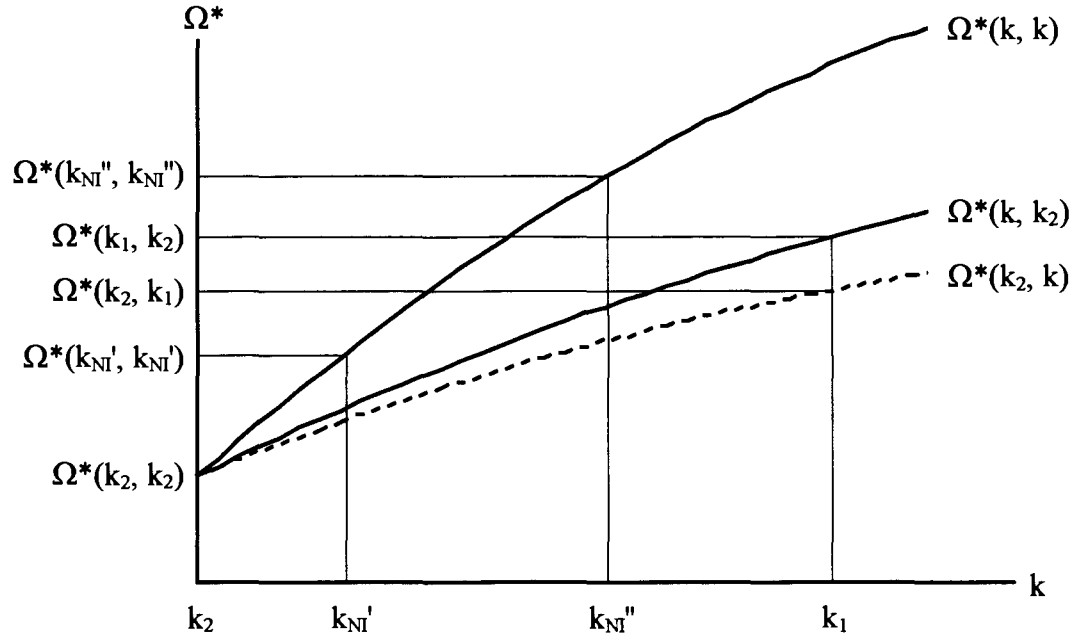

Figure 1.

In the diagram I have indicated two possible k_{NI} values. Integration dominates non-integration for k_{NI}', while it does not for k_{NI}''.

Mathematically, type 1 integration dominates non-integration, when the asset-specificity technologies are symmetrical, if

$$(10)\quad \int_{k_{NI}}^{k_1} \frac{d\Omega^*(k,k_2)}{dk}dk > \int_{k_2}^{k_{NI}} \left(\frac{d\Omega^*(k,k)}{dk} - \frac{d\Omega^*(k,k_2)}{dk} \right) dk$$

Three factors decide the trade-off. Where k_{NI} is located on the interval (k_2, k_1), how large $[d\Omega^*(k, k)/dk - d\Omega^*(k, k_2)/dk]$ is for $k \in (k_2, k_{NI})$ and how large $d\Omega^*(k, k_2)/dk$ is for $k \in (k_{NI}, k_1)$.

To again focus on risk aversion, assume symmetrical production technologies, and, to simplify, set $\rho_{1,2} = \rho_{\Gamma,\Pi} = 0$. The two integrands in (10) are then given by

$$(11)\quad \frac{d\Omega^*(k,k)}{dk} - \frac{d\Omega^*(k,k_2)}{dk} = (1\text{-}k) + r_1(1\text{-}k)\sigma_\Gamma^2 - r_2 k\sigma_\Gamma^2 + \zeta\frac{\zeta^2 - (k-k_2)\zeta + r_2\sigma_\Pi^2}{2\zeta^2 + (r_1+r_2)\sigma_\Pi^2}$$

$$(12)\quad \frac{d\Omega^*(k,k_2)}{dk} = (1\text{-}k) - r_1 k\sigma_\Gamma^2 + r_2(1\text{-}k)\sigma_\Gamma^2 + \zeta - \zeta\frac{\zeta^2 - (k-k_2)\zeta + r_2\sigma_\Pi^2}{2\zeta^2 + (r_1+r_2)\sigma_\Pi^2}$$

Again consider the two extreme cases that I discussed in propositions 1 and 2.

PROPOSITION 3: If the risk-bearing costs associated with the non-contractible benefits are unimportant, and the production and asset-specificity technologies are symmetrical in nature, then integration is more likely to dominate non-integration when the risk preferences of the two managers are very different.[12]

PROOF: According to proposition 1, type 1 integration dominates type 2 integration when manager 1 is more risk averse than manager 2, if the risk-bearing costs associated with the non-contractible benefits are unimportant. [$d\Omega^*(k, k)/dk - d\Omega^*(k, k_2)/dk$] decreases in r_1 when $\sigma_\Gamma \rightarrow 0$, while $d\Omega^*(k, k_2)/dk$ then increases. The inequality in (10) is therefore more likely to hold for the same values of k_2, k_{NI} and k_1, the larger r_1 is. Same effect if r_2 decreases (as long as $a^* < 1$). Similar if manager 2 is the most risk averse. That is, integration is more likely when $|r_1 - r_2|$ is large. QED.

PROPOSITION 4: If the risk-bearing costs associated with the verifiable profit stream are unimportant, and the production and asset-specificity technologies are symmetrical in nature, then integration is more likely to dominate non-integration when the risk preferences of the two managers are very different.

PROOF: According to proposition 1, type 1 integration dominates type 2 integration when manager 1 is less risk averse than manager 2, if the risk-bearing costs associated with the verifiable benefits are unimportant. [$d\Omega^*(k, k)/dk - d\Omega^*(k, k_2)/dk$] increases in r_1 when $\sigma_\Pi \rightarrow 0$, while $d\Omega^*(k, k_2)/dk$ then decreases. The inequality in (10) is therefore more likely to hold for the same values of k_2, k_{NI} and k_1, the smaller r_1 is. Same effect if r_2 increases (as long as $a^* < 1$). Similar if manager 2 is the least risk averse. That is, integration is more likely when $|r_1 - r_2|$ is large. QED.

Propositions 3 and 4 are only stated for very extreme values of σ_Π and σ_Γ. The result does hold, however, also for most other parameter settings (although not always). We can therefore conclude that there is, in general, a tendency for integration to dominate non-integration when the two managers have very different risk preferences. The intuition being that if one of the managers is very risk averse, while the other is not, then her risk-bearing costs are much more sensitive to changes in ownership structure. Hence, when it is good that she owns assets (because the risk-bearing costs associated with the non-contractible benefits are low), she should own them all. But, if it is very costly for her to own assets, she should not own any. In any case, they choose integration.

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[12] Although (11) and (12) are shown for the case where $\rho_{1,2}$, $\rho_{\Gamma,\Pi} = 0$, propositions 3 and 4 are valid also when $\rho_{1,2}$, $\rho_{\Gamma,\Pi} > 0$. Note that σ_{12} and $\sigma_{\Gamma\Pi}$ both are irrelevant if $\sigma_\Gamma \rightarrow 0$, while $\sigma_{\Gamma\Pi}$ is irrelevant if $\sigma_\Pi \rightarrow 0$.

Note that asymmetries in the asset-specificity and production technologies typically will skew the result, so that non-integration can be optimal even if the risk aversion preferences of the two managers are very different. Also remember that integration can dominate non-integration, even if the two managers have the same risk aversion (and the production and asset-specificity technologies are symmetrical in nature), when non-integration does not strengthen the bargaining positions much compared to joint ownership, while integration does.

I should also comment on the role of the parameters ζ_1 and ζ_2 (which determine how important the verifiable profits are relative to the non-contractible benefits). All my results are valid regardless of what values these parameters take. In fact, the effects that are described in propositions 1 to 4 are even stronger when the verifiable profits are very important. Then the choice of ownership structure tends to become more sensitive to differences in risk preferences, although the ownership structure as such will be less important (since the managers are mainly motivated by the verifiable profit stream anyway).

5. An example

In this section I go through three numerical settings to illustrate how the different ownership structures perform. For now, ignore third-party participation. I assume that the two managers and the two assets are symmetrical in every respect, except for the risk aversion of the two managers and the asset specificity of their investments. The three cases differ only in the uncertainty of the non-contractible benefits.

Assume these parametric values

$$\zeta_1 = \zeta_2 = 1$$
$$r_2 = 4$$
$$\sigma_3 = 1$$
$$\rho_{1,2} = \rho_{1,3} = \rho_{2,3} = \tfrac{1}{2}$$

Define $R \equiv r_1 / r_2$. R is then a measure of the relative risk aversion. Note that r_2 is fixed. Only r_1 is allowed to change.

To compare ownership structures, define an asset-specificity technology that exhibits a weak form of symmetry, in the sense that there is a linear relation between the specificity of the two managers' investments

$$\varphi_{T1} = 1 - \tfrac{1}{2}A\eta_1 \qquad \psi_{T1} = 1 - \tfrac{1}{2}\eta_2$$
$$\varphi_{NI} = 1 - \tfrac{1}{2}A\eta_{NI} \qquad \psi_{NI} = 1 - \tfrac{1}{2}\eta_{NI}$$
$$\varphi_{T2} = 1 - \tfrac{1}{2}A\eta_2 \qquad \psi_{T2} = 1 - \tfrac{1}{2}\eta_1$$

where $0 < \eta_1 < \eta_{NI} < \eta_2 \leq 1$, and $A \in (0, {}^1/\eta_2]$. A can be interpreted as a measure of relative investment specificity. η_1 is used when a manager owns both assets, η_{NI} when she only owns one asset and η_2 when she does not own any asset at all.

Set $\eta_1 = 0.05$, $\eta_{NI} = 0.26$ and $\eta_2 = 0.50$. Manager 2's bargaining positions (i.e. her incentives for the non-contractible benefit) under the different ownership structures are then fixed at $\psi_{T1} = 0.750$, $\psi_{NI} = 0.870$ and $\psi_{T2} = 0.975$.

Consider three cases

(i) $\sigma_1 = \sigma_2 = 0.1$

(ii) $\sigma_1 = \sigma_2 = 0.3$

(iii) $\sigma_1 = \sigma_2 = 0.5$

Let $\Omega_k^*(R, A)$ denote the maximum expected joint surplus for a given ownership structure. Solve $\Omega_{T1}^*(R, A) = \Omega_{NI}^*(R, A)$ and $\Omega_{NI}^*(R, A) = \Omega_{T2}^*(R, A)$ to find the indifference curves $A(R)|_{T1=NI}$ and $A(R)|_{NI=T2}$ for the three cases. These are shown in figure 2.

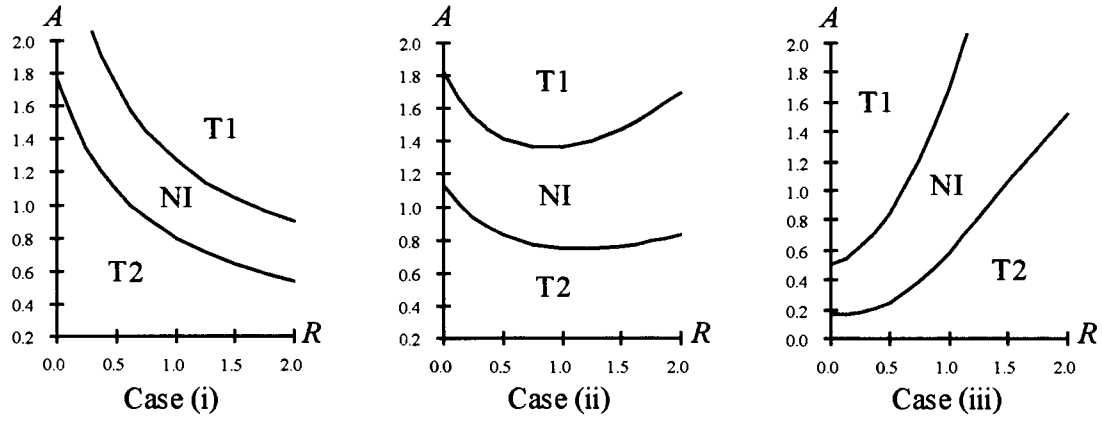


Figure 2.

Remember that R and A increase in manager 1's risk aversion and the specificity of her investments respectively, while manager 2's position is kept constant. For $R = A = 1$, both managers are equal in every respect. I have calibrated the model (by adjusting η_{NI}), so that non-integration then is the best ownership structure.

In case (i), where the risk-bearing costs associated with the non-contractible benefits are relatively unimportant, a manager is more likely to own the assets, the more risk averse she is. This case corresponds to proposition 1 (which was stated for $\sigma_1, \sigma_2 \to 0$, and $A = 1$).

As the risk-bearing costs associated with the non-contractible benefits become more important, that result is no longer valid for high levels of total risk aversion, see case (ii). And, when these costs become even more important relative to the risk-bearing costs associated with the verifiable profits, the opposite result is true for all levels of risk aversion, see case (iii). This corresponds to proposition 2 (which was stated for $\sigma_3 \to 0$ and $A = 1$).

Finally, observe that while non-integration dominates integration in all three cases when $A = R = 1$, that is no longer the case when R takes a value very different from 1. Managers with very different risk preferences tend to integrate their operations, if the technology otherwise is symmetrical. This observation corresponds to propositions 3 and 4.

6. Third-party participation

There can be external third parties that are willing to share the risk-bearing costs associated with the verifiable profits, although they do not take part in the firm's value creation activities. Denote this ownership structure third-party participation (TP). The three parties' shares of the profits are then a, b and (1-a-b) for manager 1, 2 and the third party respectively.

In the model, the introduction of a non-productive risk averse third party relaxes the budget balancing constraint for the two managers. On the other hand, the third party's risk-bearing costs must be included in the expected joint surplus function.[13]

$$(13)\quad \Omega_{TP}(a, b) = (1 + \zeta_1)\, e_1(a) + (1 + \zeta_2)\, e_2(b) - c_1(e_1(a)) - c_2(e_2(b))$$
$$- \tfrac{1}{2} r_1 [\, \varphi^2\sigma_1^2 + (1-\psi)^2\sigma_2^2 + a^2\sigma_3^2 + 2\varphi(1-\psi)\sigma_{12} + 2\varphi a\sigma_{13} + 2(1-\psi)a\sigma_{23}\,]$$
$$- \tfrac{1}{2} r_2 [\, (1-\varphi)^2\sigma_1^2 + \psi^2\sigma_2^2 + b^2\sigma_3^2 + 2(1-\varphi)\psi\sigma_{12} + 2(1-\varphi)b\sigma_{13} + 2\psi b\sigma_{23}\,]$$
$$- \tfrac{1}{2} r_3 (1-a-b)^2\sigma_3^2$$

The productive managers' first-order conditions are given by

$$(14a)\quad c_1'(e_1) = \varphi + a\,\zeta_1$$

$$(14b)\quad c_2'(e_2) = \psi + b\,\zeta_2$$

After finding the first-order derivatives of (13) with respect of a and b, the optimal incentives can be found by using (14a), (14b) and the marginal reaction functions that

[13] The third party does not necessarily need to be only one person. It can also be seen as the aggregate of a syndicate (Wilson 1968).

the first-order conditions imply. Assuming quadratic cost functions, it is straight forward to find the optimal incentives

$$a^* = \frac{\left[\zeta_2^{\,2} + (r_2 + r_3)\sigma_3^{\,2}\right]\left[\zeta_1^{\,2} + \zeta_1(1-\varphi) + r_3\sigma_3^{\,2} - r_1\{\varphi\sigma_{13} + (1-\psi)\sigma_{23}\}\right] - r_3\sigma_3^{\,2}\left[\zeta_2^{\,2} + \zeta_2(1-\psi) + r_3\sigma_3^{\,2} - r_2\{(1-\varphi)\sigma_{13} + \psi\sigma_{23}\}\right]}{\left[\zeta_1^{\,2} + (r_1 + r_3)\sigma_3^{\,2}\right]\left[\zeta_2^{\,2} + (r_2 + r_3)\sigma_3^{\,2}\right] - \left[r_3\sigma_3^{\,2}\right]^2}$$

$$b^* = \frac{\left[\zeta_1^{\,2} + (r_1 + r_3)\sigma_3^{\,2}\right]\left[\zeta_2^{\,2} + \zeta_2(1-\psi) + r_3\sigma_3^{\,2} - r_2\{(1-\varphi)\sigma_{13} + \psi\sigma_{23}\}\right] - r_3\sigma_3^{\,2}\left[\zeta_1^{\,2} + \zeta_1(1-\varphi) + r_3\sigma_3^{\,2} - r_1\{\varphi\sigma_{13} + (1-\psi)\sigma_{23}\}\right]}{\left[\zeta_1^{\,2} + (r_1 + r_3)\sigma_3^{\,2}\right]\left[\zeta_2^{\,2} + (r_2 + r_3)\sigma_3^{\,2}\right] - \left[r_3\sigma_3^{\,2}\right]^2}$$

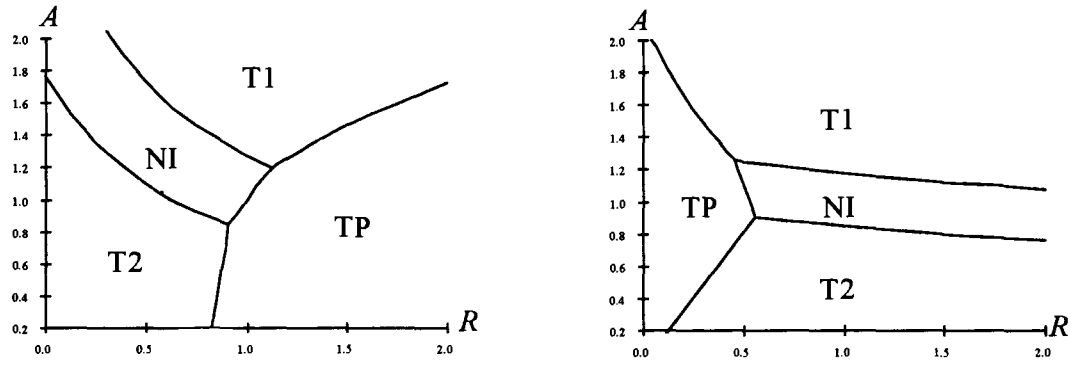
Normally a third party will receive a positive percentage of the profits, so that the incentives for the two productive managers are weakened. However, in some situations it can theoretically be optimal to let the third party strengthen the two managers' incentives instead, in the sense that $a + b > 1$. In the first case, the third party can be interpreted as an investor who pays the managers a fixed amount *ex ante*, while in the latter case the third party must be paid *ex ante* to gear up the investments of the two managers.

If the introduction of a third party to the monetary contract does not affect the residual control rights, the parties can freely choose among the ownership structures as before. In such an environment, the introduction of a third party can only improve upon the situation, since the monetary contract will only deviate from the optimal two-party contract if the expected joint surplus increases. That is usually the case, unless $r_3 = \infty$ (when the third party is unable to help with the risk sharing) or the budget balancing constraint is not binding for the two managers (optimal incentives add to one, even if a third party could take part).

However, a third party might be willing to take on such risks only if the original owners give up some control rights. If for instance the third party will be part of the contract only when all the three parties share the residual control rights on both assets, then we have a much more interesting situation, since there then are costs associated with the third-party participation. Although the third party cannot be part of the renegotiation process, such a structure could be motivated by a fear on the third party's side that the two managers somehow can cheat on her. Therefore she wants the exit costs for both of the two parties to be as high as possible. When she has residual control rights, she can refuse them access to both assets if she finds out that they do indeed cheat. At the same time she wants both managers to be able to punish the other, in case there is some cheating that only the other party can detect (and there is no way this manager can prove the cheating to the third party).

Assume such a setting, where $\varphi_{TP} = \varphi_{T2}$ and $\psi_{TP} = \psi_{T1}$, and consider the numerical example in section 5. First, set all the parameters as in case (i), and denote this case (iv). Second, let the risks associated with the verifiable profits be $\sigma_3 = 0.3$, instead of

$\sigma_3 = 1$, and denote this case (v). In both cases, the risk aversion of the third party is set equal to the risk aversion of manager 2, so that $r_3 = 4$. In the first case, the third party plays the investor role, while in the second case she gears up the investments for the two managers. Figure 3 shows the optimal ownership for both cases, as determined by the relative risk aversion (R) and the relative investment specificity (A).



Case (iv) Case (v)

Figure 3.

In case (iv), third-party participation is optimal for high levels of total risk aversion, since the reduced risk-bearing costs then outweigh the reduced incentives from both the non-contractible benefits and the verifiable profits. In case (v), however, third-party participation is optimal for low levels of risk aversion. Only then can the incentives from the verifiable profit stream (a and b) be sufficiently strengthened to outweigh the reduced incentives from the non-contractible benefits and the increased total risk-bearing costs.

In other words, the third party helps to gear up the investments when the total risk-bearing costs associated with the verifiable profit stream are low (due to low levels of uncertainty and risk aversion). And she plays the role as an investor when the total risk-bearing costs associated with the verifiable profit stream are high.

7. Concluding remarks

I show in this essay that the effect of risk aversion on the choice of ownership is not obvious. It can be efficiency enhancing to give ownership rights to the most risk averse manager, if risk-bearing costs associated with non-contractible benefits are low. The least risk averse manager is then instead given a larger share of the verifiable profits. On the other hand, if the risk-bearing costs associated with the non-contractible benefits are high, then the least risk averse manager is more likely to

own assets. There is a tendency to integrate if the risk preferences are very asymmetrical. A non-productive third party may join as an investor when the risk-bearing costs are high, while she instead can help to gear up the investments when the risk-bearing costs are low.

Although I have used a simple model to demonstrate these results, they seem to be more general in nature. In fact, they can be seen as specialised cases of a very general (and hence not very useful) result: When there are several instruments available for motivation, the mix of these should reflect the relative costs of each for the parties involved.

I have somewhat arbitrarily assumed that there are two assets. There could of course be more. Then more ownership structures would be available to the parties. In the model, ownership is only important in the sense that it decides the parties' relative bargaining positions. The more assets there are (that are specific to investments), the more flexibility the parties have in finding jointly favourable bargaining positions. If there is only one asset, non-integration becomes irrelevant. Note that an asset could be in the form of a brand name, a company name or an organisation consisting mainly of human capital.

Ownership rights are also more flexible than I assume. Instead of one party having full ownership rights to an asset, there could be, for instance, a 51:49 division of ownership shares. Then the majority owner can make many decisions without the consent of the other party, but unanimity is required for others, as specified in a charter. They could also specify specific decisions where the right to decide is given exclusively to the minority owner. The model can be used to analyse these more general settings as well, since the (net) bargaining positions of the two parties can be seen as reflecting all types of decision rights.

The model seems robust with respect to bounded rationality considerations. *Ex ante*, the two managers only need to agree on the ownership structure and a split of the profit stream. And, *ex post*, they agree on a monetary transfer to ensure that the gains from cooperation are split according to their bargaining positions. Although they do not actually perform the calculations, they can over time learn what kind of arrangement that is mutually beneficial with respect to incentives. In line with this thinking, large companies are observed to be experimenting with different governance structures for joint ventures.

In the model I focus on asset ownership (a form of authority) and explicit profit-sharing contracts. One could also imagine that reputation effects or other forms of trust could be used to reduce the hold-up problem. In essay III, I therefore study asset ownership and implicit contracts. Together, these two essays reflect Bradach

and Eccles' (1989) observation that price, authority and trust mechanisms are found both in markets and in firms.

ESSAY III

Asset ownership and implicit contracts

This essay aims to develop a richer logical framework for a theory of the firm that combines asset ownership and implicit contracts. In a dynamic model with two-sided investments there is room for firms, spot employment, relational contracting, spot markets, partnerships and mutual hostage taking. Symmetrical ex-post bargaining positions are shown to support effective implicit contracts, when the parties are sufficiently patient. Relational contracting (non-integration) and partnerships (joint ownership) are therefore typically attractive when the parties' investments are of similar specificity. Choosing between technologies, strong inter-dependencies (more hold-up) can be good. The proposed implicit contract is easy to relate to for the two managers, with its focus on each manager's realised contribution to the joint surplus.

1. Introduction

Williamson (1975, 1985) and Klein, Crawford and Alchian (1978) observed that specific investments can play an important role to determine optimal asset ownership. Building on this idea, Grossman and Hart (1986) and Hart and Moore (1990) have suggested formal models to show the benefits and costs of integration with respect to the hold-up problem. But relationships where integration is considered tend to be long-term in nature. Reputation effects might therefore discipline the parties, enabling them to enter into an implicit contract that can improve the effective incentives of those managers that have investments to make.[1]

[1] An interesting discussion of reputation effects with respect to the theory of the firm is found in Kreps (1990). He considers a situation with one employer and many employees. Unforeseen contingencies render long-term complete contracts impossible. Instead the employer is given the authority to decide on adaptations as time goes by and the environment changes. Then the employees must trust that the authority will be used fairly. As unforeseen contingencies tend to follow patterns, the employer can build up a reputation for meeting the contingencies in a certain way. Kreps argues that a corporate culture is partly characterised by the principles that govern such decision-making and partly by the means by which the principles are communicated.

In this essay I combine the instruments of asset ownership and implicit contracts to develop a richer logical framework for a theory of the firm.[2] With my formulation, where there are two managers/owners who both make relationship- and asset-specific investments, there is room for firms, spot employment, relational contracting, spot markets, partnerships and mutual hostage taking. The predictions on ownership structures and the qualities of the implicit contract (if it is viable) seem to be more realistic than those of other comparable models (Halonen 1994, Baker, Gibbons and Murphy 1997).

While Halonen (1994) argues that to choose the worst ownership structure of the one-shot game can be good in the repeated setting to provide strong punishment after cheating, I show that when choosing between ownership structures (for a given technology), the parties should, in fact, aim for strong *ex-post* bargaining positions. Then the temptation to renege on the implicit contract is weakened. Choosing between technologies, however, strong mutual interdependencies can be good, even if it does not lead to higher returns on investments, because a technology characterised by a high level of specificity provides strong punishments. In other words, Halonen's result is not relevant for the choice of ownership structure but for the choice of technology.

And, while Baker, Gibbons and Murphy (1997), hereafter BGM, study a setting with one-sided investments (and one asset) only, I allow both managers to invest (and two assets). This opens up for more balanced relationships. In particular, I show that partnerships (joint ownership) and mutual hostage taking (cross ownership) are viable also in a model where the parties invest in human capital only (and not in the physical assets). That has typically not been the case in earlier models on property rights. I demonstrate, for example, that partnerships are likely to occur in settings where two (or more) parties have similar technologies, they take a long-term perspective, and there is for all practical purposes only one asset to own (e.g. the company name). These conditions are satisfied for many law and management consulting firms, where partnerships are prevalent.

Due to the one-sided investments in BGM's paper, they predict integration (in the sense that the non-investing party owns the asset) only when the investing manager otherwise would enjoy too strong incentives and thus overinvest. The only function of integration is thus to dampen the incentives of the supplier. In my model, however, as in the Grossman-Hart-Moore approach for the spot mode, a transfer of

[2] In essay II, I discuss how ownership rights and *explicit* contracts can combine to govern business activities. Together, these two essays reflect Bradach and Eccles' (1989) observation that price, authority and trust mechanisms are found both in markets and in firms.

ownership rights can imply a trade-off between the incentive strengths of the investing managers.

BGM suggest a rather complex relational contract with a fixed "salary" and a variable payment that depends on the development in the value of the good both when it is used inside the relationship and when it is used outside the relationship. The implicit contract in my model should be easier to relate to for the two managers from a bounded rationality perspective, with its focus on each manager's realised contribution to the joint surplus (when they choose to cooperate).

In particular, I am worried about a manager's ability to understand the role a fixed payment will play when it is part of an implicit contract (and hence is not enforced by a court). Further, I show that it is the party with the worst bargaining position that must commit to this recurring fixed payment, which therefore must be interpreted as a "bribe" and not a "salary". The fact that the weakest party is usually the one with the highest risk aversion or the strictest wealth constraint will limit the attractiveness of such an arrangement. Finally, a fixed transfer can conflict with the parties' social norms (of equity). It may not be considered fair to take advantage of the expected weak bargaining position of the other party to secure a fixed payment (or bribe) in addition to a large share (up to 100 percent) of own value added.

In other words, there are many reasons why one would not expect to observe fixed transfers as part of an implicit contract in real-world business relations.[3] I nevertheless analyse also that case (then the problem, in fact, has a simple closed-form solution), before I turn my attention to the more realistic case, where the implicit contract does *not* include a fixed transfer (and the analysis is somewhat more cumbersome). I show that symmetry then can be good for an implicit contract. The parties may choose an ownership structure where they end up with more symmetrical *ex-post* bargaining positions than the optimal ownership structure under the spot mode would have implied. Further, I show that ownership matters even when the parties are infinitely patient. A first-best contract can be sustained, also then, only when the bargaining positions are relatively symmetrical.

The essay proceeds as follows. In section 2 I suggest a general governance framework for two assets and two productive managers/owners. Then, in section 3, I develop the one-period model. I assume risk neutrality, linearity, independent technologies and quadratic cost functions to neutralise all effects except for a simple version of the hold-up problem found in Hart (1995). The basic model is a variation of the one I use in essay II, and it is very different from the models by Halonen and

[3] I do not claim that fixed transfers are not important in business relations. But, my impression is that a fixed transfer is usually part of a verifiable contract, and it is paid *to* the weaker party.

Baker, Gibbons and Murphy, especially in the way uncertainty and investment specificity is modelled.

In section 4 I introduce an implicit contract that is linear in the observable, but not verifiable benefits of the two parties. In section 5 I analyse the case where the implicit contract may include a fixed transfer, and in section 6 I focus on implicit contracts without fixed transfers. I suggest some more structure with respect to the investment specificity technology in section 7. This is helpful to illustrate some comparative results in the spot governance mode. Then I use this investment specificity structure in section 8 to show with an example how the optimal governance structure will be determined by the discount rate and the relative investment specificity of the two managers. Finally, in section 9, I make some concluding remarks.

2. A general framework

In this section I suggest a general governance framework for two assets and two productive managers/owners. Both make unobservable asset- and relationship-specific investments. When uncertainty is resolved, the two managers make some further non-contractible decisions (e.g. to trade a particular good). It is impossible (or too costly) to contract *ex ante* on the *ex-post* decision, due to the high degree of uncertainty (Hart and Moore 1999, Segal 1999). This cycle of *ex-ante* investments and *ex-post* decisions and outcomes is repeated in future periods.

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. An asset could for instance be a factory, a distribution network or a company name, and a manager could include the whole management team.

There are two instruments available to influence the incentives to invest. The two parties can allocate ownership rights to the assets, giving the owner(s) residual control rights (Grossman and Hart 1986). And they can agree to an *implicit contract* on observable benefits. The benefits are not verifiable, so a third party (a court) cannot enforce the contract, but in a repeated setting reputation effects may discipline the managers.

Reputation effects work only if the managers are sufficiently patient. Otherwise they must rely on *spot governance*, where the parties worry only about the current period when they make decisions. If that is the case, assume that renegotiations lead to

efficient *ex-post* decisions, regardless of *ex-ante* investment levels and ownership structure. The negotiated monetary transfer depends on the parties' bargaining positions. The ownership rights will influence these bargaining positions, since the value of a manager's outside option is affected. A manager's investment level will thus reflect her marginal benefits after the anticipated renegotiation process.

Define asset ownership as the right to deny other parties access to the asset (Hart and Moore 1990). In that case there are five distinct ownership structures. Either manager 1 owns both assets (which, following Hart (1995), I call *Type 1 integration - T1*), manager 2 owns both assets *(Type 2 integration - T2)*, each manager owns the asset most specific to her investments *(Non-integration - NI)*, each manager owns the asset most specific to the other manager's investments *(Cross ownership - CO)*, or, finally, the two managers jointly own the two assets *(Joint ownership - JO)*. Under joint ownership both parties must agree for any of them to have access to the asset. In other words, both have a form of veto power.

Then there are altogether ten different categories of governance. These are summarised in figure 1 below, where I also name the categories.[4]

Contracting mode	***Ownership structure***				
	T1	T2	NI	CO	JO
Spot governance	Spot Employment I	Spot Employment II	Spot Market		
Implicit contracts	Firm I	Firm II	Relational Contracting	Mutual hostage taking	Partnership

Figure 1.

Under *spot employment* one of the managers owns both assets, and in each period she offers the other party a contract which is unaffected by the past. *Firms* are characterised by the same ownership structure, but the parties are to some extent disciplined by reputation effects. Under non-integration I call the categories *spot market* and *relational contracting*. And, cross ownership and joint ownership structures in the implicit contracting mode are called *mutual hostage taking* and *partnerships* respectively.

[4] The figure is inspired by the framework for one asset and one-sided investments found in Baker, Gibbons and Murphy (1997), which distinguishes between spot outsourcing, relational outsourcing, spot employment and relational employment.

As the reader will see when I define the formal model, joint ownership and cross ownership are dominated by non-integration in the spot governance mode, and these categories are therefore crossed out. However, joint ownership and cross ownership can be viable in an implicit contract mode.

Non-integration and cross ownership are not relevant if there is only one asset. If there are more than two assets, more ownership structures will be available to the parties. In this model, ownership is only important in the sense that it decides the parties' relative bargaining positions. The more assets there are (that are specific to investments), the more flexibility the parties have in finding jointly favourable bargaining positions.

3. The one-period model

There are two assets and two productive risk-neutral parties, manager 1 and manager 2. At $t = 0$ they make non-observable investments in human capital (e_1 and e_2).

The benefits at $t = 1$ for the two managers are observable to manager 1 and 2 but not verifiable to a third party. The benefits depend on the investments at $t = 0$, 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 some of (or preferably all) the assets. Whether cooperation has taken place or not is also observable to the two parties but not verifiable to outsiders.

Assume independent technologies that are linear in an agent's effort e_j ($j \in \{1,2\}$). If they choose to cooperate, the two managers' value added (net of $t = 1$ costs) are given by

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

$$\theta_2^C = e_2 + \varepsilon_2$$

where $e_j \geq 0$, $E[\varepsilon_j] = 0$ and $\varepsilon_j \in [-\varepsilon, \varepsilon]$.[5] In the more general case, θ_j^C could be a function of both e_1 and e_2. However, the independent technology property is not necessarily unrealistic. Suppose manager 2's manufacturing costs decide θ_2^C (after investing in production competencies), and that the price manager 1 can take for the product in the end market decides θ_1^C (after market research investments). There is

[5] The assumption that investment levels and the stochastic variables enter the benefit functions additively is inspired by Holmstrom and Milgrom (1991). Alternatively we could let the range of ε_j depend on e_j, for instance so that $\varepsilon_j \in [-e_j, e_j]$. The results of this essay would still hold qualitatively. In fact, the self-enforcement constraints (in section 4) would then be simplified.

no reason to believe that marketing should influence production costs and that (firm-specific) production technology investments (that are unobservable to the buyers) should influence the price in the output market. But I do not rule out correlation between ε_1 and ε_2.

If, however, the two parties choose not to cooperate, their benefits are reduced to

$$\theta_1^{NC} \equiv \gamma_k \theta_1^{C}$$
$$\theta_2^{NC} \equiv \lambda_k \theta_2^{C}$$

where γ_k, $\lambda_k \in [0,1)$ are constants that depend on the ownership structure $k \in K \equiv \{T1, T2, NI, CO, JO\}$. This assumption is strong in the sense that total and marginal benefits move together. That does not necessarily need to be the case, but it is consistent with Hart and Moore (1990) and Hart (1995). The assumption is also strong in the sense that the nature of the uncertain variables is the same under both cooperation and non-cooperation.

The formulation of investment specificity is valid only for non-negative non-contractible benefits. I restrict my attention to that case. With the quadratic cost function that I will use, $\varepsilon_1, \varepsilon_2 \geq -\frac{1}{2}$ (that is $\varepsilon \leq \frac{1}{2}$) is a sufficient condition for non-negative benefits, as the investments (e_1 and e_2) then always will be larger than $\frac{1}{2}$.[6]

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). To simplify the analysis, assume quadratic cost functions

$$c_j(e_j) = \tfrac{1}{2} e_j^2, \quad j \in \{1, 2\}.$$[7]

Define $\varphi_k \equiv \frac{1}{2}(1+\gamma_k)$ and $\psi_k \equiv \frac{1}{2}(1+\lambda_k)$, which can be interpreted as the parties' respective *bargaining positions* (which must not be confused with the parties' bargaining *power* in a Nash bargaining sense). The maximisation problems of the two managers for a given ownership structure k then simplify to

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[6] The bounds on the error terms can be made less restrictive by including positive fixed terms in the functions for θ_1^{C} and θ_2^{C}.

[7] Most of the results in this essay are robust with respect to the form of the cost function. A notable exception is proposition 6.8 (that stronger interdependencies can be good), which is not true if investments are very elastic (with respect to the investment specificity parameters).

$$e_1^k = \underset{e_1}{\text{Argmax}}\, U_1 = \underset{e_1}{\text{Argmax}}\, \{ \varphi_k e_1 + (1-\psi_k) e_2 - \tfrac{1}{2} e_1^2 \} = \varphi_k$$

$$e_2^k = \underset{e_2}{\text{Argmax}}\, U_2 = \underset{e_2}{\text{Argmax}}\, \{ (1-\varphi_k) e_1 + \psi_k e_2 - \tfrac{1}{2} e_2^2 \} = \psi_k$$

Note that first-best investment levels are $e_1^* = e_2^* = 1$, so the managers always underinvest in the spot governance mode (since $\varphi, \psi < 1$). They should then choose the ownership structure (determining specific values of φ_k and ψ_k) that maximises the expected joint surplus

$$\begin{aligned} \Omega_k(\varphi_k, \psi_k) &= e_1(\varphi_k) + e_2(\psi_k) - c_1(e_1(\varphi_k)) - c_2(e_2(\psi_k)) \\ &= \varphi_k + \psi_k - \tfrac{1}{2}\varphi_k^2 - \tfrac{1}{2}\psi_k^2 \end{aligned}$$

where $e_1(\varphi_k)$ and $e_2(\psi_k)$ denote the optimal investments of the two managers, for a given investment specificity.

Although not necessary to generate the main results of the essay, it can be helpful to assume a ranking of the ownership structures that I discussed in section 2, in the sense that

$$1 > \gamma_{T1} \geq \gamma_{NI} \geq \gamma_{CO} \geq \gamma_{T2} = \gamma_{JO} \geq 0$$

$$1 > \lambda_{T2} \geq \lambda_{NI} \geq \lambda_{CO} \geq \lambda_{T1} = \lambda_{JO} \geq 0$$

Then, it follows directly from the definitions of φ and ψ that

$$1 > \varphi_{T1} \geq \varphi_{NI} \geq \varphi_{CO} \geq \varphi_{T2} = \varphi_{JO} \geq \tfrac{1}{2}$$

$$1 > \psi_{T2} \geq \psi_{NI} \geq \psi_{CO} \geq \psi_{T1} = \psi_{JO} \geq \tfrac{1}{2}$$

With these assumptions, the value of the outside option increases (weakly) with the number of assets the manager controls. Consider the set of inequalities for manager 1. By definition, there is a special link between manager 1 and asset 1, and the outside value is therefore assumed to be higher for the manager if she owns *her* asset instead of the other one (i.e. $\gamma_{NI} \geq \gamma_{CO}$). Type 2 integration and joint ownership are equivalent with respect to the outside option for manager 1, since manager 2 has the right to exclude her from both assets under both ownership structures.

The expected joint surplus increases in φ and ψ for the relevant range of these parameters. Joint ownership and cross ownership are therefore (weakly) dominated by non-integration in the spot governance mode (since $\varphi_{NI} \geq \varphi_{CO} \geq \varphi_{JO}$ and $\psi_{NI} \geq \psi_{CO} \geq \psi_{JO}$).

4. A linear implicit contract

Imagine that the cycle I 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. In this setting reputation effects may sustain implicit contracts.

Consider an implicit contract based on the realisations of the observable, but non-verifiable benefits of the two parties (θ_1^C and θ_2^C). Assume that the implicit contract is restricted to be linear, in the form of a vector (a, b, t), where a is 1's share of θ_1^C, b is 2's share of θ_2^C and t is a fixed transfer, which is positive when manager 1 is on the receiving end. Linear contracts are attractive from a bounded rationality perspective and to avoid strategic behaviour during a period.[8]

There is a common positive discount rate, r, which is constant over all periods. In other words, the parties are equally impatient with respect to when they would like their benefits. The implicit contract is continued as long as both parties respect it. But if one party chooses to renege on the contract, all *trust* is destroyed, and the parties will be unable to enter into an implicit contract afterwards.

After the uncertainty is resolved in one period, the two parties can write a verifiable contract on transactions in that period, so there is no risk of one of the parties honouring the implicit contract *ex post* while the other does not. Either the implicit contract is fulfilled in its entirety, or, if a party chooses to renege, the parties' bargaining positions decide the distribution of the surplus for that period (as in the spot governance mode).

There are three major scenarios for the future relations of the two parties when an implicit contract is broken. The most extreme would be that they become so angry with each other that no transaction is possible whatsoever. Or, they could agree to deal with each other in a spot governance mode without being allowed to change the ownership structure, even if another structure would yield a higher expected joint surplus (as in Halonen 1994). Finally, they could transfer the ownership rights (if that is desirable), and then settle in a spot governance mode under the best possible ownership structure for that mode (as in Baker, Gibbons and Murphy 1997).

Theoretically, the second scenario is odd, because the ownership structure under the implicit contract also decides the joint surplus after the implicit contract is broken. In

[8] Holmstrom and Milgrom (1987) argue convincingly for linear incentive contracts.

other words, the parties could agree on a very disadvantageous ownership structure to increase the expected *punishments* of contract violations.

The third scenario is more consistent with the basic assumptions. If the parties could have performed renegotiations under spot governance, it is difficult to understand why they cannot agree on an ownership transfer and a future spot relationship after an implicit contract is broken. The ownership transfer does only require that they negotiate a payment, which is verifiable and can be enforced by a court. And the spot governance mode as such does not require any trust at all, so the fact that there has been an implicit contract in place should not stop the parties from entering into a spot relationship afterwards (at least in a setting without very heated emotions).

Assume therefore that an ownership transfer is possible after an implicit contract violation. Index the best ownership structure under an implicit contract $i \in K$, and the best ownership structure under spot governance $s \in K$. Using the expression for the expected joint surplus from section 3, the discounted value added (Δ) from the transfer of ownership rights is

$$\Delta = {}^{1}/_{r} [\{ \varphi_s - \tfrac{1}{2}\varphi_s^2 + \psi_s - \tfrac{1}{2}\psi_s^2 \} - \{ \varphi_i - \tfrac{1}{2}\varphi_i^2 + \psi_i - \tfrac{1}{2}\psi_i^2 \}]$$

By definition $\Delta \geq 0$. Assume a 50:50 split of the value added from such a transfer.

For an implicit contract to hold, it must be incentive compatible for the two managers both *ex ante* and *ex post* in every period. *Ex ante*, a manager can follow three strategies.[9]

First, she can plan to keep the implicit contract forever. Given that the other manager follows the same strategy, the managers' effort levels are

$$e_1 = \underset{e_1}{\text{Argmax}} \{ a e_1 + (1-b) e_2 + t - \tfrac{1}{2} e_1^2 \} = a$$
$$e_2 = \underset{e_2}{\text{Argmax}} \{ (1-a) e_1 + b e_2 - t - \tfrac{1}{2} e_2^2 \} = b$$

Second, she can *ex ante* choose not to accept the implicit contract and communicate this to the other manager. Then a transfer of assets will occur immediately (if that is optimal), and there will be a spot relationship from period one. For the two managers to instead prefer the implicit contract (and follow the first strategy), the following inequalities must be satisfied

$$(1a) \quad {}^{1}/_{r} \{ \tfrac{1}{2} a^2 + b(1-b) + t \} \geq {}^{1}/_{r} \{ \tfrac{1}{2} \varphi_i^2 + \psi_i (1-\psi_i) \} + \tfrac{1}{2} \Delta$$

[9] Baker, Gibbons and Murphy (1997) discuss *ex-post* constraints only. In Halonen (1994) the implicit contract is linked directly to observable investments, so that only the *ex-ante* constraint is relevant.

(1b) $^1/_r\{ \frac{1}{2} b^2 + a(1-a) - t \} \geq {}^1/_r\{ \frac{1}{2} \psi_i^2 + \varphi_i (1-\varphi_i) \} + \frac{1}{2} \Delta$

Third, the manager can pretend that she accepts the implicit contract but *plan* to renege on it. Suppose that manager 1 follows this strategy while manager 2 invests according to the implicit contract. Manager 1 then invests φ, which is going to be her share of her own value added. And manager 2 invests b, which is more than she would invest under spot governance. This strategy would of course only be possible for one period. The following inequalities must thus hold for the two managers to prefer to be honest (and follow the first strategy)

(2a) $(1 + {}^1/_r)\{\frac{1}{2} a^2 + b(1-b) + t\} \geq \frac{1}{2} \varphi_i^2 + b(1-\psi_i) + {}^1/_r\{\frac{1}{2} \varphi_i^2 + \psi_i(1-\psi_i)\} + \frac{1}{2} \Delta$

(2b) $(1 + {}^1/_r)\{\frac{1}{2} b^2 + a(1-a) - t\} \geq \frac{1}{2} \psi_i^2 + a(1-\varphi_i) + {}^1/_r\{\frac{1}{2} \psi_i^2 + \varphi_i(1-\varphi_i)\} + \frac{1}{2} \Delta$

Ex post, after the uncertainty for that period is resolved, a manager may be tempted to renege on the implicit contract if the value added of the other manager is unexpectedly high while her own value added is low. Then the spot bargaining solution (φ, ψ) can be better for her in that particular period than the implicit contract (a, b). On the other hand, if she reneges, a spot relationship prevails forever after, which (in expectancy) generates lower future benefits, as given by (1a) and (1b). So for both managers to honour the contract *ex post*, the following two inequalities must hold in any given period

(3a) $a(e_1(a) + \varepsilon_1) + (1-b)(e_2(b) + \varepsilon_2) + t + 1/r\,[ae_1(a) + (1-b)e_2(b) + t - c_1(e_1(a))]$
$\geq \varphi_i(e_1(a) + \varepsilon_1) + (1-\psi_i)(e_2(b) + \varepsilon_2) + 1/r\,[\varphi_i e_1(\varphi_i) + (1-\psi_i)e_2(\psi_i) - c_1(e_1(\varphi_i))] + \frac{1}{2}\Delta$

(3b) $(1-a)(e_1(a) + \varepsilon_1) + b(e_2(b) + \varepsilon_2) - t + 1/r\,[(1-a)e_1(a) + be_2(b) - t - c_2(e_2(b))]$
$\geq (1-\varphi_i)(e_1(a) + \varepsilon_1) + \psi_i(e_2(b) + \varepsilon_2) + 1/r\,[(1-\varphi_i)e_1(\varphi_i) + \psi_i e_2(\psi_i) - c_2(e_2(\psi_i))] + \frac{1}{2}\Delta$

DEFINITION 4.1: An implicit contract is *self-enforcing* if (3a) and (3b) hold for all possible realisations of the uncertain variables ε_1 and ε_2.[10]

Later I will show that $a \geq \varphi_i$ and $b \geq \psi_i$ in all optimal implicit contracts. For now, just assume that this is true. Remember that $\varepsilon_j \in [-\varepsilon, \varepsilon]$. For an implicit contract to be self-enforcing, (3a) must hold for $(\varepsilon_1, \varepsilon_2) = (-\varepsilon, \varepsilon)$ and (3b) must hold for $(\varepsilon_1, \varepsilon_2) = (\varepsilon, -\varepsilon)$. (3a) and (3b) are then satisfied for all possible combinations of ε_1 and ε_2. Note that we do not need the particular probability distributions of ε_1 and ε_2.

[10] Self-enforcement is a strong condition (which is also used by Baker, Gibbons and Murphy 1997). In a more realistic version of the model, the parties could be willing to engage in an implicit contract that is broken in a given period with some positive probability. However, this extension does not seem to add significant insights.

We know that $(e_1, e_2) = (\varphi_i, \psi_i)$ under spot governance and $(e_1, e_2) = (a, b)$ if the implicit contract is expected to hold. When $a \geq \varphi_i$ and $b \geq \psi_i$, the self-enforcement constraints can thus be written as

(4a) $(b-\psi_i)(b+\varepsilon) - (a-\varphi_i)(a-\varepsilon) - t \leq 1/r\,[\tfrac{1}{2}a^2 + b(1-b) + t - \tfrac{1}{2}\varphi_i^2 - \psi_i(1-\psi_i)] - \tfrac{1}{2}\Delta$

(4b) $(a-\varphi_i)(a+\varepsilon) - (b-\psi_i)(b-\varepsilon) + t \leq 1/r\,[\tfrac{1}{2}b^2 + a(1-a) - t - \tfrac{1}{2}\psi_i^2 - \varphi_i(1-\varphi_i)] - \tfrac{1}{2}\Delta$

In other words, the gains from reneging in that particular period (that are given on the left-hand sides of the inequalities) must be offset by the expected future losses (that are given on the right-hand sides). Observe that the constraints are strengthened (for the same values of φ_i and ψ_i) if a transfer of ownership rights is expected after an implicit contract is broken (i.e. $\Delta > 0$), compared to the case where no such transfer is expected (i.e. $\Delta = 0$), since the *punishment* is reduced.

It is straightforward to show that (4a) and (4b) are stronger than the *ex-ante* constraints (1a), (1b), (2a) and (2b) if

$$(5) \quad \varepsilon \geq \text{Max}\left(\frac{(a-\varphi_i)^2}{2(a-\varphi_i+b-\psi_i)}, \frac{(b-\psi_i)^2}{2(a-\varphi_i+b-\psi_i)}, \frac{|a(a-\varphi_i)-b(b-\psi_i)+t|}{a-\varphi_i+b-\psi_i} \right)$$

This (sufficient – but not necessary) condition has the unfortunate feature that it includes the endogenous variables a, b and t. However, even with only the knowledge that $a \geq \varphi_i$, $b \geq \psi_i$ and $\psi_i, \varphi_i \geq \frac{1}{2}$ one can establish some limit values for the critical ε. It turns out that $\varepsilon \geq \frac{1}{4}$ is enough to guarantee that all the *ex-ante* constraints are satisfied for an optimal self-enforcing implicit contract under all possible settings.[11] This critical level of uncertainty is less than half of the minimum investment level for a manager.

All the major results of this essay are valid, irrespective of whether it is the *ex-ante* or the *ex-post* constraints that are binding (although a couple of the propositions must be slightly rephrased). It turns out to be more convenient to work with the *ex-post*

[11] Take the first expression of the parenthesis, which relates to (2a). This has its maximum value when $b = \psi$, $\varphi = \frac{1}{2}$ and $a = 1$, giving it a value of $\frac{1}{4}$. The analysis is similar for the second expression, which relates to (2b). For the third expression (relating to (1a) and (1b)) one must distinguish between the case where t can be non-negative and the case where t must be zero, which correspond to sections 5 and 6 respectively. In the former case, using the closed-form solutions for a, b and t that are developed in section 5, it can be shown that $\varepsilon \geq 0.375$ is sufficient (while a numerical analysis reveals that only $\varepsilon \geq \frac{1}{4}$ is necessary to guarantee the satisfaction of (1a) and (1b)). In the latter case, the maximum value is found by setting $b = \psi$ (or $a = \varphi$), which reduces the expression to a (or b), which then never would be set higher than 1. This is, however, a highly unrealistic solution. Numerical analysis reveals that (1a) and (1b) are satisfied for an *optimal* self-enforcing implicit contract also with a very small ε, when t must be zero.

constraints. Therefore, assume in the rest of the essay that ε is large enough for (5) to be satisfied and the *ex-ante* constraints to be ignored.

Then an optimal self-enforcing implicit contract solves

$$\underset{(a,b,t)}{\text{Max}} \{ a - \tfrac{1}{2} a^2 + b - \tfrac{1}{2} b^2 \}, \text{ subject to (4a) and (4b).}$$

Define $I \equiv {}^3/_2(\varphi_i^2 - \psi_i^2) - (\varphi_i - \psi_i)$. Note that $\varphi_i < \psi_i \Leftrightarrow I < 0$ for $\varphi_i, \psi_i \in [\tfrac{1}{2}, 1)$. I can be interpreted as a measure of manager 1's bargaining position relative to manager 2, given the ownership structure under the implicit contract. Remember from section 3 that the expected joint surplus in the spot governance mode is given by $\Omega_s \equiv \varphi_s + \psi_s - \tfrac{1}{2}(\varphi_s^2 + \psi_s^2)$. Setting in for Δ, (4a) and (4b) can then be reformulated as

(6a) $(b-\psi_i)(b+\varepsilon) - (a-\varphi_i)(a-\varepsilon) - t \leq 1/r [\tfrac{1}{2} a^2 + b(1-b) + t - \tfrac{1}{2} I - \tfrac{1}{2} \Omega_s]$

(6b) $(a-\varphi_i)(a+\varepsilon) - (b-\psi_i)(b-\varepsilon) + t \leq 1/r [\tfrac{1}{2} b^2 + a(1-a) - t + \tfrac{1}{2} I - \tfrac{1}{2} \Omega_s]$

where $\Omega_s = \Omega_i$ if no transfer of ownership rights is expected after an implicit contract violation.

The Lagrangian for the optimal self-enforcing implicit contract is given by

(7) $L(a, b, t, \lambda_1, \lambda_2) = a - \tfrac{1}{2} a^2 + b - \tfrac{1}{2} b^2$

$- \lambda_1 \{ (b-\psi_i)(b+\varepsilon) - (a-\varphi_i)(a-\varepsilon) - t - 1/r [\tfrac{1}{2} a^2 + b(1-b) + t - \tfrac{1}{2} I - \tfrac{1}{2} \Omega_s] \}$

$- \lambda_2 \{ (a-\varphi_i)(a+\varepsilon) - (b-\psi_i)(b-\varepsilon) + t - 1/r [\tfrac{1}{2} b^2 + a(1-a) - t + \tfrac{1}{2} I - \tfrac{1}{2} \Omega_s] \}$

where λ_1 and λ_2 denote the Lagrange multipliers for (6a) and (6b) respectively.

5. The optimal implicit contract with a fixed transfer

The implicit contract defined in the previous section could include a fixed transfer (as in Baker, Gibbons and Murphy 1997). I will later argue that such transfers are not observed in business relations as part of an implicit contract due to bounded rationality, risk aversion and social norms. However, from a theoretical point of view, it is interesting to study how such implicit contracts would have performed.

In section 4 I assumed that incentives are stronger under the implicit contract for both managers. Now I need to show that this result does hold.

PROPOSITION 5.1: An optimal implicit contract (with a fixed transfer) provides (weakly) stronger incentives for both the two managers compared to the spot governance mode under the same ownership structure (i.e. $a \geq \varphi_i$ and $b \geq \psi_i$).

PROOF: Proof by contradiction. Suppose that $a < \varphi_i$. Then $b > \psi_i$, since the implicit contract otherwise is worse than the spot governance mode. For the implicit contract to be self-enforcing, (3a) must now hold for $(\varepsilon_1, \varepsilon_2) = (\varepsilon, \varepsilon)$ and (3b) must hold for $(\varepsilon_1, \varepsilon_2) = (-\varepsilon, -\varepsilon)$. The Lagrangian for the optimal implicit contract is then given by

$$L(a, b, t, \lambda_1, \lambda_2) = a - \tfrac{1}{2} a^2 + b - \tfrac{1}{2} b^2$$
$$- \lambda_1 \{ (b-\psi_i)(b+\varepsilon) + (\varphi_i-a)(a+\varepsilon) - t - 1/r [\tfrac{1}{2} a^2 + b(1-b) + t - \tfrac{1}{2} I - \tfrac{1}{2} \Omega_s] \}$$
$$- \lambda_2 \{ -(\varphi_i-a)(a-\varepsilon) - (b-\psi_i)(b-\varepsilon) + t - 1/r [\tfrac{1}{2} b^2 + a(1-a) - t + \tfrac{1}{2} I - \tfrac{1}{2} \Omega_s] \}$$

where λ_1 and λ_2 denote the Lagrange multipliers for the two self-enforcement constraints. The first-order condition with respect to t implies that $\lambda_1 = \lambda_2 \equiv \lambda$ for the optimal contract. Then $\partial L / \partial a = 1-a + \lambda\{2\varepsilon + 1/r(1-a)\}$, which is positive for $a < \varphi_i$ (< 1). In other words, in the optimal contract a should be set at least equal to φ_i. But this result contradicts the assumption that $a < \varphi_i$, which thus cannot hold. Similar for $b < \psi_i$. QED.

We can therefore use (7) from the previous section to find the optimal implicit contract, remembering that the solution must satisfy the requirement $a \geq \varphi_i$ and $b \geq \psi_i$. As in the proof of proposition 5.1, the first-order condition with respect to t implies that $\lambda_1 = \lambda_2 \equiv \lambda$. The fixed transfer t is used to make the 'marginal costs' of each constraint the same. (6a) and (6b) can thus be combined to one constraint

$$(8) \quad 2\varepsilon (a + b - \varphi_i - \psi_i) \leq 1/r (a - \tfrac{1}{2}a^2 + b - \tfrac{1}{2}b^2 - \Omega_s)$$

If this constraint is satisfied, some t exists, so that both (6a) and (6b) hold.

First, consider the situation where $a > \varphi_i$ and $b > \psi_i$. The first-order conditions with respect to a and b then imply that the managers will enjoy equal incentives, even if they have very different bargaining positions (i.e. $a = b \equiv \alpha$). Equal incentives are good because the managers have identical convex cost functions. The solution to the optimisation problem is given by

$$(9) \quad \bar{\alpha} = \mathrm{Min}\left(1, 1 - 2\varepsilon r + \sqrt{(1-2\varepsilon r)^2 + 2\varepsilon r(\varphi_i + \psi_i) - \Omega_s}\right)$$

Note that with this implicit contract one should choose the ownership structure that maximises the sum $(\varphi_i + \psi_i)$, while under spot governance the structure that maximised $(\varphi_s + \psi_s - \frac{1}{2}\varphi_s^2 - \frac{1}{2}\psi_s^2)$ was best.[12]

Before we go on, consider under what circumstances first-best is sustainable.

PROPOSITION 5.2: A first-best implicit contract is *always* sustainable if the two parties are sufficiently patient (i.e. the discount rate is sufficiently low), when the implicit contract can include a fixed transfer.

PROOF: From (8) we see that first-best can be sustained when $2\varepsilon(2 - \varphi_i - \psi_i) \leq 1/r\,(1 - \Omega_s)$, which is always satisfied for $r \to 0$, since $\Omega_s < 1$ for all $\varphi_s, \psi_s \in [\frac{1}{2}, 1)$. QED.

Second, assume that $\bar{\alpha} < \text{Max}(\varphi_i, \psi_i)$. Suppose for instance that $\psi_i < \varphi_i$, so that $\psi_i < \bar{\alpha} < \varphi_i$. From the proof of proposition 5.1 we then know that $a^* = \varphi_i$. Set this value of a into the constraint (8), and solve for the optimal value of b

$$(10)\quad \bar{b} = 1 - 2\varepsilon r + \sqrt{(1-2\varepsilon r)^2 + 2\varphi_i - \varphi_i^2 + 4\varepsilon r\psi_i - 2\Omega_s}$$

Similarly, consider the case where $\varphi_i < \psi_i$, so that $b = \psi_i$. Then the optimal a is given by

$$(11)\quad \bar{a} = 1 - 2\varepsilon r + \sqrt{(1-2\varepsilon r)^2 + 2\psi_i - \psi_i^2 + 4\varepsilon r\varphi_i - 2\Omega_s}$$

The incentives under the optimal implicit contract are thus given by

$$(a^*, b^*) = \begin{cases} (\bar{\alpha}, \bar{\alpha}) & \text{if} \quad \text{Max}(\varphi_i, \psi_i) \leq \bar{\alpha} \\ (\varphi_i, \bar{b}) & \text{if} \quad \psi_i < \bar{\alpha} < \varphi_i \\ (\bar{a}, \psi_i) & \text{if} \quad \varphi_i < \bar{\alpha} < \psi_i \end{cases}$$

where $\bar{\alpha}$, $\bar{a}$ and $\bar{b}$ are defined in (9), (10) and (11). Now consider the fixed transfer of the contract.

[12] We should therefore reconsider the second proposition of Baker, Gibbons and Murphy (1997). There they argue that a transfer of ownership rights to a supplier will strengthen this supplier's incentives from the implicit contract. Hence, they claim, incentives are higher-powered under non-integration than under integration. As (9) illustrates, however, when the other party's bargaining position is weakened as a result of the transfer, it is not obvious under what ownership structure the incentives are the strongest. The technology will decide.

PROPOSITION 5.3: The manager with the best bargaining position will receive the fixed transfer, if such a transfer is part of the optimal implicit contract (i.e. $\varphi_i > \psi_i \Rightarrow t \geq 0$ and $\varphi_i < \psi_i \Rightarrow t \leq 0$).

PROOF: First, assume that $(a^*, b^*) = (\overline{\alpha}, \overline{\alpha})$, and that (6a) and (6b) bind. Subtract each side of (6b) from the respective side of (6a) to find t

$$t = \frac{\frac{1}{2}I + (\varphi_i - \psi_i)\overline{\alpha}r}{1+r}$$

Since $\varphi_i > \psi_i \Leftrightarrow I > 0$, it follows directly that t must be positive if $\varphi_i > \psi_i$, and vice versa. If the constraints are not binding, then a non-zero t is not needed in the implicit contract.

Second, consider the situation where $\psi_i < \overline{\alpha} < \varphi_i$. Then (6a) and (6b) with $(a^*,b^*) = (\varphi_i, \overline{b})$ imply that

$$t = \frac{(\overline{b} - \psi_i)(r\overline{b} + \frac{3}{4}(\overline{b} + \psi_i) - \frac{1}{2})}{1+r}$$

which also must be positive, since $\overline{b} > \psi_i \geq \frac{1}{2}$. Similarly, $\varphi_i < \overline{\alpha} < \psi_i$ implies that $t < 0$. QED.

In other words, it is the party with the worst bargaining position who must commit to a recurring fixed payment. This arrangement does not seem very attractive with respect to risk sharing. Adding risk aversion to the model, one would expect the weakest party to be the most risk averse of the two. She could also be wealth constrained, so that she would have difficulties paying a fixed payment in periods where the profits are low due to uncertain (external) factors. Risk aversion and wealth constraints can thus limit the use of fixed payments.

A fixed payment from a weaker to a stronger party will have much in common with the bribes or protection money that are observed in corrupt or Mafia-ridden societies. Such arrangements conflict with the social norms of most societies. A payment should compensate for value creation (through productive activities that are in the interest of the paying party) and not for a threat to obstruct justice or cause damage. In the same way, it can be considered unfair to take advantage of another party's high investment specificity to secure a fixed payment in addition to a large share (up to 100 percent) of own value added. In particular, it can be contrary to the social norm of equity, which prescribes that outcomes should be allocated among partners according to their inputs or contributions.

However, the strongest argument against the use of a fixed transfer as part of an implicit contract is based on the bounded rationality of the involved people. Managers will surely have difficulties understanding the role fixed payments could play in an implicit contract to shift the incentives to renege. For a fixed transfer to work, it must be established *ex ante* and be the same in every period. This demands very strong analytical capabilities, and the parties must be very conscious of how the implicit contract is going to work.

An implicit contract on the *share* of each manager's value added seems much easier to relate to. It is straightforward that a higher share of own value added strengthens the incentives to invest. And the managers can learn over time what share that will work in their particular environment. These are the shares that then will be considered a fair distribution of the value creation. A first-best contract will, of course, be particularly easy to understand. It will also conform fully to the social norm of equity.

My impression is that fixed payments do not seem to be included in implicit contracts in practice. But the empirical evidence remains to be gathered. Here I claim only that there are enough arguments to warrant a study of models where a fixed transfer is not allowed as part of the implicit contract. This I will do in the next section.

Note that I do not claim that fixed transfers are not important in business relations. But, I would argue that when there is such a recurring payment, it is usually part of a verifiable contract, and it is paid *to* the weaker party as part of a risk-sharing arrangement.

6. The optimal implicit contract without a fixed transfer

Consider a model where the implicit contract does not include a fixed transfer (which does seem to conform to actual business practice). That is, t is set equal to zero. A simple closed-form solution to the optimisation problem does then not exist. We must instead show the results in a somewhat more indirect way.

The *ex-ante* constraints (1a) and (1b), where $t = 0$, are useful to prove that the incentives are stronger for both managers under this implicit contract.

PROPOSITION 6.1: A viable implicit contract (without a fixed transfer) provides stronger incentives for *both* the two managers compared to the spot governance mode under the same asset ownership structure (i.e. $a > \varphi_i$ and $b > \psi_i$).

PROOF: (1a) and (1b) must also hold for $\Delta = 0$ (since $\Delta \geq 0$). Set $\Delta = 0$, multiply each inequality with r (which is positive) and reformulate to get

(12a) $\frac{1}{2}(a - \varphi_i)(a + \varphi_i) - (b - \psi_i)(b + \psi_i - 1) \geq 0$

(12b) $\frac{1}{2}(b - \psi_i)(b + \psi_i) - (a - \varphi_i)(a + \varphi_i - 1) \geq 0$

First, note that at least one of the inequalities $a > \varphi_i$ and $b > \psi_i$ must hold for an implicit contract to yield a higher joint surplus than the spot governance mode. Suppose $a > \varphi_i$. The second term of (12b) is then negative (since $\varphi_i \geq \frac{1}{2}$). For the inequality to hold, the first term must therefore be positive. That is, $a > \varphi_i \Rightarrow b > \psi_i$. Similarly, $a > \varphi_i$ must hold for (12a) to be satisfied if $b > \psi_i$. QED.

In other words, we can again use the optimisation problem as it is stated in (7), and we do not need to check for $a \geq \varphi_i$ and $b \geq \psi_i$, since the optimal contract will always satisfy those conditions (when (5) is assumed to hold). From the constraints (6a) and (6b) we can calculate the maximum discount rate for a given implicit contract to be feasible (when $t = 0$).

$$r \leq [\tfrac{1}{2} a^2 + b(1-b) - \tfrac{1}{2} I - \tfrac{1}{2} \Omega_s] / [(b-\psi_i)(b+\varepsilon) - (a-\varphi_i)(a-\varepsilon)] \equiv f(a, b, \varphi_i, \psi_i, \Omega_s)$$

$$r \leq [\tfrac{1}{2} b^2 + a(1-a) + \tfrac{1}{2} I - \tfrac{1}{2} \Omega_s] / [(a-\varphi_i)(a+\varepsilon) - (b-\psi_i)(b-\varepsilon)] \equiv g(a, b, \varphi_i, \psi_i, \Omega_s)$$

That is, $r \leq \text{Min}\{f(\cdot), g(\cdot)\}$. It can be shown that for a viable implicit contract, $f_a, g_b > 0$ and $f_b, g_a < 0$.

PROPOSITION 6.2: The manager with the strongest bargaining position will also (weakly) have the strongest incentives to invest under the optimal implicit contract (i.e. $\varphi_i > \psi_i \Rightarrow a \geq b$ and $\varphi_i < \psi_i \Rightarrow a \leq b$).

PROOF: Suppose $\varphi_i > \psi_i$. If $a = b$, then $g(\cdot) > f(\cdot) \geq r$ for a viable implicit contract. Since $f_a > 0$ and $g_a < 0$, the coefficient a can be increased until $g(\cdot) = f(\cdot)$. That will be a better implicit contract, since manager 1's incentives are strengthened, unless a and b already take the first-best values. $a < b$ will never be optimal, since $g(\cdot) > f(\cdot)$ then too. (To reach an optimal implicit contract, both a and b should be increased, but a must be increased more than b.) Similar for $\varphi_i < \psi_i$. QED.

COROLLARY: Managers with equal bargaining positions will enjoy the same incentive strength under an implicit contract (i.e. $\varphi_i = \psi_i \Rightarrow a = b$).

PROOF: From the proof of proposition 6.2 it is clear that $\varphi_i \geq \psi_i \Rightarrow a \geq b$ and $\varphi_i \leq \psi_i \Rightarrow a \leq b$. $a = b$ must therefore hold for $\varphi_i = \psi_i$. QED.

Note that proposition 6.2 and its corollary are true only when the production technologies of the two managers are symmetrical in nature. That is, the benefit and cost functions must be identical, and the ranges of the two error terms must be the same.

PROPOSITION 6.3: For sufficiently low discount rate r (i.e. the parties are sufficiently patient), a self-enforcing implicit contract *always* exists that is better than the optimal spot governance relationship.

PROOF: Suppose that the parties choose the best ownership structure for the spot governance mode as a basis for the implicit contract, so that $\Delta = 0$. In this setting, it is sufficient to show that for any combination (φ_i, ψ_i), where $\varphi_i, \psi_i \in [½, 1)$, there exists a pair (a, b), where $a \in (\varphi_i, 1]$ and $b \in (\psi_i, 1]$, so that the right hand sides of (4a) and (4b) are positive, when $t = 0$. Then the inequalities will hold if r is sufficiently low.

The following two inequalities are sufficient conditions for the right hand sides of (4a) and (4b) to be positive when $\Delta = 0$

$$a > \sqrt{\varphi_i^2 + 2\psi_i(1-\psi_i) - 2b(1-b)} \equiv h(b)$$

$$a < ½ + ½\sqrt{1 + 2b^2 - 2\psi_i^2 - 4\varphi_i(1-\varphi_i)} \equiv k(b)$$

$b \to \psi_i \Rightarrow h(b), k(b) \to \varphi_i$ and $k'(b) > h'(b) > 0$. Then some $b > \psi_i$ must exist, so that there is a non-empty range (h(b), k(b)) from which $a > \varphi_i$ can be chosen to satisfy both these conditions. QED.

In a first-best implicit contract (a, b) = (1, 1), and the self-enforcement constraints are given by

$$r \leq ½\,\frac{1 - I - \Omega_s}{(2 - \varphi_i - \psi_i)\varepsilon + (\varphi_i - \psi_i)} \equiv f^{FB}(\varphi_i, \psi_i, \Omega_s)$$

$$r \leq ½\,\frac{1 + I - \Omega_s}{(2 - \varphi_i - \psi_i)\varepsilon - (\varphi_i - \psi_i)} \equiv g^{FB}(\varphi_i, \psi_i, \Omega_s)$$

Since $\varphi_i < \psi_i \Leftrightarrow f^{FB}(\cdot) > g^{FB}(\cdot)$, it is only the self-enforcement constraint for the manager with the strongest bargaining position that is relevant for a first-best implicit contract.

PROPOSITION 6.4: First-best is not always sustainable, even if the discount rate goes to zero, when the implicit contract cannot include a fixed transfer.

PROOF: Let $r \to 0$. (4a) and (4b) are then reduced to the *ex-ante* constraints (1a) and (1b). With $t = 0$, $\Delta = 0$ and $a = b = 1$, these constraints imply that

$$½ + ½\sqrt{2\psi_i^2 - 1} \leq \varphi_i \leq \sqrt{1 - 2\psi_i(1-\psi_i)} \quad \text{for } \psi_i > \sqrt{½}.$$

For $\psi_i \leq \sqrt{½}$, only the second inequality is relevant. Note that the values φ_i can take include ψ_i. Suppose that $\psi_i = 0.75$. Then $0.677 \leq \varphi_i \leq 0.791$ must hold for a first-best implicit contract to be sustainable. The constraints will be even stricter for $\Delta > 0$. If φ_i has a value outside the critical range, first-best is not sustainable. QED.

The proof of proposition 6.4 indicates that for a first-best implicit contract to be self-enforcing, the two managers must enjoy relatively similar bargaining positions. The next proposition shows that equal bargaining positions are good to sustain first-best, since deviations from such symmetry will increase one of the parties' temptation to renege on the implicit contract.

PROPOSITION 6.5: Suppose that an ownership structure can be chosen where the managers have equal bargaining positions ($\varphi = \psi$), and that the managers are just sufficiently patient for first-best to be sustained with an implicit contract (without fixed transfer) for that ownership structure. That is, $r = f^{FB}(\cdot) = g^{FB}(\cdot)$. A one-sided change in bargaining positions would then require the parties to be more patient for the first-best implicit contract to still be self-enforcing (since $f^{FB}(\cdot)$ or $g^{FB}(\cdot)$ must decrease).

PROOF: Suppose $\varphi_i = \psi_i$. Then $f^{FB}(\cdot) = g^{FB}(\cdot)$. It is straightforward to verify that f_φ^{FB}, $g_\psi^{FB} < 0$ and f_ψ^{FB}, $g_\varphi^{FB} > 0$, both when a transfer of ownership rights is expected after an implicit contract is broken and when it is not expected (as long as $f^{FB}(\cdot)$, $g^{FB}(\cdot) > 0$). A one-sided increase or decrease in φ_i or ψ_i must therefore reduce either $f^{FB}(\cdot)$ or $g^{FB}(\cdot)$. QED.

The basic results that were stated in propositions 6.1, 6.2 and 6.3 are valid regardless of whether the implicit contract can include a fixed transfer or not.[13] That is not true for propositions 6.4 and 6.5. Proposition 5.2 showed that symmetry was not important for a first-best implicit contract with a fixed transfer. But, without such a transfer, the implicit contract is no longer as effective. It is then more difficult to provide the managers with equal incentives (which is good because the managers have identical convex cost functions). That means that the choice of ownership structure becomes more important. Ownership structures with symmetrical bargaining positions are good, because it is then easier to achieve similar incentive strengths for the two managers.

[13] The proofs are straightforward for the case with a fixed transfer, since one can then use the closed-form solution for (a*, b*).

a) The choice of ownership structure

Now consider the choice of ownership structure in some more detail. Assume that technology is given, so that the only way the managers can influence their respective bargaining positions is through their common choice of ownership structure.

To investigate whether it in general is optimal to choose an ownership structure different from the one that is optimal under spot governance, consider the optimisation problem given in (7) when a transfer of ownership rights is expected to take place after an implicit contract violation ($\Delta > 0$). Due to the envelope theorem, $\partial L/\partial \varphi_i$ and $\partial L/\partial \psi_i$ express the change in the maximum joint surplus for a one-sided strengthening of manager 1's and manager 2's bargaining positions respectively.

(13a) $\partial L / \partial \varphi_i = - \lambda_1 \{ a - \varepsilon + \frac{1}{2} (3\varphi_i - 1) / r \} + \lambda_2 \{ a + \varepsilon + \frac{1}{2} (3\varphi_i - 1) / r \}$

(13b) $\partial L / \partial \psi_i = \lambda_1 \{ b + \varepsilon + \frac{1}{2} (3\psi_i - 1) / r \} - \lambda_2 \{ b - \varepsilon + \frac{1}{2} (3\psi_i - 1) / r \}$

PROPOSITION 6.6: Suppose that r is sufficiently low so that a self-enforcing implicit contract exists that is better than the best spot governance relationship. Then it is always optimal to marginally *strengthen* one of the parties' bargaining positions (while the other is held constant), as long as both coefficients of the optimal implicit contract are below the first-best level (a, b < 1), a transfer of ownership rights is expected to take place after an implicit contract is broken, and the bargaining positions under the spot governance mode are not affected.

PROOF: $\lambda_1, \lambda_2 > 0$ if both constraints are binding. In (13a) use the expressions for λ_1 and λ_2, that are found from $\partial L / \partial a = 0$ and $\partial L / \partial b = 0$, to find

$$\partial L / \partial \varphi_i > 0 \Leftrightarrow (1-a) \left(a + 2b - \psi_i + \frac{3(b + \varphi_i) - 2}{2r}\right) + (1-b) \left(a - \varphi_i + \frac{3(a - \varphi_i)}{2r}\right) > 0$$

The latter inequality is always satisfied when a, b < 1, since $a > \varphi_i \geq \frac{1}{2}$ and $b > \psi_i \geq \frac{1}{2}$. Similar for $\partial L / \partial \psi_i$. QED.

Strong bargaining positions are in general good for the implicit contract, since the temptation to renege then is weak for a given implicit contract (as φ_i is close to a and ψ_i is close to b). That means that there will be a tendency to choose the ownership structure under an implicit contract with as strong bargaining positions as possible. This tendency is also present under spot governance, since the expected joint surplus, $\Omega_s = \varphi_s + \psi_s - \frac{1}{2} (\varphi_s^2 + \psi_s^2)$, increases in φ_s and ψ_s for the relevant range of these parameters. These two results held together show that the same ownership structure tends to maximise the expected joint surplus under both spot governance and implicit contracting. However, as propositions 6.4 and 6.5 indicate, an implicit contract can also benefit from symmetry in the bargaining positions. Hence, if another ownership

structure implies more symmetrical bargaining positions, it can be optimal to choose that structure instead of the one that is optimal under spot governance.[14]

To illustrate how an implicit contract can benefit from symmetry, assume that the best ownership structure in a spot governance mode is $(\varphi_s, \psi_s) = (0.9, 0.6)$, so that $\Omega_s = 0.915$, and set $\varepsilon = ½$. A first-best implicit contract is then self-enforcing for a given set of (φ_i, ψ_i), if the discount rate (r) is not higher than the values given in table 1. Some boxes are left blank. These combinations of φ_i and ψ_i are not relevant for the given value of Ω_s, since if they were available in the implicit contract mode, they would also be available as spot governance structures yielding a higher Ω_s. Negative values indicate that the first-best implicit contract is not self-enforcing even if the discount rate is zero.

		ψ(s)										
		0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	0.99
	0.50	0.09	0.05	0.02	-0.02	-0.06	-0.11	-0.15	-0.20	-0.25	-0.31	-0.35
	0.55	0.05	0.09	0.05	0.00	-0.04	-0.10	-0.15	-0.20	-0.26	-0.32	-0.37
	0.60	0.02	0.05	**0.11** JO	**0.05** CO	-0.01	-0.07	-0.14	-0.20	**-0.26** T1		
	0.65	-0.02	0.00	0.05	0.12	0.04	**-0.03** NI					
	0.70	-0.06	-0.04	**-0.01** T2	0.05	0.14						
φ(s)	0.75	-0.11	-0.10	-0.07	-0.03							
	0.80	-0.15	-0.15	-0.14								
	0.85	-0.20	-0.20	-0.20								
	0.90	-0.25	-0.26	-0.26								
	0.95	-0.31	-0.32									
	0.99	-0.35	-0.37									

Table 1.

Observe that a one-sided weakening of a party's bargaining position now can be good to sustain a first-best contract, since it leads to more symmetrical bargaining positions. This may seem counter to proposition 6.6, but the reader should remember that the proposition was valid for a, b < 1 only. It can be optimal to set one of the coefficients higher than one, if the bargaining positions are very different (and the implicit contract is relatively close to achieve first-best). Then the inefficiencies due to over-investment are outweighed by the strengthened incentives to invest for the manager with the weakest bargaining positions. Over-investment is necessary to keep the implicit contract self-enforcing. Weakening the strongest bargaining position can then be good, since over-investment is reduced and at the same time the other (under-investing) manager's incentives is strengthened.

Since technology is fixed, the two managers may only choose between the five sets of (φ_i, ψ_i) that correspond to the ownership structures defined in section 2. In the table

[14] There is also a tendency to choose the same ownership structures for both governance modes if the implicit contract can include a fixed transfer, but then more *asymmetrical* bargaining positions can support a better implicit contract under some settings.

I have indicated five boxes (with bold font), so that the basic assumptions of section 3 with respect to bargaining positions for the different ownership structures are satisfied ($\varphi_{T1} \geq \varphi_{NI} \geq \varphi_{CO} \geq \varphi_{T2} = \varphi_{JO}$ and $\psi_{T2} \geq \psi_{NI} \geq \psi_{CO} \geq \psi_{T1} = \psi_{JO}$). This example is summarised in table 2.

Ownership structure	φ_i	ψ_i	Max r to sustain first-best
T1	0.90	0.60	-0.26
NI	0.75	0.65	-0.03
CO	0.65	0.60	0.05
T2	0.60	0.70	-0.01
JO	0.60	0.60	0.11

Table 2.

Suppose for instance that the discount rate is 0.08. Then joint ownership (partnership) is optimal, since that is the only structure where first-best can be sustained. But if we change the assumptions of what bargaining positions that each ownership structure implies, the ranking can change. Suppose (φ_{CO}, ψ_{CO}) = (0.65, 0.65), while the other assumptions remain the same. Then cross ownership (mutual hostage taking) dominates the other structures to achieve first-best. Similarly, if (φ_{NI}, ψ_{NI}) = (0.70, 0.70), non-integration (a relational contract) would be better. In this way we can also change around the assumptions so that integration (type 1 or type 2) becomes optimal.

PROPOSITION 6.7: The optimal ownership structure for the implicit contract mode can be different from the optimal structure under spot governance. No ownership structure can be ruled out before the corresponding bargaining positions are known.

PROOF: One can easily construct examples from table 1 that satisfy the assumptions with respect to the relative bargaining positions of the different ownership structures, so that in each example a different ownership structure is optimal under the implicit contract, while the structure that is optimal under spot governance remains unchanged. QED.

To sum up, the two managers should choose the same ownership structure under the implicit contract as they would have done under spot governance, unless another ownership structure with more symmetrical bargaining positions can support a better implicit contract. The assumptions we have made so far are in general not enough to rule out any of the ownership structures as the optimal one under implicit contracting (while joint ownership and cross ownership are dominated by non-integration under spot governance).

b) The choice of technology

Above I assumed that technology was given, so that only the choice of ownership structure could influence the bargaining positions. Now consider the situation where the managers can choose between technologies. For simplicity, assume that the managers choose the ownership structure for the implicit contract that yields the highest expected joint surplus also in the spot governance mode. Then no transfer of ownership rights is expected after an implicit contract violation ($\Delta = 0$). Focus on the interesting special case where the two managers have equal bargaining positions in the first place.

PROPOSITION 6.8: Suppose that the two managers have equal bargaining positions $\varphi = \psi \equiv k$. Assume that the discount rate r is sufficiently low, so that a self-enforcing implicit contract exists for that setting, but that first-best is not sustainable. Then the expected joint surplus can be increased through a *weakening* of one of the parties' bargaining positions (while the other is held constant), when a transfer of ownership rights is not expected to take place after an implicit contract is broken.

PROOF: Set $\varphi \equiv \varphi_i = \varphi_s$ and $\psi \equiv \psi_i = \psi_s$. If $\varphi = \psi \equiv k$, then $a = b \equiv \alpha$ (from the corollary to proposition 6.2) and $\lambda_1 = \lambda_2 \equiv \lambda$ in the Lagrangian for the optimisation problem (since everything is symmetrical). If $\alpha < 1$, both constraints must be binding, so that $\lambda > 0$. $\partial L/\partial\varphi$ and $\partial L/\partial\psi$ express the change in the maximum joint surplus for a one-sided strengthening of manager 1's and manager 2's bargaining positions respectively. From (7) it can then be shown that (when $\varphi = \psi \equiv k$)

$$\frac{\partial L}{\partial \varphi}, \frac{\partial L}{\partial \psi} < 0 \quad \Leftrightarrow \quad r < \frac{1-k}{2\varepsilon}$$

From (4a) and (4b), we know that under these circumstances $r \leq (2 - \alpha - k) / 4\varepsilon$ must hold for the implicit contract to be self-enforcing. The inequality on the right hand side is then always satisfied, since $k < \alpha$. In other words, $\partial L/\partial\varphi < 0$ and $\partial L/\partial\psi < 0$ hold if the implicit contract is self-enforcing, $\varphi = \psi \equiv k$ and $a = b < 1$. QED.

The proposition is independent of whether the implicit contract can include a fixed transfer or not. Compare the result with proposition 6.6, when a weakening of bargaining positions was bad, because the temptation to renege in a given period then increases. Now that effect is countered by an increase in the future losses associated with an implicit contract violation, since the incentives under spot governance are weakened as well. That was not the case in proposition 6.6, where the expected joint surplus under spot governance (Ω_s) was held constant.

Proposition 6.8 shows that with the specific cost functions that I have assumed in this essay, the net effect of a weakening of bargaining positions is positive if the parties

have similar bargaining positions to start with. That does no longer need to be the case if the managers have very asymmetrical bargaining positions.[15] Also note that the proposition is no longer true if investments are very elastic with respect to the investment specificity parameters.[16]

Since the proposition only holds when no transfer of ownership rights is expected after an implicit contract violation, the result is not relevant for the choice between ownership structures. But, if there are alternative *technologies*, then one with higher investment specificity can generate a higher joint surplus. Hence, I have shown that under some circumstances stronger interdependencies can be good, even if such a technology does not imply higher returns on investments.[17] The model provides therefore 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).

The fact that stronger interdependencies sometimes are good can also be illustrated with a diagram that shows the highest value the discount rate can take for a first-best implicit contract (without fixed transfers) to be self-enforcing, see figure 2 (where $\varepsilon = ½$ and $\Delta = 0$). A weakening of φ (ψ) is always good to sustain a first-best implicit contract if $\varphi > \psi$ ($\varphi < \psi$). And, when $\varphi = \psi \equiv k$, a smaller k can sustain a first-best contract for higher discount rates (proposition 6.8). Observe that symmetrical bargaining positions are good to sustain first-best (proposition 6.5), and that first-best is not always sustainable, even if the discount rate is zero (proposition 6.4). The absolute level of the discount rate in figure 2 is not very interesting, since it depends crucially on the technology assumptions of the model (e.g. the form of the cost function and the choice of ε).

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[15] $\partial L / \partial \varphi < 0$ and $\partial L / \partial \psi < 0$ will hold as long as $|\varphi - \psi|$ (and hence $|a - b|$) is not too large, when a, $b < 1$. The critical value that $|\varphi - \psi|$ can take decreases in ε (stronger temptation to renege), while it increases in r (more weight on future losses).

[16] Suppose $c_i(e_i) = {}^1/_m\, e_i^m$. Then $m \geq 1.58$ must hold for proposition 6.8 to be valid ($m = 2$ in my model). When investments are very elastic, however, the increased temptation to renege dominates the increased punishment effect (Halonen 1994).

[17] Note that stronger interdependencies can be good also when asset transfers are expected after an implicit contract violation, but only if investment specificities for the optimal ownership structure under spot governance then increase, so that expected future losses associated with reneging become more important.

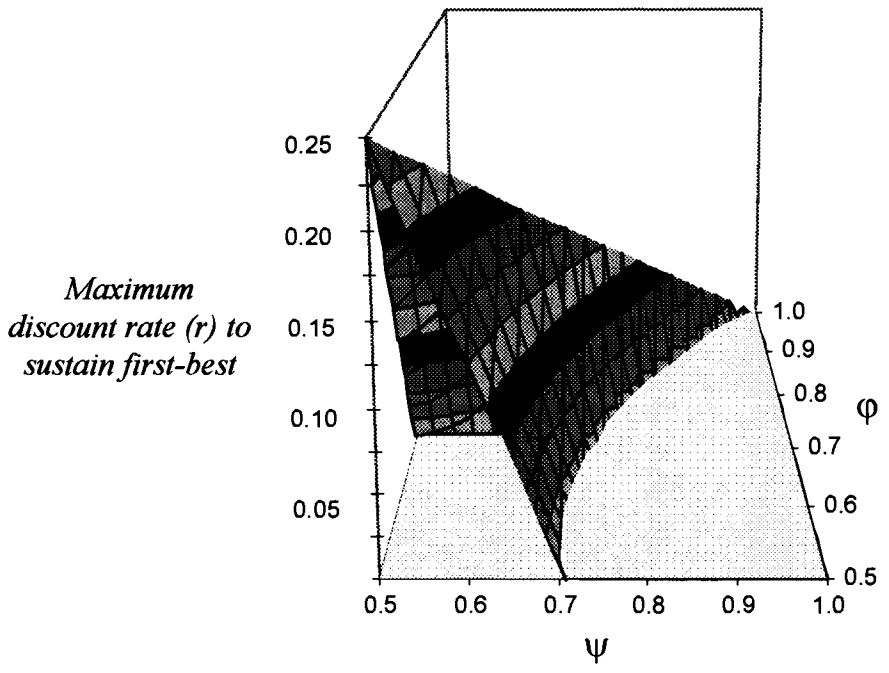

Figure 2.

7. The choice of ownership structure under spot governance

As stated in section 6, the assumptions we have taken so far are not strong enough to rule out any of the ownership structures in the implicit contract mode, and I do not think that such (stronger) assumptions should be taken in a general theory of the firm. However, some more structure with respect to the investment specificity technology can be useful to illustrate some of the results. In this section I develop a model of the investment specificity technology that allows us to compare the different ownership structures under spot governance. In the next section I use this model to construct an example with implicit contracts.

Assume a weak form of symmetry, in the sense that there is a linear relation between the specificities of the two managers' investments[18]

$$\varphi_{T1} = 1 - \tfrac{1}{2}A\eta_1 \qquad \psi_{T1} = 1 - \tfrac{1}{2}\eta_2$$

$$\varphi_{NI} = 1 - \tfrac{1}{2}A\eta_{NI} \qquad \psi_{NI} = 1 - \tfrac{1}{2}\eta_{NI}$$

$$\varphi_{T2} = 1 - \tfrac{1}{2}A\eta_2 \qquad \psi_{T2} = 1 - \tfrac{1}{2}\eta_1$$

[18] Since cross ownership and joint ownership are dominated by non-integration in the spot governance mode, those ownership structures are ignored in this section.

where $0 < \eta_1 \leq \eta_{NI} \leq \eta_2 \leq 1$, and $A \in (0, {}^1/\eta_2]$. A can be interpreted as a measure of relative investment specificity. η_1 is used when a manager owns both assets, η_{NI} when she only owns one asset and η_2 when she does not own any asset at all.

Setting the expressions for φ and ψ into the expression for the expected joint surplus found in section 3, it is straightforward to show that

(14) $\Omega_{T1} > \Omega_{T2} \Leftrightarrow A > 1$

(15) $\Omega_{T1} > \Omega_{NI} \Leftrightarrow (\eta_{NI}^2 - \eta_1^2)A^2 > \eta_2^2 - \eta_{NI}^2$

(16) $\Omega_{T2} > \Omega_{NI} \Leftrightarrow \eta_{NI}^2 - \eta_1^2 > (\eta_2^2 - \eta_{NI}^2)A^2$

Although outside the core of this essay (and not necessary for the example in the next section), consider some interpretations and special cases of these three results. First, compare integration of type 1 and type 2.

DEFINITION 7.1: Manager 1 has a higher (lower) investment specificity than manager 2 when $A > 1$ ($A < 1$).

PROPOSITION 7.1: The manager with the highest degree of investment specificity should own both assets in the spot governance mode when integration is optimal.

PROOF: The proposition follows directly from (14) and definition 7.1. QED.

Second, compare integration and non-integration.

DEFINITION 7.2: The two assets are strictly complementary when $\eta_2 = \eta_{NI}$.

Then one asset is of no value if it cannot be used together with the other asset.

PROPOSITION 7.2: If the assets are strictly complementary in nature, some type of integration (weakly) dominates non-integration in the spot governance mode.

PROOF: If the assets are strictly complementary in nature, we can substitute η_{NI} for η_2 in (15) and (16), which then imply

$$\Omega_{T1} \geq \Omega_{NI} \Leftrightarrow \eta_{NI} \geq \eta_1$$

$$\Omega_{T2} \geq \Omega_{NI} \Leftrightarrow \eta_{NI} \geq \eta_1$$

The inequalities on the right hand side are by definition satisfied, hence both T1 and T2 (weakly) dominate NI. QED.

Finally, consider a situation where a manager is essential to an asset, so that the other manager cannot gain from owning that asset (if the two managers do not cooperate).

DEFINITION 7.3: A manager is essential for the asset most specific to her investments when $\eta_1 = \eta_{NI}$.

PROPOSITION 7.3: Non-integration (weakly) dominates integration in the spot governance mode when both managers are essential with respect to the asset most specific to each manager.

PROOF: If both managers are essential for the asset most specific to their own investments, we can substitute η_{NI} for η_1 in (15) and (16), which then imply

$$\Omega_{T1} \leq \Omega_{NI} \quad \Leftrightarrow \quad \eta_2 \geq \eta_{NI}$$

$$\Omega_{T2} \leq \Omega_{NI} \quad \Leftrightarrow \quad \eta_2 \geq \eta_{NI}$$

The inequalities on the right hand side are by definition satisfied, hence both T1 and T2 are (weakly) dominated by NI. QED.

In this section I have demonstrated that non-integration dominates integration in the spot governance mode if each manager is essential to the use of *her* asset, while the opposite is the case if the assets are strictly complementary in nature. The manager with the highest investment specificity will then own both the assets.

Since Hart and Moore (1990) and Hart (1995) have already provided us with excellent insights on the choice of ownership structure in the spot governance mode, I have kept my discussion in this section rather short. Note that proposition 7.2 is a variation of proposition 6 in Hart and Moore (1990) and proposition 2(E) in Hart (1995 ch.2), while proposition 7.3 corresponds to proposition 8 in Hart and Moore (1990) and proposition 2(D) in Hart (1995 ch.2).

8. An example

Assume the investment specificity technology of section 7. Set $\eta_1 = 0.30$, $\eta_{NI} = 0.38$, $\eta_2 = \eta_{JO} = 0.50$ and $\varepsilon = ½$. Manager 2's bargaining positions under the different ownership structures are then

$$\psi_{T1} = \psi_{JO} = 0.75, \quad \psi_{NI} = 0.81 \quad \text{and} \quad \psi_{T2} = 0.85.$$

Since I have argued that implicit contracts are not likely to include fixed transfers, assume that this is the case (i.e. $t = 0$ as in section 6). The managers choose the governance structure (ownership structure and governance mode) that maximises expected joint surplus.

Figure 3 shows how the optimal governance structure is jointly determined by the relative investment specificity (A) and the discount rate (r).

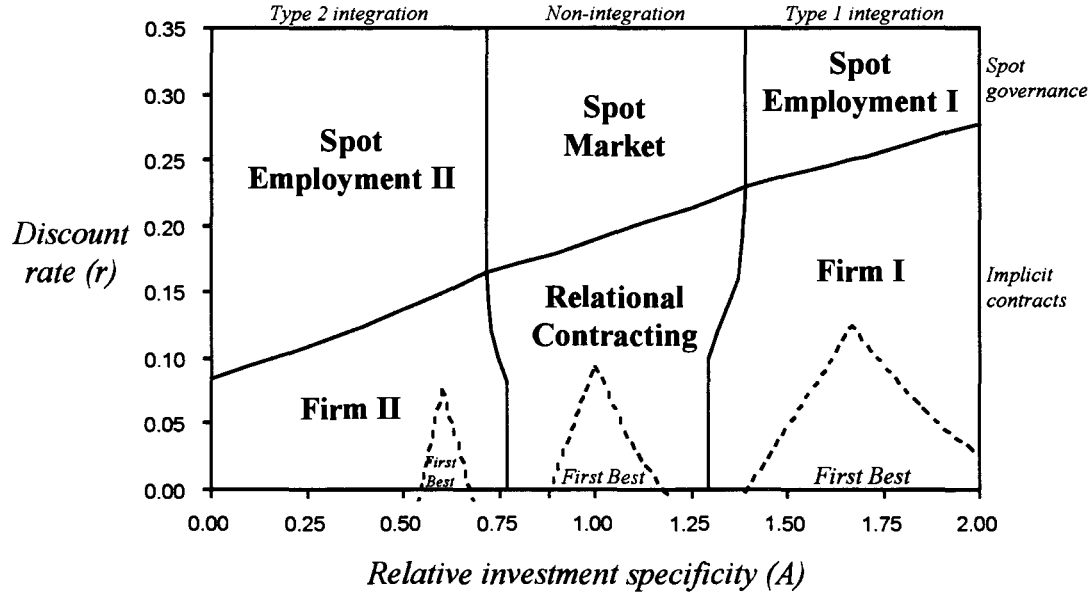

Figure 3.

As stated in proposition 6.3, irrespective of investment technology, an implicit contract can always be found that outperforms spot governance when the discount rate is sufficiently low (i.e. the parties are sufficiently patient). However, first-best is not always sustainable, even if the discount rate goes to zero (proposition 6.4).

The two managers' bargaining positions are equal for three values of the relative investment specificity parameter A: $A = \eta_1/\eta_2 = {}^3/_5$ (under T2), $A = 1$ (under NI, CO and JO) and $A = \eta_2/\eta_1 = {}^5/_3$ (under T1). First-best can only be achieved if A is close to these values (and the corresponding ownership structure is chosen). Exactly equal bargaining positions are superior with respect to how impatient the parties can be (proposition 6.5).

For high discount rates there exists no self-enforcing implicit contract. The indifference curves between spot employment (I and II) and spot market are found from (15) and (16) in section 7. The investment specificity technology is defined so that going from spot employment to spot market, the positive effects of one manager's strengthened incentives outweigh the negative effects of the other manager's weakened incentives when A is close to 1.

For a given technological setting (here denoted by a specific A), the same ownership structure tends to maximise the expected joint surplus under both spot governance and implicit contracts, since strong bargaining positions are good under both

governance modes (proposition 6.6). However, an ownership structure with more symmetrical bargaining positions can under some settings sustain a better implicit contract, although the expected joint surplus under spot governance does go down. This is typically the case when the optimal ownership structure under spot governance would have implied that one of the managers had to be given incentives to over-invest in the corresponding implicit contract.

In the example, more symmetrical bargaining positions are obtained by choosing integration for a larger range of A under implicit contracting than under spot governance. With other values of η_1, η_2 and η_{NI} it could be the other way around. In fact, for sufficiently large η_{NI}, non-integration would be dominated by integration under spot governance for all values of A, while relational contracting still could dominate firms.

The indifference curve between spot governance and implicit contracts is influenced by the overall level of efficiency loss due to relationship- and asset-specificity. The way the example is constructed, the specificity of manager 1's investments increases as A increases, while the specificity of manager 2's investments is constant. In other words, the overall efficiency loss in the spot governance mode increases going from left to right in the diagram. The potential gains of implicit contracts are then larger, and an implicit contract is self-enforcing for higher discount rates (Baker, Gibbons and Murphy 1997).

Compare the three areas where first-best is possible. Note that the area to the right (where the overall efficiency loss is higher) is larger than the other two areas. This illustrates the same phenomenon that we saw in proposition 6.8 and figure 2. Technologies with strong interdependencies can be good, although the returns on investments remain the same.

Relational contracting dominates mutual hostage taking and partnerships for all (A, r) in this example, due to the linear relation between the specificities of the two mangers' investments. However, partnerships become more interesting if there, for all practical purposes, is only one asset to own. That is often the case, either because the assets are very complementary in nature, or because the asset is indivisible. Then non-integration and cross ownership are not relevant. In the spot governance mode, joint ownership will be dominated by spot employment as before. However, partnerships can dominate firms. This is illustrated in figure 4, where the assumptions otherwise are the same as in figure 3.[19]

[19] η_1 is now used when a manager owns the single asset, and η_2 (= η_{JO}) is used when she does not own it.

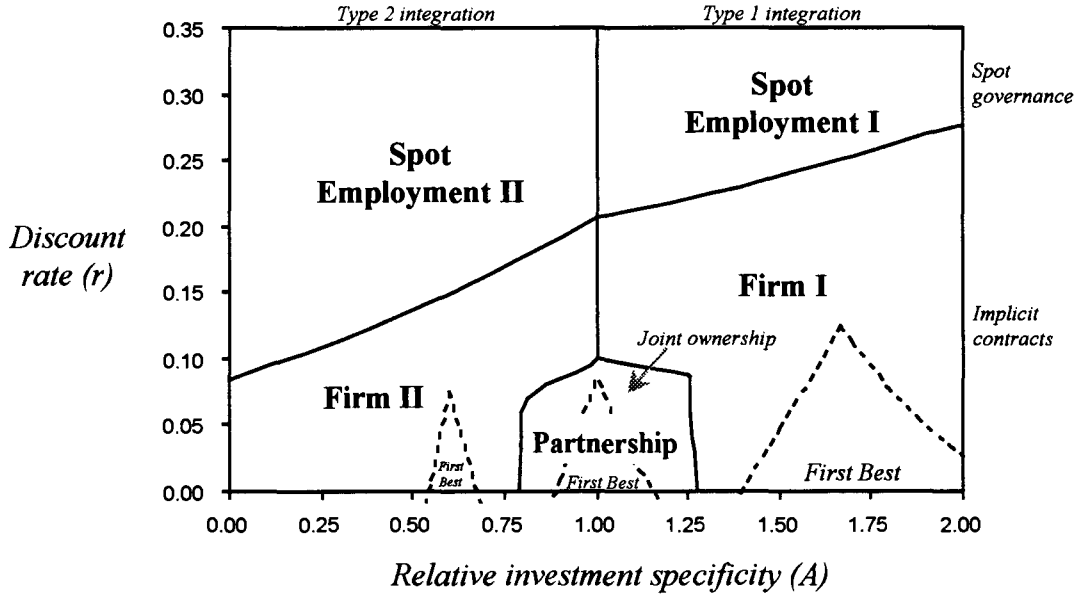

Figure 4.

Settings where the two parties have similar technologies, they take a long-term perspective, and there is only one asset to own, are favourable to partnerships. These conditions seem to be satisfied for many law and management-consulting firms (where the only significant asset is the company name), which indeed often are jointly owned by active partners.

Of course, the size of the area in figure 4 where partnership dominates firms depends on the parameter setting. Partnership will be the optimal structure under a larger range of (r, A) if for instance η_1 is reduced (while the other parameters remain the same), since the regions for first-best under Firm I and Firm II then will be further away from A = 1.

9. Concluding remarks

In this essay I have suggested a model for corporate governance with asset ownership and implicit contracts. In a dynamic setting, where both managers make asset- and relationship-specific investments, there is room for partnerships (joint ownership) and mutual hostage taking (cross ownership) alongside firms, relational contracting, spot employment and spot markets.

First, I studied an implicit contract that could include a fixed transfer. In that setting the problem has a closed-form solution, which simplifies the analyses. However, I argued that there are strong arguments against such a fixed transfer, which would have to be paid by the party with the weakest bargaining position. In particular, I

emphasised bounded rationality, risk sharing and social norms. Therefore, I have also analysed the case where the implicit contract does not include a fixed transfer.

I showed that ownership then matters even if the parties are infinitely patient. Although the same ownership structure tends to be optimal under spot governance and implicit contracts, another structure with more symmetrical bargaining positions can sometimes sustain a better implicit contract. The fact that symmetry can be good for the implicit contract may explain why long-term partners that otherwise seem very similar, often have symmetrical ownership rights. Either they own a firm together on equal terms (partnerships), or they work together on a long-term basis as two separate firms (relational contracting).

The bargaining positions (resulting from the levels of investment specificity) can be influenced not only by the ownership structure but also by the initial choice of technology. In some settings, the parties will benefit from increasing the technical interdependencies to weaken the bargaining positions. Holmstrom and Roberts (1998) refer to several examples where an extraordinary high degree of mutual dependence seems to explain why an alliance has worked well. But, one should remember that the expectation of a more effective business process usually is the main motivation for the introduction of relationship-specific technology in a business firm. The important insight is therefore that the choice of technology will have both operational and transaction cost consequences.

To focus on the fundamental issues of investment specificity, I have used a very simple modelling technology. Still, I was able to generate predictions on ownership structures and the qualities of the implicit contract that seem to be more realistic than those of earlier comparable papers (Halonen 1994, Baker, Gibbons and Murphy 1997). In particular, with two parties who both invest, the model is relevant for partnerships and strategic alliances to support innovative activities (as described by Teece 1992).

The model is flexible in the sense that it is valid for any number of assets. In fact, asset ownership enters the model only in the way it determines the *ex-post* bargaining positions of the two managers. Therefore one may use the model also in a setting where the parties contract on other types of decision rights that can impact the bargaining positions, for example the right to decide on (or to veto) product modifications or licensing to third parties. And, the model can be used if an explicit contract regulates the rights to the income stream when the parties cannot agree on a fair split according to the implicit contract (Klein 1996). The more rights there are to distribute, the more flexibility the parties have in finding a governance structure that can support a good implicit contract.

A manager in the model can be interpreted as a business unit or a large firm that has interactions with other units or firms. The model has not, however, room for a centralised authority that can instruct a unit on how much to invest or on how the cooperation with other units in the same firm should be regulated (see essay IV). It could be extended to include more than two parties by using the Shapley value as a solution concept (Hart and Moore 1990).

The model seems realistic in a bounded rationality perspective, since the structure of the managerial decisions is quite simple. In an implicit contract mode, they must only choose an ownership structure and agree on a way to split the joint surplus according to how they *feel* that each manager has contributed to the joint surplus. However, if the implicit contract was to include a fixed transfer, the managers would have to perform more conscious calculations, since the fixed transfer can only work when it is agreed upon and understood *ex ante*.

To simplify the analysis, I let the joint surplus depend additively on the two managers' investments, so that the implicit contract could be based on the value added of each manager. Theoretically this is not very different from a situation where the implicit contract is based on two observable signals that depend on both the two managers' efforts. From a more practical point of view, the important thing is that the two managers learn to split the joint surplus in a way that they both agree is *fair* in every period based on commonly observed information. This fairness norm can develop over time, influenced by the way people have traditionally shared surplus, going back to how hunter-gatherer societies learnt to share food in prehistoric times (Binmore 1998).

Like Baker, Gibbons and Murphy (1997), I do only consider a quadratic cost function. This is of course a very special case. On the other hand, most of the results seem robust with respect to the form of the cost functions (and the benefit functions), as long as these are symmetrical for the two managers.[20] However, if one of the managers has higher or more rapidly increasing marginal costs, then that would typically favour the other manager as asset owner.

I have ignored the haggling costs associated with the different governance structures (Williamson 1985). One would expect these costs to depend on the relative bargaining positions of the two parties. It seems natural to believe that symmetrical bargaining positions (as well as very extreme asymmetrical positions) are good for the haggling process, since symmetry (in the negotiation outcome) is a powerful focal point (Schelling 1960). If that is the case, symmetrical bargaining positions can

[20] I have already repeatedly commented on the exception, proposition 6.8.

reduce both the hold-up problem (under an implicit contract without a fixed transfer) and the haggling costs.

This essay is of course only interesting if the hold-up problem as such is important for asset ownership. In my opinion, it must be relevant for the build-up of capabilities and firm resources, since such investments typically are firm specific in nature. And, judging by the attention given to these aspects of the firm in recent strategy literature, the success of a company depends to a very large degree on these investments. If that is the case, it must be relevant for a theory of the firm to consider how the incentives to make investments depend on the ownership structure.

ESSAY IV

The decentralisation of management activities

- Towards a management-based theory of the firm -

We must understand a broad spectre of management activities to develop an empirically relevant theory on organisation design. In a model to study decentralisation I include management activities such as information search and processing, communication, bargaining, decision-making and control in an environment where local managers maximise sub-unit profits. In four extensions I allow various behavioural assumptions, for example by incorporating the well-documented self-enhancement bias. I also discuss why the owner-given authority of a central manager in an integrated hierarchy may better support central information processing and decision-making than bargaining-based authority under market organisation.

1. Introduction

Managers in a large corporation have a wide variety of important tasks to perform. For example, they search for, process and communicate information about new opportunities. They make decisions or delegate decision authority. They motivate subordinates through explicit incentive contracts (or more indirect compensation and promotion policies). They monitor and control activities of subordinates. And they bargain with other managers in cooperating units or firms.[1]

Much of the research done by economists on organisations has been focusing on how economic incentives can motivate employees to provide truthful information (adverse selection) and not to misbehave (moral hazard). Certainly, these mechanisms can be important, but they capture only very little of what is going on. Untruthful reporting and shirking do not appear to be the major problems for organisations of today. And,

[1] Other managerial activities include the efforts to influence norms, values and role expectations throughout the organisation and the partaking in some of the operational activities of the firm, for example in the sales process.

since one would not expect an agent's inclination to cheat to be that different from one company to another, such phenomena can hardly account for the observed diversity among companies with respect to their degree of decentralisation.

I have therefore in this essay chosen a different approach to the study of organisations. I acknowledge agency costs. But, instead of focusing on the underlying individual incentives, I take the motivation as given, in the sense that I assume that a manager will always try to maximise the profits of the unit she leads. By ignoring the steady day-to-day operations of the firm, and interpreting all change in terms of projects, I am able to include important aspects of the other management activities. In particular I can include the costs of information search, processing and communication, which seem crucial to understand why some management activities are decentralised in some organisations, and not in others.

I use the model to show how the incentive problems, communication flows and control activities shift when decision authority on project research and project implementation is delegated. These factors impact the nature and level of information search and processing centrally and locally. Local managers will do more research on local projects, while central managers will focus more on the global projects (which affect several sub-units), when the project research decision is delegated. And the local managers will do more and the central managers will do less of the overall information search and processing when the project implementation decision is delegated. Under a decentralised organisation design local projects are favoured, and fewer global projects are implemented.

The delegation of authority involves a trade-off between incentive problems and information processing, communication and control costs. But these costs are not necessarily monotonic in nature. The delegation of more decision authority can, in fact, under some circumstances reduce the incentive problems. The local manager will then no longer want to skew her other decisions (that were already delegated) to influence the outcome of the now decentralised decisions (as she would if they were centralised). And, while vertical communications are reduced, lateral communications increase, as local managers must engage in costly bargaining to reach an agreement on global projects.

I four extensions I relax some of the behavioural assumptions of the model. First, I allow a local manager to also have some interest in the corporate profits (and not only in the profits of the local unit). In another extension I assume that a manager can base her decisions on incomplete information (in the sense that not all the processed information is communicated to her) and analyse how that affects the organisation design decision. Finally, I let decision-makers suffer from the self-enhancement bias, which is a well-established empirical phenomenon. I discuss its

effect on the project selection decision (leading to fewer – or smaller – global projects under decentralised structures) and the way central managers may disturb the local managers (insisting on the evaluation of centrally generated project ideas).

Although the main focus of the essay is confined to the decentralisation of management activities within a firm's boundaries, the model is also useful to understand under what circumstances two otherwise independent units should be integrated. The introduction of a centralised authority (with information-processing and decision-making capabilities) explains why and how integration can reduce the hold-up problems discussed by Klein, Crawford and Alchian (1978) and Williamson (1975, 1985). Comparing an integrated hierarchy and a market organisation, I argue that one must consider the benefits and costs of owner-given authority (from external capital owners to a central management unit), relative to the costs of bargaining between independent units to establish and maintain some common authority structure. This contrasts with the property-rights approach (developed by Grossman, Hart and Moore), where there is no room for a central manager with coordination authority.

My focus in this essay on information search, processing and communication has been inspired by the work of several distinguished economists, who have stressed the importance of knowledge transfers (Hayek 1945, Jensen and Meckling 1986) and information networks (Arrow 1974, Marchak and Radner 1972, Radner 1992, Bolton and Dewatripont 1994). Also Demsetz (1995) and Holmstrom and Roberts (1998) argue in recent work that information and knowledge, and their accrual and distribution by management, are key to understanding organisations and their design.

There have been some previous attempts to formalise aspects of authority and decentralisation in an organisational setting with agency costs. Aghion and Tirole (1995) study the role of formal and real authority for the growth of firms. Authority can be delegated to strengthen a local manager's incentives to invest in information search, but the agent may then select other projects than the principal would. Holmstrom and Tirole (1991) study transfer-pricing policies under different organisational forms. As in my model, they let the unit managers negotiate joint-surplus-enhancing agreements under decentralisation. And, Nault (1998) analyses the location of investment decision authority for global and local projects, when local managers have better local knowledge. He takes up the discussions by Hayek (1945) and Jensen and Meckling (1986) on co-location of information and decision rights and shows that a collocation may not be optimal when the costs of synchronising global and local investments are high.

The essay proceeds as follows. In section 2 the setting is defined. Then, in section 3, I develop a model of information processing and decision-making for an organisation

with a central authority and two sub-units. In section 4 communication and agency costs are added to the model, and I compare three different levels of delegation. In section 5 I provide four examples of how the model can be extended. I argue that the model can be used to understand issues related to the hold-up problem and integration in section 6, while in section 7 I discuss the differences between a hierarchy and a market organisation in a somewhat wider context. Section 8 includes a summary and some concluding remarks.

2. The setting

Consider a company with many units, each run by a management team that has complete control over all activities performed within the unit. There are also some central authorities. Ignore issues concerning the division of labour within units and management teams and internal incentive problems within these subgroups. In other words, the central authorities are seen as one person (a *Principal*), as is a local management team (a *Manager*).

I assume that both central and local managers base their decision-making on economic reasoning. However, while central authorities include the benefits and costs of all sub-units to maximise total surplus, a local manager cares only about the profits of her own unit, maybe because that is the main criterion for performance measurement and promotions. In my general discussion I thus fix the motivation of the managers, and I ignore a manager's reasons for having that objective function. I ignore risk aversion, private costs of individual managers, and their search for perquisites, since I believe that these mechanisms are less important to the organisation design problem than a manager's drive to improve the results of the unit for which she is responsible.[2]

Ignore also the steady day-to-day operations of the company, to focus on the activities performed by the central authorities and the local managers to improve performance. The actual actions that are taken are seen as projects. One project could be to improve the production or other internal business processes – another could be to develop a new product or to target a new customer group. Every project aims at some change that will increase the expected profits of the company. Some are purely local in nature, in the sense that such *local projects* will only affect the profits of one unit, while *global projects* affect several units.

Before they design the project portfolio for a coming period, central and local managers invest in information search and processing activities. The more

[2] See essay I for a discussion of economic and social motivational bases for economic maximising behaviour.

information they gather and process, the better they will be at designing profitable projects. Assume that there are also two distinct classes of information elements, local and global. A better understanding of the *local information elements* will increase the expected value of local projects. Similarly, *global information elements* are important for global projects.

There are two kinds of uncertainties that can play a role during the information search and processing period. First, the manager does not know in advance what kind of information or knowledge that her information search and processing will reveal. She can find very valuable information, while other bits of information cannot be used at all – or are redundant to previously gathered information. Second, the environment can change, so that information one earlier would expect to be very valuable no longer can be used, for example due to demand or competitive shocks. This uncertainty will typically affect local and global projects differently, which will impact the weight of these classes of projects in the optimal project portfolio.

To sum up, the central and local managers perform management activities such as the search for and processing of information elements, the decision on how much to invest in these activities, and the selection of projects (based on the processed information). These management activities are either local or global in nature, as they relate to local or global information elements and projects. We can thus distinguish between four general (non-exclusive) categories of corporate coordination strategies, see figure 1.

	Central authorities	*Local managers*
Local activities	**Stand-alone influence**	**Local management**
Global activities	**Linkage influence**	**Local coordination initiatives**

Figure 1.

Central authorities perform *stand-alone influence* activities when they search for and process local information elements, they decide the level of local investments in these activities, or they select the local projects. Similarly, they perform *linkage influence* activities when they are concerned with global information elements and projects, since these relate to several business units. *Local management* indicates that local managers are involved in the processing of local information elements or the

decisions on local projects. And, under *local coordination initiatives*, local managers process global information elements or they select global projects.[3]

First, consider the search for and processing of information elements. Local and central managers can perform these activities in parallel, or one of the parties can specialise in the processing of one class of information elements. Four of the available structures for the division of information processing activities are listed in figure 2, where the boxes on the left refer to the categories defined in figure 1.


All-round information processing


Shared responsibilities for the research of global projects


Specialised information processing


Fully decentralised information processing

Figure 2.

Second, consider the decisions on how much to invest in information search and processing and the selection of projects. These decisions must be made either locally or centrally. I study three levels of delegation, see figure 3.

	Local project research decision	***Project selection***
Centralisation	**Central**	**Central**
Partial decentralisation	**Local**	**Central**
Decentralisation	**Local**	**Local**

Figure 3.

Under *Centralisation* the central authorities decide the project research investments and the project selection. Under *Partial Decentralisation* the central authorities still select the projects, but the local managers decide their own information search and processing. And, under *Decentralisation* the local managers also select the project portfolio. The central authorities decide their own project research activities throughout.

[3] The terms "stand-alone influence" and "linkage influence" are used by Goold, Campbell and Alexander (1994) as two types of "parental-value-creation" activities.

Of course, the level of delegation of decision authority (in figure 3) will impact the level of decentralisation of information search and processing activities (in figure 2). In section 4 I will, in fact, show that there is, first, a tendency for more specialisation as one goes from Centralisation to Partial Decentralisation, and, second, a tendency for more decentralisation when the organisation moves from Partial Decentralisation to Decentralisation.

3. A model

The timeline of the model is illustrated in figure 4. First, local and central managers perform information search and processing activities. Then uncertainty is resolved. Projects are selected. And they are implemented. There can, of course, be uncertainty in the project implementation phase as well, but this is not modelled explicitly. One may imagine that the sequence is repeated over time, so that t = 0 in one sequence can be interpreted as t = 1 in the previous one, although I do not model that either. The central authorities decide the level of delegation to maximise the total surplus of coming sequences.

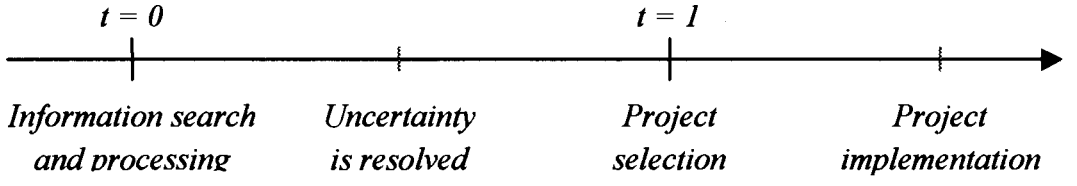

Figure 4.

Assume the information is structured in such a way that all information elements of a particular class (local or global) are identical *a priori*, in the sense that they look the same before they are processed. To simplify, the value of local projects is independent of the global information elements, and the value of global projects is independent of the local elements. The costs of a party are independent of the activities of the other parties in the organisation. And there is a given capacity for project implementation. The project selection decision is then reduced to a question of what percentages of this capacity that are used for local and global projects respectively.

For now, ignore communication and agency costs, as these will depend on the level of delegation. Then only search and processing costs are important for the choice of what party that should process a particular element of information. To simplify the objective function, assume there are only two units in the organisation (in addition to the central authorities) and that only one of these has the capacity to invest in information processing activities and implement local projects. The other unit

participates only in (but is necessary for) the implementation of the common global project. The reader should bear in mind, however, that the model is meant to illustrate a situation with several active units, and that the simplification is for expository reasons only. The central authorities can also perform information search and processing activities.

Ex post, after uncertainty is resolved, the joint surplus function, $\phi(\cdot)$, is assumed to depend on the sunk investments, the state of the world at t = 1, $\omega \in \Omega$, and the percentage of the implementation capacity that is used for local projects, $L \in [0, 1]$, in the following way:

$$(1)\quad \phi(\cdot) = \pi^{L}(x_M + x_P, L; \omega) + \pi^{G}(y_M + y_P, 1 - L; \omega) - C^{M}(x_M, y_M) - C^{P}(x_P, y_P)$$

where π^L and π^G are the benefits from **L**ocal and **G**lobal projects respectively and C^M and C^P are the expected information search and processing costs of the local **M**anager and the central authorities (the **P**rincipal) respectively. The variables of those functions are

x_M - The number of local information elements processed by the manager
x_P - The number of local information elements processed by the principal
y_M - The number of global information elements processed by the manager
y_P - The number of global information elements processed by the principal

All the functions are assumed to be non-decreasing. The benefit functions are (separately) concave in each of the two variables, and the cost functions are (separately) convex in each variable.[4] Any uncertainty that affects the cost functions is suppressed. The cross-derivatives of the benefit functions are assumed to be positive, as information about a class of projects must be more valuable the more important these projects are for the organisation.[5] And, to include management overload effects, so are the cross-derivatives of the cost functions.

This information and uncertainty technology is very general in nature. I only assume that past information gathering cannot have negative value in a given state of the

[4] The assumption of convex cost functions is also realistic when a manager is interpreted as a management team, as an increase in team size intensifies the coordination and communication problems within the management team (Blau 1970) and slows down the decision-making process (Thomas and Fink 1963).

[5] This is always satisfied if the benefit function can be written as the product of two non-decreasing functions containing L and the investments respectively, e.g. $\pi^L(\cdot) = g(L; \omega)h(x_M + x_P; \omega)$.

world and that its marginal value decreases the more one already knows.[6] The technology can therefore be given many different interpretations.

Above I have indicated an interpretation where many information elements are combined to design projects. This process is, in fact, similar to the one used by a child playing with Lego or Meccano. First, she gathers pieces of different shape, size and colour. And then she combines the pieces to build something. Some pieces can be used for many kinds of structures and are therefore always valuable, while others are more specialised. The value of an extra piece will depend on its characteristics, what kind of pieces the child already owns, and what she wants to build (which again can depend on uncertain factors, such as the random suggestions by a grandmother).

In this analogy the investment levels would correspond to the number of pieces that the child and her mother gathered before the child started to build. L could be the time they agreed for the child to spend building Lego as opposed to Meccano that day. And the state of the world, ω, would signify both the characteristics of the pieces that they happened to pick up, and the outside preferences for what the child should build. The resulting benefit level would indicate how happy the child is with her work and how proud the mother becomes.

One could also imagine that each information element corresponds to the value of a particular project, as in the search theory initiated by Stigler (1961, 1962), wherein agents search for price quotations for commodities or job offers. The search is seen as draws from the same probability distribution. A fundamental result from this theory is that whatever the precise distribution happens to be, it is certain that increased search will yield positive, but diminishing expected returns (Stigler 1961).[7]

In this setting the investment level would correspond to the number of local and global projects to be ranked. L could be the percentage of implementation capacity used for the best local project, so that (1-L) of the capacity is used for the best global project. The state of the world determines the value of each project that has been evaluated, and impacts thus both the ranking and the absolute value of the projects (as in the models by Hart and Moore (1999) and Segal (1999) that provide a foundation for incomplete contracts).[8]

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[6] In fact, for most of the discussion, a negative second-order derivative is only needed beyond some finite value of investments.

[7] With project values uniformly distributed between zero and one, the expected maximum project value with n searches will be $n/(n+1)$. When the values are normally distributed with mean m and standard deviation σ, the expected maximum value at the nth observation is approximately $m + \sigma\sqrt{2\ln n}$ (Alchian 1970).

[8] Following the tradition of Stigler (1961, 1962) and Alchian (1970) I suppress any dynamic aspect of the search problem to focus on the expected search intensity, which is the only relevant variable

A third possibility is to interpret the initial activities as investments in an information system. Then the more one invests in an information system, the finer future signals will partition or classify the states of the world, for example in the Blackwell (1951) sense (Laffont 1993 chapter 4). With higher-quality information, the decision-maker can select projects (strategies) with better precision. This interpretation is in accordance with the team-theoretic analysis by Marschak and Radner (1972) and the information analysis by Demski (1980).

Imagine there is a finite number of possible states of the world. The investment level could then correspond to the number of *boundaries* between groups of states that the decision-maker will be able to recognise. See figure 5 for an example with three states of the world, $\upsilon_i \in \{\upsilon_1, \upsilon_2, \upsilon_3\}$.

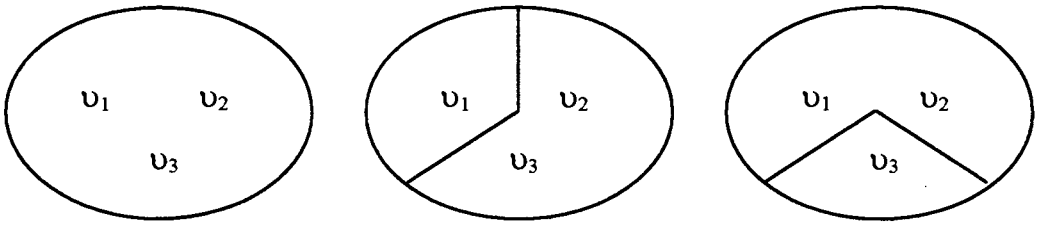

Figure 5.

Without investing in information processing, a manager cannot distinguish between any of the states, as in case (a). After one element is processed, a boundary is introduced, as in case (b) or case (c). Then the decision-maker may be able to distinguish between two sets of states. For each new information element that is processed, another boundary is added, so the value function is non-decreasing. And, if the boundary is drawn from a probability distribution over all possible boundaries (with replacement), the value function must be concave in investment levels. The parameter ω in the model then reflects what boundaries that are revealed in the search process and the υ_i that is realised.

In other words, although I have tended to choose my words according to the first interpretation, any underlying uncertainty technology where the value of information is positive (but the marginal value is decreasing in effort) could support the model. My interpretation, where many information elements are combined to design a

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for the organisation design problem. The optimal stopping rule is of no interest. But the model could be seen as reflecting a more complex search process over many (shorter) periods, with the searcher determining her search intensity in any given period at the start of that period if she continues the search (Morgan and Manning 1985). The search intensity then corresponds to how many *parallel* information-gathering processes the searcher chooses to pursue.

project, seems close to how information is gathered and used for projects in the real world.

Now consider the maximisation problem at t = 1 of $\phi(\cdot)$ from (1) with respect to the optimal capacity split decision L. Since there are no communication or agency costs, it does not matter at this stage what party that makes the decision. Assuming an interior solution, L is implied by the first-order condition

$$(2) \qquad \pi_2^L(x_M + x_P, L; \omega) = \pi_2^G(y_M + y_P, 1 - L; \omega)$$

where $\pi_2^L(\cdot)$ and $\pi_2^G(\cdot)$ are the derivatives of these functions with respect to their second variables. The optimal decision is then a function $L^*(x_M + x_P, y_M + y_P; \omega)$. $L^*(\cdot)$ is non-decreasing in $(x_M + x_P)$ and non-increasing in $(y_M + y_P)$, since both π^L and π^G are concave in their second variables and the cross-derivatives are positive. That is, an increase in $(x_M + x_P)$, while $(y_M + y_P)$ is kept constant, will tend to increase the expected benefits of the local projects both directly and indirectly (through a higher L).

With the decision rule $L^*(\cdot)$, the joint maximisation problem for the central authorities and the active local manager with respect to investments is given by

$$(3) \underset{(x_M, x_P, y_M, y_P)}{\text{Max}} \sum_{\omega \in \Omega} \pi^L(x_M + x_P, L^*(\cdot); \omega) f(\omega) + \sum_{\omega \in \Omega} \pi^G(y_M + y_P, 1 - L^*(\cdot); \omega) f(\omega) - C^M(x_M, y_M) - C^P(x_P, y_P)$$

$$\text{subject to: } x_M, x_P, y_M, y_P \geq 0$$

where $f(\omega)$ is the probability density function with respect to the states of the world at t = 1 (which are assumed to be of a finite number).

So far, we have not introduced any communication or agency costs. From (3) it is easily seen, however, that the division of labour between the central authorities and the local managers with respect to investments in information search and processing will differ substantially between organisations characterised by different benefits and cost functions – even in such a simple setting.

Information-class-specific *learning effects* of current and past periods (leading to lower marginal costs when the aggregate level of information processing increases) tend to favour specialisation (see figure 2 of section 2), when management capacity is limited. So do *switching costs*. A manager loses time moving her attention between the classes of information elements, when information is found in different places or a good understanding of the information requires investments that are specific to one class of information (e.g. learning the characteristics of another business unit). The

specialisation of tools, for example information systems, can also favour a strict division of labour.[9]

On the other hand, *management overload* effects (leading to increasing marginal costs) can favour shared responsibilities for information processing. When one manager experiences difficulties handling more information elements of one class, another manager should help her, as long as the marginal net benefits then are higher than if she worked on the other class of information elements.

Although I will not use this particular cost function in any of the following analyses, to illustrate benefits from specialisation and costs of management overload, consider an example where the information processing costs of the local manager are given by

$$(4) \quad C^M(x_M, y_M) = \left[\lambda_1 {x_M}^{\alpha} + \lambda_2 {y_M}^{\beta} + k(x_M, y_M)\right]^{\delta}$$

Then $k(x_M, y_M)$ can be seen as a switching cost, taking some positive value (k) when x_M and y_M both are positive and being zero elsewhere. $\alpha, \beta < 1$ would imply learning effects in the current period, while $\lambda_1 \neq \lambda_2$ could be due to learning effects of past periods or, more generally, reflect the manager's competencies. $\delta > 1$ (and $\alpha, \beta > 1$) would indicate management overload effects. Note that when $\alpha, \beta < 1$, this cost function is not convex, even if $C_{11}, C_{22} \geq 0$, because $C_{11}C_{22} - C_{12}^2 < 0$. For the analysis in this essay it is sufficient that the function is separately convex in each variable (i.e. positive second-order derivatives).

A cost function with independent elements ($\delta = 1$) would tend to favour all-round information processing as a solution to (3), while all-round processing, in general, is not a viable solution when there is a linear relation between the elements of the cost functions ($\alpha, \beta = 1$), even if $k = 0$. It is not difficult to come up with different functional forms in (3), so that any of the structures in figure 2 of section 2 (for the division of information processing activities) could be efficient.

Note that this primitive analysis clearly shows that full decentralisation would not necessarily be the best information processing structure, even if the local managers (and their staff) were expected to act in the interest of the whole corporation. If, for instance, the central authorities are more competent processing global information elements, then total cost minimisation may lead to a centralisation of these activities. Central authorities can also have special competencies (e.g. technical expertise) with respect to some local information elements.

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[9] These benefits from specialisation are more or less the same as those Adam Smith (1976) emphasised with respect to production: The increase of dexterity (learning effects), the saving of time lost in passing from one species of work to another (switching costs) and the invention of machines which facilitate and abridge labour (specialised tools).

The optimal degree of centralisation or decentralisation in a multiunit corporation will depend on the benefits and costs associated with the local and central information search, processing and decision-making.

The way I see it, benefits from specialisation and costs of management overload constitute the *raison d'être* for a decentralisation of management activities. Communication and agency problems (which are considered in the next section) are *costs* of this decentralisation.

4. The delegation of decision authority

In this section communication and agency costs are added to the problem. I focus on a setting where a local manager cares about the profits of her own unit only. Assume common knowledge *ex ante* of the benefit and cost functions. In other words, there are no learning effects specific to one of the parties (from past periods) with respect to the planning of the information search and processing.

With communication and agency costs, the delegation of decision authority becomes important. Two types of decisions are made. First, how much to invest in information search and processing (project research). And, second, what project portfolio to select. Focus on the three levels of delegation that were defined in figure 3 of section 2; Centralisation, Partial Decentralisation and Decentralisation.

The chapter is written in a relatively informal way. See the Appendix for a more formal analysis.

a) Centralisation

Under Centralisation the central authorities decide both the central and local project research activities, and they select the projects. Since the active local manager otherwise would maximise local profits only, there must be some monitoring or *control costs* to ensure that she invests according to the plan (e.g. through the establishment and follow-up of project groups). These costs will typically depend on the level of the local manager's information processing activities, and they will reflect how strong the local manager's incentives are to deviate from the specified investment levels, which will differ between the classes of the information elements.

To keep the model tractable, assume that the control costs, given by the function $c(x_M,y_M)$, are additive to the other costs.[10]

When local managers process information elements that are relevant to the centralised project portfolio decision, these must be communicated to the central authorities and then be read and maybe even be reprocessed there. In other words, there are some expected *sending costs* born by the sender and some expected *reading costs* born by the reader, given by $s^M(x_M, y_M)$ and $r^P(x_M, y_M)$ respectively.[11] Again I have assumed additive functions to separate the effects of delegation, although it ignores compound management overload effects. Note though, that the assumption of additive cost functions can be realistic when the activities are assumed to take place in different periods of time.

Project implementation costs are due to the communication of the selected projects to the units and the monitoring and control during the implementation phase. These costs can, in general, depend on the investment levels and the decision on project implementation, as well as the uncertainty on the state of the world (which again influences the project design). Denote the project implementation costs by $PI(x_M, y_M, x_P, y_P, L; \omega)$. One would expect the project implementation costs to be non-increasing in local investment levels (since that will economise on project communication costs as the local managers then become more knowledgeable), non-decreasing in central investment levels (due to higher communication costs) and non-increasing in L (since the objective functions of the central and local managers then are better aligned – reducing the control costs).[12]

The expected joint surplus under Centralisation (C) is then given by

$$(5)\quad \Phi^C(\cdot) = \sum_{\omega\in\Omega}\pi^L\left(x_M + x_P, L^*(\cdot);\omega\right)f(\omega) + \sum_{\omega\in\Omega}\pi^G\left(y_M + y_P, 1 - L^*(\cdot);\omega\right)f(\omega)$$
$$- C^M(x_M, y_M) - C^P(x_P, y_P) - c(x_M, y_M) - s^M(x_M, y_M) - r^P(x_M, y_M)$$
$$- \sum_{\omega\in\Omega} PI(x_M, y_M, x_P, y_P, L^*(\cdot);\omega)f(\omega)$$

[10] This function could also include the costs of central information search and processing activities that would be necessary to plan the local investment levels, if the assumption of common knowledge *ex ante* was to be relaxed.

[11] If all the processed information elements are used to design the best projects, all the elements must be communicated to the decision-maker. But if information elements correspond to independent projects, it is sufficient to communicate the characteristics of the best projects only.

[12] One could imagine that the control activities were restricted to global projects only, since when they are implemented, the local manager will want to use the rest of the implementation capacity for the best local projects anyway. As more capacity is used for global projects, there would then be more to control and, hence, higher control costs.

which the central authorities maximise with respect the investment levels x_M, y_M, x_P and y_P, when $L^*(x_M + x_P, y_M + y_P; \omega)$ is the capacity split that maximises the *ex-post* ($t = 1$) surplus. First-order derivatives are given in the Appendix.

When all the decisions are made centrally, they are based on the corporate (and therefore the socially correct) objectives. But the central authorities must spend resources on control activities to ensure that the decisions are carried out by the rest of the organisation. There are also costs associated with the communication of processed information to the central authorities and with the communication of the decisions and plans back to the organisation.

Note that high control and communication costs in the investment phase favour centralised information processing, while the communication part of the project implementation costs work in the opposite direction. The control costs (those associated with both information processing and project implementation) favour local projects, since the incentive problems then are less severe (as the sub-unit enjoys all the benefits from these projects).

b) Partial Decentralisation

Under Partial Decentralisation (PD) a local manager decides the sub-unit's investments in information search and processing herself, while the central authorities select the projects. There is no need for control activities of the information processing, and the expected joint surplus is given by

$$(6)\quad \Phi^{PD}(\cdot) = \sum_{\omega\in\Omega}\pi^{L}(x_M + x_P, L^*(\cdot);\omega)f(\omega) + \sum_{\omega\in\Omega}\pi^{G}(y_M + y_P, 1 - L^*(\cdot);\omega)f(\omega) - C^M(x_M, y_M) - C^P(x_P, y_P) - s^M(x_M, y_M) - r^P(x_M, y_M) - \sum_{\omega\in\Omega} PI(x_M, y_M, x_P, y_P, L^*(\cdot);\omega)f(\omega)$$

Assume (for simplicity) that project implementation costs affect the central accounts only, and that central costs are not allocated to the sub-units.[13] A local manager's maximisation problem is then given by

$$(7)\quad \underset{(x_M, y_M)}{\text{Max}} \sum_{\omega\in\Omega}\pi^{L}(x_M + x_P, L^*(\cdot);\omega)f(\omega) + \mu\sum_{\omega\in\Omega}\pi^{G}(y_M + y_P, 1 - L^*(\cdot);\omega)f(\omega) - C^M(x_M, y_M) - s^M(x_M, y_M)$$

[13] If central costs were allocated to the local units, the local managers might also consider some of these costs. The allocated shares would, however, typically not reflect the actual extra central costs generated by the unit. To achieve that, the central authorities would, in fact, have to perform the same kind of control activities as under Centralisation.

subject to: $x_M, y_M \geq 0$

where μ denotes the unit's share of the benefits from the global project and $L^*(\cdot)$ is the decision rule for implementation capacity that maximises the *ex-post* ($t = 1$) joint surplus (which is decided by the central authorities *ex post* – but anticipated by the local manager *ex ante*).

μ is seen as an exogenous variable given by the company's accounting rules. These rules are set arbitrarily, because it is assumed that it would be prohibitively costly to design and follow up an accounting system that could credit every active unit with all the global benefits that it contributes to (as investments are not observed by the central authorities). One would expect these accounting costs to be of at least the magnitude of the control costs under Centralisation.

μ can theoretically be larger than one (or negative), if a global project implies extra work in one unit, while the expected extra revenues will mostly impact the accounts of the other unit. Assume, however, that $\mu < 1$, so that the active unit receives less than the full global benefits. To simplify the exposition, μ is shown as a constant. But μ could depend on the realisation of the random variables (which again decides the project selection) and the investment levels. Then it must be included in the summation over all possible states of the world. The qualitative analyses would remain the same.

Comparing (6) and (7) with (5), we see that the delegation of the investment decision has three direct consequences:

A. No need of control activities to follow up the manager's information search and processing activities.
   [The control costs $c(x_M, y_M)$ are no longer subtracted from the joint surplus.]

B. The local manager considers only a fraction of the global benefits.
   [The global benefits are multiplied with $\mu < 1$ in her maximisation problem.]

C. The local manager ignores her impact on the central authorities' reading and project implementation costs.
   [The cost elements $r^P(\cdot)$ and $PI(\cdot)$ are omitted from her maximisation problem.]

All these factors are due to the sub-optimising local behaviour, without which control activities would not be needed under Centralisation and incentives would not be skewed under Partial Decentralisation.

Factor A implies direct cost savings from delegation. When the control costs under Centralisation are increasing in the local information search and processing activities, the delegation will also tend to advance the local project research.

B and C are incentive effects. Factor B makes the investments in global projects less attractive for the local manager compared to investments in the local projects, for a given implementation capacity allocation (L). That will lead the local manager to underinvest in the processing of the global information elements, while she will overinvest in the processing of the local elements.

The net effect of factor C is not so clear. While the reading costs of the central authorities can be expected to be increasing in local information processing (as more information elements must be communicated to the central authorities), project implementation costs can be decreasing in local information processing (as less communication is necessary to inform the local managers about the projects that are to be implemented). And, while reading extra local information elements can be more costly for the central authorities than reading extra global elements (due to a poorer understanding of local matters), extra investments in local information elements will tend to reduce project implementation costs more than extra investments in global elements (as local projects become more attractive to implement at $t = 1$ and the objective functions are better aligned in the project implementation phase). In other words, there can be opposing effects both in absolute and relative terms, and factor C's direct impact on the local investments in information search and processing is therefore ambiguous.

The factors B and C also impact the investment levels in a more indirect way. Because the objective function for the local manager now differs from the objective function of the central authorities, the local manager will want to influence the capacity allocation decision L (i.e. the envelope theorem does not hold). She could then theoretically engage in direct influence activities, as described by Milgrom and Roberts (1988), but in this model she can only influence the decision indirectly – through her investments in information processing.

This indirect effect leads the local manager to overinvest even more in the research of local projects, while global projects will receive even less attention, due to her limited share of the global benefits (μ). Then the more attractive local projects will get a larger share of the project implementation capacity. On the other hand, the local manager will ignore the fact that central project implementation costs decrease when L is raised. Again there are two opposing effects. It turns out that the first effect dominates when μ is small (i.e. there is a large incentive gap for global projects), while the second effect dominates when μ is close to 1.

Therefore, summing up all the incentive effects, we can conclude that:

When a local manager is expected to receive only a small or moderate share of the benefits from global projects under Partial Decentralisation, she will tend to

underinvest in the research of global projects, while she will tend to overinvest in the research of local projects.

On the other hand:

When a local manager is expected to receive a large share of the benefits from global projects under Partial Decentralisation, the underinvestment problem tends to disappear. She may then, in fact, overinvest in the research of both global and local projects or, in the extreme case, overinvest in global and underinvest in local elements, if the central project implementation costs are very important.

Formal conditions are given in the Appendix. The most interesting case is the one where a unit captures only a moderate share of the global benefits, for example in a setting where two units equally share these benefits ($\mu = ½$). One would then expect the first result to hold, so that the local manager overinvests in the research of local projects, while she underinvests in the research of global projects. Assume in the following that this, in fact, is the case.

Although the central authorities under Partial Decentralisation have given up the right to decide on local investments, and hence must accept the resulting under- and overinvestment, they can reduce the costs of these incentive effects by adjusting their own central investment levels. In particular, they will compensate by investing more in the research of global projects, while they will focus less on the local ones. There are some special cases where the central authorities would be able to cancel out the incentive effects completely, for example when the central costs are linear (i.e. there are no management overload effects). Or, when the local underinvestments are identical to the overinvestments ($x_M - x_M^* = y_M^* - y_M$) and the central cost functions are of the form $C(x_P + y_P)$, which implies perfect substitutability between local and global project research.

This latter example illustrates that the central authorities can better deal with the incentive problems when they research both local and global projects. Then the marginal costs of researching global projects go down when the central authorities reduce their research of local projects (as the cross-derivatives of the cost functions are positive). In general, of course, the central authorities can only hope to dampen the incentive problems – not to eliminate them completely. Then $(x_M + x_P)$ increases and $(y_M + y_P)$ decreases when the investment decision is delegated. From the first-order condition for L it follows that there will also be a tendency to allocate more of the implementation capacity to local projects.

When a local manager works too much on local and too little on global projects, the central authorities can reduce this incentive problem by investing more in the research of global projects and less in the research of local projects centrally.

These adjustments are less costly to make when the central authorities process both classes of information elements.

We would therefore expect a more specialised information processing (as defined in figure 2 of section 2) when the decision on how much to invest in information search and processing is delegated. We would also expect a stronger overall focus on local projects, for both project research and project implementation, at the expense of the global projects.

Comparing the two alternative structures, Partial Decentralisation is attractive compared to Centralisation when the following conditions are satisfied:

- The control activities associated with a centralisation of the project research decision are very costly [high $c(\cdot)$].
- An active (investing) unit enjoys a large share of the benefits from the resulting global projects [large μ].
- The local research of global projects is unimportant [y_M would be negligible also under Centralisation].
- The local disregard of central costs does not have a very negative net impact on the local manager's incentives to invest.[14]

The decision on investments in information search and processing (project research) should be delegated if significant control costs can be saved and the resulting misalignment of local incentives is not too detrimental in nature.

Note, however, that if the costs of the misalignment of incentives are not high under Partial Decentralisation, the control costs under Centralisation are typically not important either. The central authorities do not need to impose very strict control, since the local manager would not want to do things very differently anyway. In fact, the trade-off may boil down to a comparison of what party has the best knowledge and expertise to plan the local information search and processing activities, irrespective of incentives. The local managers may, for example, have a better knowledge of the local opportunities, while the central authorities may have a better understanding of the needs of the entire organisation. Such considerations can also lead to structures where the decision on the local research of the local projects is

[14] There will only be a moderate negative or even a positive net incentive effect from the disregard of central cost elements when

$r_1^P(x_M, y_M) + \sum_{\omega \in \Omega} PI_1(x_M, y_M, x_P, y_P, L^*(\cdot); \omega) f(\omega)$ is small (or even negative),

$r_2^P(x_M, y_M) + \sum_{\omega \in \Omega} PI_2(x_M, y_M, x_P, y_P, L^*(\cdot); \omega) f(\omega)$ is large (or at least not very negative), and

$PI_5(x_M, y_M, x_P, y_P, L^*(\cdot); \omega)$ is negative.

delegated, while the central authorities remain in control of the local research of the global projects. The central authorities can do this, for example, by establishing and following up mandatory work groups to research global issues, and then let the local managers spend the rest of their available management capacity on the research of local projects.

c) Decentralisation

Under Decentralisation the local manager chooses her own project research activities, as under Partial Decentralisation. The project portfolio decision is now the outcome of a bargaining process among the local managers. They can agree on side-payments (perhaps in the form of transfer prices), so that both units are credited with a fair share of the global projects.

Assume that the writing and enforcement costs associated with an *ex-ante* contract between the local managers on project research activities would be at least equal to the central authorities' control costs under Centralisation. Also assume that the costs of writing and enforcing an *ex-ante* contract on the implementation capacity split (L) are prohibitively high (compared to the communication costs under Partial Decentralisation), or that a contract cannot improve the incentives due to high uncertainty (Hart and Moore 1999, Segal 1999).

The investment levels under Decentralisation will then instead reflect the parties' respective *ex-post* bargaining positions (as in Grossman and Hart 1986). The project portfolio decision coming out of the bargaining process is enforced (at some costs) by the central authorities. Note that these enforcement costs need not be high, as they relate to the implementation of concrete projects that can be described in some detail (after the uncertainty is resolved).

The bargaining process among the local managers generates some local costs as well. Casual observations indicate that most of these costs are associated with the exchange of information on the alternative projects and the effects that these will have on the various parts of the organisation, rather than the haggling as such. For simplicity, assume therefore that haggling is free, but that the communication of the information that is needed for the bargaining is not.[15] To enable everyone to have an understanding of both the potential total joint surplus and the outside options, they need to exchange information on both local and global projects.

A manager will be interested in such a bargaining process only if she expects her unit's share of the increased joint surplus to exceed the bargaining costs. I assume

[15] Alternatively, the haggling costs could be seen as embedded in the lateral communication costs.

this to be the case, so that project selection reflects the maximisation of joint surplus (of the two sub-units), according to the Coase Theorem. The two local managers in the model are assumed to have equal bargaining power, resulting in a symmetrical Nash bargaining solution, since both of them are necessary for the project implementation phase.[16]

The expected joint surplus under Decentralisation (D) is then given by

$$(8)\quad \Phi^{D}(\cdot) = \sum_{\omega\in\Omega}\pi^{L}\left(x_M + x_P, L^{D}(\cdot);\omega\right)f(\omega) + \sum_{\omega\in\Omega}\pi^{G}\left(y_M + y_P, 1 - L^{D}(\cdot);\omega\right)f(\omega)$$
$$- C^{M}(x_M, y_M) - C^{P}(x_P, y_P) - s^{P}(x_P, y_P) - r^{M1}(x_P, y_P) - s^{M1}(x_M, y_M)$$
$$- r^{M2}(x_M, y_M, x_P, y_P) - \sum_{\omega\in\Omega} PC\left(x_M, y_M, x_P, y_P, L^{D}(\cdot);\omega\right)f(\omega)$$

where $s^{P}(\cdot)$ are the costs associated with the sending of the centrally processed information elements to both the two local managers, $r^{M1}(\cdot)$ are the reading costs of the active local manager of those elements, $s^{M1}(\cdot)$ are the costs associated with the sending of locally processed information elements to the other local manager and $r^{M2}(\cdot)$ are the total reading costs of the second local manager. $PC(\cdot)$ are the project control costs under Decentralisation (to enforce the bargaining solution), which are different from the project implementation costs under Centralisation and Partial Decentralisation, since the communication and control structures change. The decision rule, $L^{D}(x_M + x_P, y_M + y_P; \omega)$, maximises the *ex-post* ($t = 1$) joint surplus for the two local units.

However, with the bargaining process introduced above, the maximisation problem of the active local manager is also affected by the capacity split that would be the result if the local managers were unable to reach a cooperative agreement. Since both parties are needed for the implementation of global projects, only local projects would then be selected. In other words, in the case of disagreement $L = 1$ for all possible states of the world ($\omega \in \Omega$), regardless of the investment levels.

As before, assume that project control costs affect central accounts only. And allow for the global projects to also affect units that do not take part in the bargaining process, because they are not needed for the implementation phase or they do not yet exist, as they represent future business areas. Let $\nu \in [0,1]$ be the fraction of the benefits from the global projects that the cooperating units do enjoy. To simplify the exposition, ν is assumed to be a constant.

The maximisation problem of the active manager is then given by

[16] With only one active local manager in the investment phase, this manager could theoretically be given full authority (or all the bargaining power), but the set-up is meant to illustrate a situation where many local managers are active. Equal bargaining power is therefore more realistic.

$$(9)\quad \underset{(x_M,y_M)}{\text{Max}}\ \tfrac{1}{2}\left\{\sum_{\omega\in\Omega}\pi^L\left(x_M+x_P,L=1;\omega\right)f(\omega)+\sum_{\omega\in\Omega}\pi^L\left(x_M+x_P,L^D(\cdot);\omega\right)f(\omega)\right\}$$
$$+\tfrac{1}{2}v\sum_{\omega\in\Omega}\pi^G\left(y_M+y_P,1-L^D(\cdot);\omega\right)f(\omega)-C^M(x_M,y_M)-s^{M1}(x_M,y_M)$$

subject to: $x_M, y_M \geq 0$

Since the disagreement point influences the bargaining outcome, the manager will invest as if there were a fifty percent probability of disagreement, although she in fact knows that, in the end, the decision rule that is jointly optimal for the two local managers, $L^D(x_M + x_P, y_M + y_P; \omega)$, will be implemented. The communication costs are not part of the bargaining solution, as these are sunk when the actual haggling takes place.

Comparing (8) and (9) with (6) and (7), the reader will recognise that a delegation also of the project selection decision has five direct consequences:

A. The flow of information changes dramatically. While all the processed information was channelled up to the central authorities for project design under Centralisation and Partial Decentralisation, the design decision is now made jointly by the two local managers, who both need the information for the bargaining process. [The communication cost elements $s^M(x_M, y_M)$ and $r^P(x_M, y_M)$ are replaced by $s^P(x_P, y_P)$, $r^{M1}(x_P, y_P)$, $s^{M1}(x_M, y_M)$ and $r^{M2}(x_M, y_M, x_P, y_P)$ in (8)]

B. The Project Control costs under Decentralisation are different from the Project Implementation costs under Centralisation and Partial Decentralisation. The communication of project design from the central authorities to the local units is no longer needed. But there are control costs, as the central authorities must intervene if one of the local managers makes a complaint. [$PI(\cdot)$ is replaced by $PC(\cdot)$ in (8)]

C. The local managers may select a different implementation capacity split (L) at t = 1 from the one the central authorities would have chosen, as they ignore the effect this decision will have on central control costs and benefits of units that are not part of the bargaining process. [$L^*(\cdot)$ is replaced by $L^D(\cdot)$ in (8) and (9)]

D. As the bargaining process at t = 1 takes the disagreement outcome as its point of reference, the active local manager will receive more of the joint surplus when her outside option (which is the implementation of local projects only) is worth more. [$\pi^L(x_M + y_M, L = 1; \omega)$ is included in (9)]

E. The local manager's share of the benefits from global projects is now determined by her bargaining power (which is assumed to be ½ in the model), while

accounting rules determined the share under the more centralised structures. [μ is replaced by $\frac{1}{2}\nu$ in (9)]

Factors A and B can imply large direct cost savings – or cost increases – depending on the circumstances. First, consider factor A. When the central authorities are very competent on both global and local projects, and it is efficient for them to do a lot of the project research (while the local managers focus on the day-to-day management), the communication costs will tend to be low under the more centralised structures. The central authority's reading costs are then low both because of the low volume and because they are quick to understand the implications of the information that they receive.

On the other hand, when the local managers are more competent on the design of the projects, and most project research is done locally, communication costs can be lower under Decentralisation. The crucial question is then how costly the lateral communication must be to enable efficient negotiations. It need not be very costly, if the local managers have been working closely together in the past so that they both have a good understanding of the other unit's operations. In other settings, however, bargaining becomes difficult and costly, because a local manager must spend a lot of time to understand how a project may affect the benefits and costs of each unit.

As already noted, the costs of the implementation phase can be expected to decrease when the project selection decision is delegated (factor B), as costs associated with the communication of the project design decision are saved when the local managers themselves make the decision.[17] This change is also of importance when we are to evaluate the misalignment of incentives. While the communication part of the project implementation costs could be decreasing in the locally processed information elements under the more centralised structures, that is not the case under Decentralisation. The incentive effect of ignoring cost elements is therefore no longer ambiguous. It will tend to increase the local manager's investments in the processing of both local and global information elements at $t = 0$.

The local managers' (intentional) disregard of central project control costs will also, together with their disregard of benefits from global projects to other units, impact the project selection decision at $t = 1$ (factor C). The first effect tends to favour global projects under Decentralisation, when the project control costs decrease in L (as there then are less global projects to control). The second effect favours local projects, as would imperfections in the bargaining process (so that negotiations sometimes irrationally fail). The net effect is uncertain. But, note that when L^D is

[17] Project control costs could be lower under Decentralisation also because the intrinsic motivation of local managers can be stronger when they have been very active in the decision process, as part of a retrospective rationalisation process (Pfeffer 1997).

larger than L*, local projects become more attractive (and global projects less attractive) for information search and processing at t = 0.

The *ex-ante* incentives are skewed also because the local projects have extra weight in the bargaining process between the local managers (factor D) and a local manager does not enjoy the full benefits from the global projects (factor E). Both factors make the local projects more attractive for research, while the global projects become less attractive. The more important the global projects are (i.e. the implemented L is much smaller than 1), the stronger one would expect the effect of D to be.

Comparing the incentives under Decentralisation with first-best levels, we can therefore conclude that (formal conditions are given in the Appendix):

A local manager will tend to overinvest in the research of local projects and underinvest in the research of global projects (at t = 0) under Decentralisation, due to the extra weight of local projects in the bargaining process and the limited share she receives from the global ones. Her disregard of central cost elements tends to strengthen the overinvestment and reduce the underinvestment problem.

The decision on project implementation (at t = 1) will also be distorted under Decentralisation, when there are extra benefits or costs associated with the implementation of global projects that the local managers do not consider. If the net effect favours local projects (because important benefits are ignored), it increases the incentive problem at t = 0 as well.

Comparing the incentives under Decentralisation with the incentives under Partial Decentralisation note that the importance of factor E (that a local manager's share of the global benefits now is determined by her bargaining power) will depend on what the accounting rules were under Partial Decentralisation. In an environment with many active local managers one cannot, in general, expect arbitrary accounting rules to perform better (or worse) with respect to the incentives to invest in global projects than a bargaining solution. If one is to compare Partial Decentralisation with Decentralisation in a theoretical setting, it seems therefore sensible to look at the case where $\mu = \frac{1}{2}\nu$. Then the factor E can be ignored in a comparison between the two levels of delegation.

Ignore also any direct incentive effects from the factors A and B (although these can impact how far off the investments will be from first-best levels under the two structures). We can then focus on the effects of C and D. In addition, we must consider the indirect effect of the factors B and C under Partial Decentralisation (where a local manager skewed her investments to influence the t = 1 project selection decision). Assume that the active local manager wants more local projects than the first-best decision would imply at t = 1, under all levels of delegation.

Under Partial Decentralisation she then underinvests in the research of global projects and overinvests in the research of the local ones at t = 0 to make the local projects more attractive for the central authorities at t = 1. Under Decentralisation, however, the local managers will under- and overinvest not to *influence* the t = 1 decision – but to *reflect* the suboptimal project selection decision at t = 1 that she will make together with the other local manager(s). Although the extra weight of local projects in the bargaining process leads to incentive problems under Decentralisation, it remains therefore uncertain whether the net effect (of the delegation) on the incentives at t = 0 is positive or negative.

The delegation introduces incentive problems with respect to the project selection decision at t = 1. And it will motivate a local manager to add extra weight to local projects at t = 0, when she is to decide how much to invest in project research. These factors tend to increase the incentive problems compared to under Partial Decentralisation. On the other hand, the local manager does no longer skew her investments at t = 0 to influence the investments at t = 1.

When the central benefits and costs that are generated by the global projects are unimportant, the local managers will want to make the same project selection decision at t = 1 under Decentralisation as the central authorities would. The only effect that must be considered under Decentralisation is then the overemphasis of local projects in the bargaining process, and the following result holds (see the Appendix for formal conditions):

When the central benefits and costs that are generated by global projects are unimportant, so that there are no incentive problems at t = 1 under Decentralisation, the underinvestment problem at t = 0 with respect to global projects tends to decrease as the organisation moves from Partial Decentralisation to Decentralisation. The overinvestment problem with respect to local projects may, however, increase when global projects are very important (small L).*[18]

We can therefore conclude that:

When significant benefits (or costs) are ignored by the local managers when they decide on project implementation, the t = 1 incentive problem can be very costly, and we would expect Decentralisation to be worse than Partial Decentralisation with respect to overall incentives. But the opposite can be the case when the local managers tend to make the same t = 1 decision as the central authorities would have

[18] In a deterministic version of the model that is used in subsections 5b and 5c (with equal benefit functions for local and global projects), the overinvestment problem is always reduced as an organisation moves from Partial Decentralisation to Decentralisation when L* > 0.38.

made, because the net t = 0 incentive problem then can be greater under Partial Decentralisation.[19]

Remember that going from Centralisation to Partial Decentralisation implied a stronger specialisation of the information search and processing activities, in the sense that local managers focused more on local projects while central authorities focused more on global projects. Going from Partial Decentralisation to Decentralisation will have an additional effect on the division of labour between central and local managers. Because the costs associated with project research centrally then increase, as the information must be sent to the local managers before the project design decision (factor A), central authorities will reduce their overall information processing activities. This effect is strengthened if the setting is such that the underinvestment problem is smaller and the overinvestment is stronger under Decentralisation, because the central authorities then will reduce their project research activities accordingly.

The information search and processing tends to be more decentralised when the project selection decision is delegated.

Consider again figure 2 of section 2 where some structures for the division of project research activities are illustrated. We have now shown that there is a tendency to go from all-round information processing (or fully centralised information processing) to a more specialised organisation (with respect to information search and processing) as the organisation moves from Centralisation to Partial Decentralisation. If one goes all the way to Decentralisation, there is also a tendency of more decentralised project research.

Comparing the two decentralised structures, Decentralisation is attractive compared to Partial Decentralisation when the following conditions are satisfied:

- Those information elements that have been processed centrally are not very costly to send to the units [low $s^{P}(\cdot)$, $r^{M1}(\cdot)$ and $r^{M2}(\cdot)$], maybe because they are not very important (due to central management overload) [small x_P and y_P] or the local managers are very competent.
- Lateral communication (and bargaining) is not very costly [low $s^{M1}(\cdot)$ and $r^{M2}(\cdot)$], maybe because the local managers have a thorough understanding of each other's businesses and the relationship is characterised by a high level of trust.

[19] Incentive problems at t = 1 tend to be more severe than t = 0 problems, as the central authorities can compensate more effectively for the latter by adjusting their own information search and processing activities.

- The information elements that have been processed locally would be very costly to send to the central authorities for further processing and project design [$s^M(\cdot)$ and $r^P(\cdot)$ high under Partial Decentralisation], maybe because the central authorities do not have a very good understanding of local conditions or are overloaded with work.
- Project control costs under Decentralisation are lower than the project implementation costs under Partial Decentralisation [$PC(\cdot)$ low compared to $PI(\cdot)$], maybe due to less communication (to inform on project content) and higher intrinsic motivation.
- The incentive problems with respect to project selection (at $t = 1$) are small [$L^D(\cdot)$ close to $L^*(\cdot)$], because central benefits and costs associated with project implementation and control are small [ν close to one and $PC_5(\cdot)$ close to zero] or tend to offset each other [$(1-\nu)\pi^G_2(\cdot) \approx -PC_5(\cdot)$].
- The accounting rules under Partial Decentralisation are very unfavourable to a sub-unit that invests in global projects [small μ], while a large share of the benefits are reflected in the accounts of one or the other of the cooperating sub-units under Decentralisation [large ν].
- The incentive problem associated with the extra weight on local projects in the bargaining process under Decentralisation is small, maybe because global projects are unimportant [$L^D(\cdot)$ and $L^*(\cdot)$ close to 1] or the marginal benefits of local projects are not very sensitive to the implementation capacity share [small cross-derivative of $\pi^L(\cdot)$ with respect to x_M and L].

The project selection decision should be delegated, if information processing, communication and project control costs then can be saved, the costs associated with bargaining among units are low, and the resulting incentive problems are small.

The delegation is attractive when the extra costs of the then required lateral communication are modest compared to the savings due to reduced vertical communication and central information processing. The net savings must compensate for any added incentive problems that result from the delegation. These problems can be large, when the local managers who negotiate the project selection decision ignore significant benefits or they sometimes irrationally fail to reach a value-enhancing agreement. However, when the local managers can be counted upon to reach an agreement that is close to the optimal one for the organisation as a whole, then the overall incentive problems can decrease, in which case delegation can be optimal even when the total communication and information processing costs increase.

5. Some extensions

In this section I relax some of my assumptions with respect to motivation, information completeness and rational judgement. In subsection a) I argue that the qualitative results in section 4 are valid, even when a local manager cares about corporate profits, as long as the local profits continue to be of some special interest to her. Then, in subsection b), I allow decision-making based on incomplete information and show that the manager who best understands the most risky projects should decide the project portfolio, although the other class of projects could be more important to the company.

In subsections c) and d) I incorporate the observation made by psychologists that human beings unconsciously bias their judgement on the importance of their own work. First, I study how the project portfolio will be affected and argue that the self-enhancement bias will tend to favour centralisation, with central managers insisting on too many global projects. Then I focus on how the bias will influence the central and local management capacities under Decentralisation. I argue that central managers will tend to consume too much local management capacity, insisting on local involvement in discussions on centrally processed project ideas, although the local managers should have spent that time doing own project research.

a) A local manager cares also about corporate profits

As argued in section 3, a division of labour with some degree of specialisation is the whole point of decentralisation and departmentalisation. In other words, a local manager is supposed to focus on the activities within her unit and not worry too much about what the other units do, as long as it does not affect her unit directly. With the language of this essay, a local manager should ignore the local projects of the other units, as her limited attention must be directed at those projects that are important for her unit. Then it is in the interest of both the manager and the firm that she does focus on the unit profits, as I have assumed in the model.

On the other hand, in reality, there are reasons why the firm's total profits are of some importance also to the local managers. Bankruptcy can certainly be scary for any manager (although a well-performing unit will be expected to survive even then), but also less severe circumstances can be damaging to a local manager, as firm-wide profits usually affect bonuses and perquisites for all employees. This effect is strengthened if the local manager has an explicit incentive contract based (partly) on the company profits or she identifies herself with the company (for instance due to a strong corporate culture).

The fact that a local manager also cares about the corporate profits will impact the management activities that are discussed in section 4, since the misalignment of incentives will be less important under *all* the organisational structures. First, the control costs decrease under Centralisation. Second, it reduces the under- and overinvestment problems under Partial Decentralisation and Decentralisation. Third, the incentive problems associated with the project selection decision are reduced under Decentralisation. And, finally, the project control costs in the implementation phase can decrease under all the levels of delegation.

For an illustration, assume that a local manager cares for a linear combination of unit and total profits and that α is the weight on global profits. Denote the unit profits (net of all unit costs) of the two units for Π_1 and Π_2 and the net central benefits and costs (that are not reflected in the accounts of the two sub-units) for Π_P. Then the active manager maximises $(1-\alpha)\Pi_1 + \alpha(\Pi_1 + \Pi_2 + \Pi_P) = \Pi_1 + \alpha(\Pi_2 + \Pi_P)$.

Under Partial Decentralisation, the active manager then has the following maximisation problem

$$(10)\quad \underset{(x_M, y_M)}{\text{Max}} \sum_{\omega\in\Omega} \pi^L(x_M + x_P, L^*(\cdot);\omega) f(\omega) + [\mu(1-\alpha)+\alpha] \sum_{\omega\in\Omega} \pi^G(y_M + y_P, 1 - L^*(\cdot);\omega) f(\omega)$$
$$- C^M(x_M, y_M) - s^M(x_M, y_M) - \alpha\left[r^P(x_M, y_M) + \sum_{\omega\in\Omega} PI(x_M, y_M, x_P, y_P, L^*(\cdot);\omega) f(\omega) \right]$$

subject to: $x_M, y_M \geq 0$

while her problem under Decentralisation is given by

$$(11)\quad \underset{(x_M, y_M)}{\text{Max}} \tfrac{1}{2}\left\{ (1-\alpha) \sum_{\omega\in\Omega} \pi^L(x_M + x_P, L = 1;\omega) f(\omega) + (1+\alpha) \sum_{\omega\in\Omega} \pi^L(x_M + x_P, L^D(\cdot);\omega) f(\omega) \right\}$$
$$+ \left(\tfrac{1}{2}\nu(1-\alpha) + \alpha\right) \sum_{\omega\in\Omega} \pi^G(y_M + y_P, 1 - L^D(\cdot);\omega) f(\omega) - C^M(x_M, y_M) - s^{M1}(x_M, y_M)$$
$$- \alpha\left[r^{M2}(x_M, y_M, x_P, y_P) + \sum_{\omega\in\Omega} PC(x_M, y_M, x_P, y_P, L^D(\cdot);\omega) f(\omega) \right]$$

subject to: $x_M, y_M \geq 0$

when the bargaining between the two local managers is based on unit maximisation. Note that $L^D(\cdot)$ now, in general, will be closer to $L^*(\cdot)$ than in section 4, since the local managers will also consider some of the central benefits and costs when they make decision on project implementation. And the control cost part of the project implementation costs, $PI(\cdot)$, and project control costs, $PC(\cdot)$, can decrease.

(10) and (11) have, however, the same qualitative characteristics as (7) and (9). In other words:

Allowing the local manager to also care about the corporate profits does not change the analyses of section 4 qualitatively, as long as she continues to have some special interest in the local profits ($\alpha < 1$).

Of course, the manager's interest in the company's total profit can depend on the level of delegation in the organisation. One would expect the interest (α) to decrease as more decision authority is delegated, since a manager is then seen as more accountable for the unit profits.

b) Incomplete communication

In section 4 I studied a situation where the decision-maker had perfect information before selecting the project portfolio, as she gets to know all the information that has been processed in the organisation as a whole. This is an extreme assumption of *ex-post* efficiency, but it was useful to compare the three "pure" organisational forms. As observed by Radner (1996), however, only a fraction of the available information will be brought to bear on any single decision in a large organisation.

Consider therefore the case where a manager bases her decision on incomplete information. If the central authorities take this role, they could make sure that they knew many (or all) of the global information elements (also those processed locally), while they ignored the locally processed local information elements. Then the central authorities could design the global projects that are to be implemented, and let the local managers use the rest of their project implementation capacity for local projects that are designed locally. Such a structure will save communication. In fact, if information search and processing is highly specialised, the decision on implementation capacity can, in principle, be made without any communication at all. (But the central authorities must communicate the content of the global projects that they select, so that the local managers can implement them.)

The project portfolio will then, however, tend to be inferior to a portfolio based on full information, since the central manager will be ignorant of the actual value that local projects can generate for a certain implementation capacity. In the model, the decision-maker can be seen as being unable to distinguish between some states of the world ($\omega \in \Omega$) at $t = 1$, and L must therefore be the same for these states, although it optimally should have been differentiated. The decision must be based on a coarser information partition.

To justify incomplete communication, the saved communication (and information processing) costs must be greater than the expected total loss in project values, as the decisions are based on poorer information.

Whether the implementation-capacity-split decision should be made centrally or locally under incomplete communication will depend on how well each manager can be expected to understand the critical uncertain variables. A simple example, without agency problems, can illustrate this.

Assume that the benefit functions take a square root form

$$(12) \quad \pi^L(x_M + x_P, L; \omega) = \sqrt{(x_M + x_P)L\,\varepsilon_L(\omega)}$$

$$(13) \quad \pi^G(y_M + y_P, 1-L; \omega) = \sqrt{(y_M + y_P)(1-L)\varepsilon_G(\omega)}$$

With this technology the uncertainty is reduced to a question of how attractive each class of projects is, given by the functions $\varepsilon_L(\omega)$ and $\varepsilon_G(\omega)$, which can take two values, 0 and 1, see figure 7. For positive realisations of the random variables, the project values are further determined by the level of project research at t = 0 and the implementation capacity decision.

State $\omega \in \Omega$	**Probability** $pr(\omega)$	**Local variable** $\varepsilon_L(\omega)$	**Global variable** $\varepsilon_G(\omega)$
1	p_1	0	0
2	p_2	1	0
3	p_3	0	1
4	p_4	1	1

Figure 7.

Further, assume that information search and processing capacities are given by $\tau_M = x_M + \lambda_M y_M$ and $\tau_P = \lambda_P x_P + y_P$, where λ_M and λ_P are sufficiently large for the managers to always choose $y_M = x_P = 0$. In other words, the managers are fully specialised with respect to information search and processing. Normalise the capacities to $\tau_M = \tau_P = 1$, so that $x_M = y_P = 1$. Ignore project implementation costs.

And, assume that the information structure is such that a manager will only understand the state of the local (global) variable if she has processed a sufficiently large number of local (global) information elements. In this setting a local manager always (but only) gets to know and understand the local variable $\varepsilon_L(\omega)$, while the global variable $\varepsilon_G(\omega)$ is only understood by the central authorities.

First, consider a centralised structure, where the central authorities design and insist on some global projects and then let the local managers spend the rest of their project implementation capacity on local projects that are designed locally. The central authorities can only distinguish between the sets A = {1, 2} and B = {3, 4}. The best decision rule is then

$$(14) \quad L_A = 1 \text{ and } L_B = \frac{p_4^2}{(p_3 + p_4)^2 + p_4^2}$$

Second, consider a decentralised structure, where local managers decide the project mix after a free local bargaining process that maximises the joint surplus (ν = 1). They can only distinguish between V = {1, 3} and W = {2, 4}, and their best decision rule is

$$(16) \quad L_V = 0 \text{ and } L_W = \frac{(p_2 + p_4)^2}{(p_2 + p_4)^2 + p_4^2}$$

The expected joint surplus (given the information processing capacities) is given by

$$(17) \quad \Phi^C = p_2 + \sqrt{(p_3 + p_4)^2 + p_4^2}$$

$$(18) \quad \Phi^D = p_3 + \sqrt{(p_2 + p_4)^2 + p_4^2}$$

under Centralisation and Decentralisation respectively. The company will be indifferent between the two structures when $p_2 = p_3$, since everything in this example is symmetrical. If $p_2 > p_3$, Centralisation is better, while Decentralisation is best when $p_2 < p_3$. Note that Centralisation is better for large p_2/p_3, even though the local projects (that are researched by the local manager) then are more important than the global projects (that are researched centrally), in the sense that they are expected to take a larger share of both the project implementation capacity and the returns. When $p_2 > p_3$, the global projects are more risky than the local, as there is a higher probability of them being worth nothing, while the local projects are the most risky when $p_2 < p_3$. In other words, we can draw the following conclusion for this example:

The manager who has the best understanding of the variables that determine the value of the most risky projects (at t = 1) should decide the project portfolio, even if the other projects can be more important in terms of expected returns.

If the global projects are more risky than the local projects and the central authorities learn more about these projects than the local managers, then the decision should be made centrally, although the local projects could, in fact, be more important to the company. Similarly, the local managers should make the project portfolio decision if

they understand the local projects better and these are more risky than the global ones, unless direct and indirect bargaining costs (e.g. communication costs and costs due to overinvestment) are too high.

My analysis in this subsection adds to the insight by Hickson et al. (1971) that those units "that cope most effectively with the most uncertainty should have most power within the organisation" (p. 219). This proposition is part of the received organisation theory and has been supported by empirical studies (Scott 1998).

c) Biased judgement and local loss of control

Above (in subsection b) I illustrated one possible cause of *ex-post* inefficiency, information incompleteness. As human beings are imperfect information processors, we usually cannot consider all information elements before reaching a decision. Psychologists have showed that our bounded rationality also has another important effect: Even if a person tries to make an objective judgement (based on all the available information), that judgement is likely to be unconsciously and powerfully biased.

For example, extensive evidence shows that people (at least in the western world) tend to perceive themselves as being better than others across a wide range of desirable attributes, such as honesty, cooperativeness, rationality, driving skills, health and intelligence (Bazerman 1998). Tyler and Hastie (1991) argue that individuals overestimate their contribution to an organisation. French (1968) reports that only 2 of 92 business managers rated their job performance as below the 50th percentile on a scale with similarly employed men (cited in Brown 1986). These tendencies are probably partly due to a fundamental human need to view oneself, the world and the future in a positive light for reasons of personal contentment (Taylor and Brown 1988) and mental health (Taylor 1989)[20] and partly due to an unconscious confusion of what is personally beneficial (or self-serving) with what is fair (Bazerman 1998).

Relating these mechanisms to the setting of this essay, we must expect a manager to overestimate the importance of the information elements that she has processed (as her evaluation of the importance of these elements is related to how she views her own contribution to the organisation). And, if the information processing tends to be specialised, we must expect the decision-maker to focus on the projects that she has researched when she selects the project portfolio. She may genuinely (but

[20] The nineteenth century Norwegian playwright Henrik Ibsen touched on the same idea in his famous play "The Wild Duck" (published in 1884), where Dr. Relling says to Gregers: "If you take the life-lie away, from the average person, you take his happiness away as well" (from the translation by Hall and Ewbank, which was published in 1990 by Absolute Press, Bath, England).

incorrectly) believe "her" work, and hence the projects that she has researched, to be more important for the company than the work done by other managers, or she may unconsciously want to signal her own importance to others.[21]

The problem of self-enhancement can easily be illustrated within the model framework. Assume a similar technology to the one given by (12) and (13) in subsection b), with full specialisation ($x_P = y_M = 0$), except that there now also are some parameters, θ_L and θ_G, that indicate the importance of the various projects. The benefit functions are given by

$$(18) \quad \pi^L(x_M + x_P, L; \omega) = \sqrt{\theta_L x_M L \varepsilon_L(\omega)}$$

$$(19) \quad \pi^G(y_M + y_P, 1-L; \omega) = \sqrt{\theta_G y_P (1-L) \varepsilon_G(\omega)}$$

Then, ignoring project implementation costs, the optimal project implementation capacity split, L, for a given state of nature, is given by

$$(20) \quad L^*(\cdot) = \frac{\theta_L x_M \varepsilon_L(\omega)}{\theta_L x_M \varepsilon_L(\omega) + \theta_G y_P \varepsilon_G(\omega)}$$

Say that the true values of the parameters θ_L and θ_G are 1, but that a particular manager may have a different opinion, because she overestimates the importance of her own work. In this setting, with specialised information processing, the central manager would typically believe θ_L/θ_G to be smaller than 1, while a local manager is liable to overestimate that ratio.

First, such a bias could lead to overinvestments both locally and centrally. Second, and maybe a more severe problem, *the bias will distort the project portfolio decision.* If the decision is made centrally, L will be too small (as the central authorities select too many global projects), while L could be too large when the decision is made locally (after bargaining).[22] Since judgement biases are likely to occur under both Decentralisation and Centralisation, it is not obvious what organisational form that is better in this respect. But the judgement error should be smaller if a manager is involved in the research of both classes of projects.

Note that it is not clear that a central manager will have a more balanced view than a local manager will, unless she, in fact, is more balanced in her information processing, in the sense that she researches both local and global projects. In the same way that

[21] If others judge a manager's work based on how many of "her" projects that are implemented, such a bias may, in fact, be a rational response to the (perhaps irrational) behaviour of others. My point here is stronger. Even someone who tries to be objective can make biased decisions.

[22] At least when all the local managers are active, mainly researching local projects.

local managers (when asked) typically will argue that locally researched projects are undervalued by central authorities under centralisation, central managers will feel that local managers do not consider centrally researched projects the way they should under Decentralisation.[23] Since central authorities can decide the level of delegation, the bias will work in favour of centralisation, when central authorities are dissatisfied with local decisions (even if those decisions are unbiased).

The self-enhancement bias will tend to strengthen the effect (found in section 4) that delegation leads to more local projects, when information processing to some degree is specialised across managerial levels. A central manager will see the (perceived) inefficiencies under Decentralisation as a loss, while she will ignore the effects of own biases. The self-enhancement bias tends therefore to favour centralised structures, with the central authorities insisting on implementing too many global projects.

Over time the revelation of actual project outcomes and the resulting individual learning can reduce a decision-maker's bias, but a major problem is that she will only receive feedback on those projects that, in fact, are selected (Tyler and Hastie 1991). And, self-serving biases lead people to attribute success to own competence, while failures are attributed to bad luck or the incompetence of others (Bazerman 1998). Basic judgmental biases seem unlikely to be corrected in the real world, even if there are market forces that work in that direction (Tversky and Kahneman 1986).

Also authors of strategy books have pointed to how judgement biases can impact centralised decisions. Goold, Campbell and Alexander (1994) report, for example, of an oil company where the top management suggested some new exploration approaches to its newly acquired minerals business, which the minerals management team felt compelled to try out. It took them several years to recover from the resulting losses.

This case is probably both an example of decision-making based on incomplete information (discussed in the previous subsection) and an example of a judgement bias. The central authorities overemphasised the value of their own knowledge (of oil exploration techniques), and they made therefore a bad decision on what kind of projects the minerals unit should pursue.

The example illustrates that it can be difficult to distinguish problems of imperfect information from problems of judgement biases in empirical studies based on

[23] This argument is similar to the one given by Tyler and Hastie (1991). They claim that everyone will feel undervalued and underrewarded in organisations that allocate limited resources and rewards among individuals following the principle of equity, due to the exaggerated feelings of importance and value to the organisation that individuals tend to have.

observed behaviour. To reveal the cause of the behaviour, the researcher must probably ask the decision-makers directly about available information and her attitudes towards own work (as compared to the work of others).

d) Biased judgement and loss of focus

In the previous subsection I discussed how the self-enhancement bias could skew the project selection decision. Under Decentralisation, the same bias may also have another important effect. Even if project selection is done locally in an objective way, a tendency to self-enhancement centrally can lead the central managers to occupy the local managers' time in an unproductive way. They may insist on the local managers' attendance at unproductive meetings, and that the local managers at least seriously evaluate their ideas, although these activities, in fact, are of little value to the corporation.[24]

An example will illustrate these mechanisms. Focus on a deterministic setting. In particular, assume a technology as described in figure 7 (on page 131), with $p_2 = 1$. Then only local projects are pursued both in the information processing and in the project implementation phase ($L = 1$). For simplicity, assume a linear benefit function for local projects, $\pi^L(\cdot) = x_M\theta_M + x_P\theta_P$. Suppose the true values of the parameters θ_M and θ_P are 1, but, as under subsection c), that a particular manager may have a different opinion, because she overestimates the importance of her own work. The central manager would then typically overestimate θ_P/θ_M, while a local manager is liable to underestimate that ratio.

Now view the costs of information search and processing indirectly, and focus instead on the capacities for such management activities. Consider a decentralised structure, where central and local management capacities are given by $\tau_P = x_P + sx_P$ and $\tau_M = x_M + rx_P$ respectively, where sx_P is the sending time and rx_P is the reading time associated with the communication of centrally processed information elements. The costs of the central and local management capacities are $C_P(\tau_P)$ and $C_M(\tau_M)$ respectively. Given full capacity utilisation and mandatory local reading, the expected total joint surplus is then

$$(21)\quad \Phi^D(\cdot) = \theta_M x_M + \theta_P x_P - C_M(\tau_M) - C_P(\tau_P)$$
$$= \left(\tau_M - \frac{r}{1+s}\tau_P\right)\theta_M + \frac{1}{1+s}\tau_P\theta_P - C_M(\tau_M) - C_P(\tau_P)$$

[24] Local self-enhancement can similarly lead local managers to communicate too much information to the central authorities under more centralised structures, but then a central manager will have the authority to deny access.

Maximising with respect to τ_P implies the first-order condition

$$(22) \quad \frac{\partial \Phi^D(\cdot)}{\partial \tau_P} = \frac{1}{1+s}\theta_P - \frac{r}{1+s}\theta_M - C_P'(\tau_P) = 0$$

Assume $C_P''(\tau_P) > 0$. Then (22) implies the following result:

The central management will tend to build up too large central management capacity (τ_P), when they overestimate their own importance (θ_P/θ_M). They will consume too much of the local manager's time, insisting on an evaluation of the information that they have processed. The local manager loses focus due to central "noise".

Similarly, we would expect local management capacity (τ_M) to be too small when it is decided centrally, while it will be too large when it is decided locally (due to local self-enhancement).

Under more centralised structures (where communications go from the local manager to the central authorities and local capacity is decided centrally), central managers' self-enhancement leads again to overcapacity centrally and undercapacity locally. However, then the problem is not one of loss of focus, but one of loss of information, as the central managers are not receiving as much information from the local managers as they should.

Again an example from Goold, Campbell and Alexander (1994) can illustrate some of the problems. The group management in an industrial services company insisted on a very extensive and sophisticated strategic planning process, imposing extra costs and delays on the business units. The local managers, on the other hand, felt that they should have been focusing on issues of more immediate importance, such as driving the local costs down and improving customer relationships. The judgements of both the local and the central managers in this example were probably biased in a self-enhancing way, resulting in a combination of local loss of focus and unjustified local dissatisfaction.

To avoid the traps of the self-enhancement bias that I have described in this and the previous subsection, central and local managers should strive for an open communication, so that they are, at least, aware of any differences of opinion. Central managers must learn to live with a certain level of dissatisfaction with how much attention local managers pay to global matters under a decentralised organisation design. And local managers must accept that the central authorities sometimes stress global matters more than the local managers like, as the importance could be greater than their immediate intuition may indicate.

When passing judgement on other's judgement, one should bear in mind that also one's own judgement abilities are limited.

6. The hold-up problem and integration

The search for and processing of global information elements in the model represent relationship-specific investments. And, under Decentralisation, one unit manager can hold up another unit manager (who has invested in the research of global projects) to appropriate part of the rent. The assumed bargaining outcome does therefore not reflect the *ex-ante* investments directly. It is instead based on the parties' respective outside options (in case negotiations fail). In other words, my model is an illustration of the hold-up problem discussed by Klein, Crawford and Alchian (1978) and Williamson (1975, 1985). These authors suggest that integration can be an effective way to overcome the hold-up problem under certain circumstances, but they are vague about how an integrated company can deal with the same type of issues inside the corporate borders.

In the formalised part of the literature, which has grown out of the seminal article by Grossman and Hart (1986) on the benefits and costs of integration, managers tend to own assets directly, as in Hart and Moore (1990). Integration then implies that some managers transfer their ownership rights to one designated manager, who becomes the owner of the integrated firm (with all the formerly independent entrepreneurs as employees). The outside options of the various managers change, which again affect the bargaining outcome and the managers' incentives to make relationship- and asset-specific investments.

In my model, however, assets are not owned directly by managers. Instead I take the more realistic assumption for larger firms that there are some (relatively) inactive outside owners who ultimately control the assets.[25] If one such firm buys another firm (or a unit in another firm), the ownership rights of the assets (and the ultimate control rights) are transferred from one set of financial owners to another, but a unit manager's position need not change dramatically. As before, a unit manager will decide on the business activities and the use of assets in the unit, *unless* some centralised authority takes charge. And, if she is to leave the company, she loses all control over any assets in her unit, apart from her own human capital. Integration in itself does therefore not change the outside options of a unit or its managers.

In other words, a hierarchy could (with the limitations that I discuss in section 7) mimic a market organisation with respect to bargaining among unit managers. The

[25] Holmstrom (1999) and Rajan and Zingales (1998) also observe that productive assets are today usually owned by firms and not individuals.

fact that the capital owners are the same for the two (or more) units does not in itself change the bargaining positions of the managers (and hence their incentives to invest). The managers of decentralised units will behave exactly the same way as managers of independent firms would (unless a unit manager for some reason cares about the total corporate profits under integration, as I discuss in section 5a). Integration reduces the hold-up problem if, and only if, central managers take active measures to maximise the aggregated profits of the company.

In section 4 I discussed how four classes of centralised management activities make a difference. First, the central managers can search for and process information, and, hence, they can for example compensate for local underinvestment. Second, they can decide and control the local (*ex-ante*) investments in project research. Third, they can make the (*ex-post*) decision on project selection. And, finally, they can enforce local bargaining solutions.[26]

So, I acknowledge that the hold-up problem can be important for organisation design and industry structure, but I emphasise other mechanisms than those captured in the Grossman-Hart-Moore models, where there is no room for such centralised management activities.

When integration does not affect the unit managers' ownership rights (because the rights are held by third parties), and unit managers are inclined to maximise unit profits regardless of whether they manage an independent unit or are part of an integrated company, then the existence of a centralised authority is key to understanding integration. The value (and costs) of the central management activities will determine whether two units should be integrated or operate as two independent market players. [27]

This view seems to be in line with Williamson's (1985) original ideas on the hold-up problem. He argues that (p.78): "The advantage of vertical integration is that adaptations can be made in a sequential way without the need to consult, complete, or revise interfirm agreements. Where a single ownership entity spans both sides of the transaction, a presumption of joint profit maximization is warranted." Presumably, by this he thinks of actions taken by some central authorities responsible

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[26] Of course, as I discuss in section 7, an external third party could theoretically also perform these management activities on a contract from the two (then independent) units. Unfortunately, the costs of negotiating such contracts, and the fact that they would have to be enforced by the court system, seem to be major hindrances. There is a crucial difference between the owner-given authority of central managers in an integrated company and the negotiated authority of a third party (e.g. an industry association) with the enforcement of a national (or international) court system.

[27] This is a view that seems to be shared by distinguished writers on corporate-level strategy such as Porter (1987) and Goold, Campbell and Alexander (1994), who emphasise the importance of the value-creation (and value-destruction) activities of a corporate parent.

for the entire corporation. Unfortunately he remains silent on how the central authorities in fact manage the business units and how unit managers in a large corporation behave.

My model can support and provide some underlying arguments for Williamson's two major hypotheses on integration. First, and most importantly, he argues that integration is more likely when asset specificity increases. In my model that means that the global projects become more important (compared to the local projects), leading to more distorted incentives for the local unit managers under a decentralised structure, such as a market organisation. Then there is a large potential for improvements through the introduction of centralised management activities, and integration (a hierarchy) becomes more attractive.

Second, Williamson argues that only recurrent transactions can support a unified governance structure. A higher frequency is likely to reduce the communication and control costs associated with centralisation in my model, for example through the development of standardised control processes and a common code (or language) for communication (March and Simon 1958, Cyert and March 1963). Centralisation (in an integrated structure) becomes less costly and therefore again more attractive as a way of dealing with the hold-up problem.

In the next section I discuss the differences between a hierarchy and a market organisation in a somewhat wider context.

7. Hierarchy or market organisation

Consider the two sub-units in my model. These may (as I have assumed) both be part of the same organisation, or they could be separate entities, cooperating (and competing) across organisational boundaries. Call the first structure a *hierarchy* (to indicate the existence of some central authority) and the latter a *market* organisation. In this section I discuss some of the trade-offs between these two structures in a wider perspective than I have captured in my discussion so far.

The aim is to illustrate how the insights I have derived in the previous sections fit in a more general theory of the firm, where also other mechanisms (outside my model environment) are relevant for the governance structure. I focus on two important characteristics of the firm, the existence of a unified authority structure (replacing and adding to the court system) and the internal monitoring and control (as opposed to financial market monitoring of each sub-unit).

a) Central coordination versus value destruction

The simple model in section 3 (without communication and agency costs) illustrated that to add a third information search and processing unit (to the two sub-units) can be cost effective, due to gains from specialisation and management overload effects.[28] When, in addition, local incentives are skewed so that local managers tend to focus too much on local and too little on global projects, a third management unit pursuing corporate interests can reduce these incentive problems (as I discussed in section 4). Either by simply doing more central research on global projects (and less research on local projects), or by using its authority to control the local research activities or the project selection decision.

But, having made a case for a third information search, processing and decision-making unit under some settings does not imply that the third unit must be part of a larger company that includes both the sub-units. The third party could instead be a separate entity (e.g. an industry association), as long as the incentives of its managers are aligned with the total joint interests of the two units (which then would be independent firms). Such a separate unit could do information processing and communication activities only or also be given some decision authority. In either case, some benefits from centralisation could be realised also under a market organisation.

However, there are some major differences between a market organisation and an integrated structure, where all the units are part of the same firm. In particular, the sub-units must negotiate an agreement on the establishment and the administration of the third party under a market organisation. The vaguer the tasks, and the higher the uncertainty, the more difficult it will be for the units to agree on the role of the third party, since the units (and their owners) will not only worry about the joint profits but also fight for their own special interests. The enforcement of a decision made by the third party can be particularly difficult, even if it is in the best joint interest of all the units, since it can have a significant distributive impact. Future losses from being excluded from the association can discipline a firm,[29] but if such and other reputation (or trust) mechanisms are not effective, one must rely on court enforcement, which can be slow and ineffective in nature.[30]

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[28] Hiring more managers with specialised tasks in the sub-units could have the same effect, but as indicated in footnote 4 of section 3, the marginal utility of adding a new manager to an already large management team tends to decrease with size. Creating an extra management team with specialised tasks can, however, boost the management capacity, as long as the necessary coordination activities with the other management teams are not too extensive in nature.

[29] The threat of exclusion can work quite well if the brand name is strong enough, as for hotels under the non-profit membership association Best Western International.

[30] Williamson (1985) discusses in detail the shortcomings of court ordering.

An integrated company will not have the same problems. Then the owners of the company, who will have the joint surplus in mind, decide the central management team's responsibilities and authority. No bargaining among the sub-units is necessary. Enforcement of central decisions will also tend to be swifter, as the unit managers do not have the same opportunity to appeal to a slow and bureaucratic court system. In a multilayered organisation, a manager may have the opportunity to appeal to executives higher up if she is unhappy with the decision made by her immediate superior. But the company can design much swifter appeal procedures than in an independent court system, and an executive can even refuse to listen to such complaints at all.[31]

A termination of the relationship can be a useful measure under both hierarchy and market organisation (Alchian and Demsetz 1972). However, there will be a major difference between the two structures. Within an integrated company an *individual* resigns or is fired, while under a market organisation it is the *firm* that can withdraw or be excluded from the cooperative arrangement. The crucial difference being that an individual cannot take company assets with her under the first structure, while the unit (including both the manager and the assets) remains intact under the latter. In other words, the value of the outside option for a unit manager tends to be lower if an integrated firm employs her than if she controls an independent company (consisting of that unit only), when there are asset-specific investments (Hart and Moore 1990). She is then more inclined to accept centralised decisions that are unfavourable to her unit (but are maximising joint surplus).[32]

Under some settings trust among independent firms (perhaps due to reputation effects) can support extensive communication of even very sensitive information (as in some modern network organisations). But, usually, a firm tends to be very cautious about providing other firms with information that can potentially be used for the benefits of the other firms in future bargaining processes or competitive moves. It can be difficult both to bargain about the exchange of know-how, since its value is not known for the purchaser until she has the information (Arrow 1971), and to contract on its transfer, when it has a strong tacit and learning-by-doing character (Teece 1982).

Unit managers in an integrated firm may have the same concerns about knowledge and technology appropriation by other sub-units, but the central authorities can then actively protect them. The central management can for example guarantee that the other sub-units are not allowed to start up competing activities, as that does not tend

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[31] Milgrom and Roberts (1988 p.88) argue that "top management's authority and discretion and lower management's lesser autonomy are the firm's principal defining characteristics."

[32] While Hart and Moore (1990) focus on the impact of a transfer of ownership rights on a manager's incentives to invest, I stress here instead its effects on authority relations.

to be in the interest of the company as a whole. In general, the central authorities can design and enforce *rules of the game* in a more effective way than a court system (Holmstrom 1999).[33]

In the same way, an integrated company can (but does not need to) be better able to swiftly redesign the organisation than a market organisation, where bargaining processes and formal procedures tend to be more cumbersome. Organisation design can be used actively to achieve an efficient division of labour with respect to specialisation and interdependencies from a pure information processing and communication point of view (March and Simon 1958). And it can be used to reduce agency costs, as tasks are given to units (and individuals) with externalities and measurement problems in mind (Holmstrom and Milgrom 1991). As markets, products, customers, and production and administrative technology change over time, organisation design must be adjusted in an ongoing process.

Finally, government regulations can be a problem for the market organisation. Anti-trust regulations may stop some global coordination initiatives between independent firms, while these are permitted among units within an integrated company.[34]

Although I have pointed to some benefits of integrated organisations, it is clear that the existence of a central authority can also have negative effects. In fact, Goold, Campbell and Alexander (1994) argue that the large majority of the many multibusiness parents that they have studied are net value destroyers rather than value creators. One problem is the inability of central authorities to credibly delegate authority. With owner-given authority they can always renege on their promise and intervene in the decision process, and indeed individuals with formal authority seem to be vulnerable to a propensity to manage (Williamson 1985). To avoid a negative impact on the local initiative for information search and processing due to an expectation of interventions, the central authorities may have to desist from own information search and processing activities (so that the probability of an intervention is reduced) or sell the unit to other owners (Aghion and Tirole 1995).

A related argument can be derived from my discussion in section 5 on biased judgement. When central managers are vulnerable to the self-enhancement bias, they tend to intervene in the decision process, although the decision should have been made locally (due to communication costs or tacit knowledge).[35] Further, if a

[33] Note that an independent third party also can guarantee some confidentiality by only transmitting very aggregated information back to the firms, but such mechanisms cannot replace the extensive information exchange necessary to take advantage of comprehensive cooperative opportunities.

[34] Such mechanisms will tend to favour the build-up of larger companies. Regulators may stop mergers, but they rarely split up large companies or regulate internal growth.

[35] The same negative tendencies of managers to intervene unnecessarily in subordinates' activities can also be explained by role expectations. A manager may not be able to consciously (and

manager, in fact, does delegate authority, she tends to disturb the work of the subordinate, because she wants to help with the information search and processing and therefore insists on wasteful communication, taking up valuable local management time. And the central management will tend to build up too large central management capacity. A market organisation (or extreme control of central management capacity – as in a holding company) can be the only way to effectively control these problems.

Milgrom and Roberts (1988) argue that a hierarchy is vulnerable to wasteful influence activities by subordinates. Employees engage in unproductive communication activities, to influence the allocation of resources, job design, accounting rules and other central decisions, for their individual (or unit) benefit. In a market place, however, there is no central authority structure to appeal to. Unit managers must instead create the values through business activities. On the other hand, the saved influence activities must be compared to the costs of the market negotiations between the then independent firms (Milgrom and Roberts 1990a).

b) Internal versus market monitoring

In subsection a) I focused on the centralised information processing and decision-making activities. Now consider how an integrated hierarchy and a market organisation differ with respect to the monitoring and control of sub-units. The differences arise because the central management team in a hierarchy (which again has financial owners) in reality owns the sub-unit, while under a market organisation a sub-unit is owned directly by financial owners. Therefore, in a hierarchy only one unit (the central management team) monitors and controls the sub-unit directly, while under a market organisation many independent and competing (existing and potential) financial owners evaluate the firm. Audited financial statements and market price information are (usually) available only at the company level.

Because the sub-units have the same owners in a hierarchy, the central authority will have the joint surplus in mind when they design explicit and implicit incentives for the managers of the sub-units (Holmstrom 1999).[36] When the owners can influence the incentive strength of the unit managers (while I kept motivation constant in my model), Holmstrom and Tirole (1991) argue that they will employ lower-powered

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rationally) evaluate what decisions she should make herself and what decisions she should delegate. She may then revert to the role expectation (or behavioural rule) that "managers are expected to make decisions."

[36] Holmstrom (1999) argues that a market generates information through bargaining, since also outside options are considered in the process. But that is not a characteristic that is unique for market organisation in my set-up. As illustrated with the organisation structure Decentralisation (see section 4c), such a bargaining process can take place also inside an integrated company.

incentives under integration than under non-integration, to reduce excessive rent seeking. That result is valid when a unit manager's pay is restricted to be a linear function of the unit's profits. If the unit manager's pay can be made contingent on other units' performance (or the total company profits as I indicated in section 5a), she will be motivated to put some emphasis also on corporate interests. Owners of an independent unit, on the other hand, will focus on unit profits only when they design the incentive scheme.

A unit manager may care about the total surplus of an integrated company even without an internal company incentive system supporting such behaviour. I section 5a I suggested that identification mechanisms (which are affected by the corporate culture) and bankruptcy costs can play a role. The outside labour market for managers can be another important factor (Fama 1980). Potential future employers of a unit manager may base their employment and compensation decisions on company rather than unit performance, since such information tends to be easier accessible and of higher quality.

On the other hand, if the market for managerial services is important to a unit manager, we would expect her incentives (from that outside evaluation) to be stronger under a market organisation. Information about individual performance is then available through public financial statements and stock market price information. And, in a hierarchy, where individual managerial success is less transparent to outsiders, free-riding may become a problem, as corporate performance (achieved by others) can be enough to secure a good position in another firm.

Another problem associated with the incentives of a unit manager in an integrated company is that financial information (internal or public) on the unit's performance is often less than objective. Top managers can always manipulate the accounts by changing the accounting rules or insisting on some internal transactions at subjectively set prices. Company reports, on the other hand, must be based on publicly recognised principles. The subjective nature of performance measures in an integrated company can hurt both internal company incentive systems and incentives based on outside evaluation (by future employers).

Due to the subjective performance measurement, a unit manager is also less likely to learn how to adjust the self-enhancement bias that I discussed in section 5. But, if the unit is set up as an independent company, the more objective feedback from financial accounts and market prices provide stronger pressure to adjust the judgement on own competencies.

In other words, a market organisation can provide strong incentives for a unit manager to maximise the unit profits and see own contribution in an objective way.

In a hierarchy incentives tend to be better balanced between unit and corporate interests, so that a unit manager will be more inclined to recognise global effects. But the incentives will be weaker than under market organisation.

Finally, note that when there are fixed costs associated with raising and maintaining debt and equity capital, or other types of economies of scale in the (imperfect) financial markets, a company's size will influence its cost of capital.[37] Lee, Lochhead, Ritter and Zhao (1996) find substantial economies of scale associated with raising capital (for all types of securities) in the US market from 1990 to 1994. It seems that central authorities in an integrated company can be efficient facilitators of financial services, as long as the internal costs of these activities do not eat up the (external) cost advantage.

8. Summary and concluding remarks

My focus in this essay on management activities such as information processing, communication, decision-making, control and bargaining in an environment where unit managers sub-optimise (but have fixed motivation) depart from other, more traditional, economic studies of organisations. The team theory (of Marschak and Radner), for example, generates interesting ideas on coordination and organisation design, but it ignores the incentive consequences of delegation. The principal-agent theory, on the other hand, has generated very clever models of how (explicit and implicit) incentive contracts should be designed, but it is silent on all the other important management activities. Williamson's transaction cost economics implies a much more realistic view of the firm, allowing both bounded rationality and agency costs, but it addresses questions of industry structure rather than organisation design, and it does not spell out the underlying mechanisms.

In my opinion, the benefits from specialisation and the costs of management overload form the *raison d'être* for the decentralisation of management activities. An evaluation of the benefits and costs associated with information search, processing and decision-making is thus essential to understand why the degree of decentralisation varies across companies, together with the communication and agency costs that result from such decentralisation.

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[37] The economies of scale can be attributed both to issue-related costs and differential information wealth effects (Hull, Mazachek and Ockree 1998). Announcements by small firms reveal more with respect to insider signalling because larger firms, in general, are better monitored by the market.

With the model, where both central and local managers can research global and local projects, I have indicated how the delegation of the local project research decision will save on control costs. But it will also, in general, lead to underinvestment in the research of global projects and overinvestment in the research of local projects, since a local unit enjoys only part of the benefits from the global projects. The central authorities can dampen these incentive problems by adjusting the central information search and processing activities accordingly.

A delegation also of the project selection decision can (but does not need to) save on communication and project control costs, as the flow of information changes dramatically. But the local managers may then ignore important benefits (or costs) when they make the decision, or they may fail to reach a value-enhancing agreement altogether. The overall incentive problem need not, however, become worse if the local managers tend to make the same project selection decision as the central authorities would have made. In fact, the net incentive problem can under these circumstances decrease with the extra delegation (compared to if only the local project research decision was delegated).

As more decision authority is delegated, the information processing will be, first, more specialised (in the sense that local managers focus on local projects while central authorities focus on global projects), and, then, more decentralised (in the sense that local managers do more and the central managers do less of the information search and processing). Overall, looking at the entire corporation's activities, less attention is paid to global matters.

My analyses are valid even if a local manager also cares about corporate profits, as long as she has some special interest in the profits of her own sub-unit. When a (local or central) manager makes the project selection decision based on incomplete information, communication (and information processing) costs are saved, but the decision on capacity split (between local and global projects) will be inferior to the full-information case. This decision should then be made by the manager who has the best knowledge of the most risky class of projects, although the other class of projects may, in fact, be more important to the company from an expected profits point of view.

Incorporating the well-documented self-enhancement bias into the model, in the sense that own work is seen as more important than the work of others, strengthens the effect that delegation leads to the implementation of more local projects (instead of global projects), when information processing to some degree is specialised across managerial levels. Central managers overestimate the resulting inefficiencies and favour a more centralised organisation design than objective reasoning would suggest. Even if the decision authority remains delegated, the central management

may build up too large central management capacity and consume too much of the local managers' time, insisting on ineffective communication.

As I see it, the existence of a centralised authority is key also to understanding integration. Without the intervention of some central authorities, the managers of decentralised business units will behave as if they were controlling independent firms. But central search, information processing and decision-making activities can reduce the hold-up problem (at some communication and control costs). My approach can therefore be seen as a step to spell out the mechanisms that drive Williamson's hypotheses on investment specificity and integration. It contrasts with the property-rights approach (developed by Grossman, Hart and Moore), which, with its focus on asset ownership, cannot explain the integration decisions of larger firms, where external (passive) financial owners ultimately control the assets.[38]

Even with a market organisation, the then independent units can establish a central unit of managers, when such a unit is warranted due to fundamental coordination needs (for information search, processing, communication and decision-making). The bargaining costs associated with the establishment and administration of such a separate entity, and the problems with enforcement of central decisions, must be compared with the benefits and costs of owner-given authority in an integrated company. In the latter case the financial owners give the central authorities control over the physical assets and business activities directly, and the central managers can make and enforce decisions more swiftly. They can also more effectively encourage communication among the units, as they can better control the use of the acquired knowledge and technology by other units. A potential inability to credibly delegate authority, unnecessary interventions due to judgement biases and the existence of influence activities are some disadvantages of an integrated structure.

As central authorities design a unit manager's incentives, these tend to better reflect corporate interests in a hierarchy. Identity mechanisms (influenced by the corporate culture) can work in the same direction. On the other hand, the fact that financial and labour markets monitor each unit directly under a market organisation will strengthen a unit manager's incentives. The performance of unit managers within an integrated structure is less transparent for outsiders, and the measurement can be less objective.

To conclude, I believe it important to understand a broad spectre of management activities to develop *empirically relevant theory* on organisation design. Without

[38] The property-rights approach can, however, be very useful to understand the structure of small entrepreneurial firms, when a company can be expected to employ individuals instead of using contractors, and how firms should structure joint operations with other firms (for instance in the form of joint ventures). I use the theory in the two essays where I combine asset ownership with explicit incentive contracts (essay II) and implicit contracts (essay III) respectively.

information search and processing costs for managers, the question of decentralisation becomes meaningless, as a perfectly informed central manager could make all the decisions. And, without communication costs and agency costs (including control costs and costs due to sub-optimal decisions made by local managers), there are no costs associated with the delegation of decision authority. Comparing a hierarchy with a market organisation, I have argued that owner-given central authority and authority based on bargaining differ substantially. An integrated company will therefore have other coordination capabilities than individually owned units in a market place.

As I have allowed bargaining to take place between sub-units in a hierarchy (if the central authorities do not intervene), I have incorporated the fundamental insight by Bradach and Eccles (1989) that authority and price as coordination mechanisms are found both in markets and in firms. I have, however, not been able to explicitly include the trust dimension, which is important as well (as Bradach and Eccles so convincingly argue). In this respect my theory is incomplete.[39]

My theory is also incomplete in many other ways. For example is the modelling of information and communication rather simplistic and naive. I have throughout the essay assumed that managers report truthfully about potential projects, and that they do not hide facts from their superior. In itself that does not constitute any theoretical problem with the given technology, as the costs of ensuring such complete and truthful reporting can be seen as embedded in the model's communication costs. Furthermore, with non-decreasing benefit functions, a manager will only in very marginal cases have an incentive to omit data that from a corporate perspective should have been sent. But, in a model with a richer variety of information elements, where strategic communication is more tempting, it would certainly be interesting to explicitly model the incentives to communicate information.

In the same way, the model could be extended to include a conscious evaluation by the local managers on whether it pays for them to begin a bargaining process or not under a decentralised structure (while I only consider the case where the bargaining outcome justifies the bargaining costs for both parties). Finally, in a more complete model of the firm, the control costs could be made more explicitly contingent on the strength of the incentive problem for a given organisation design.

My theoretical contributions in this essay can be seen as complementing the thoughts found in recent organisation and strategy literature on how knowledge is utilised in organisations of cooperating individuals and why this is important for understanding

[39] In essay I, I developed an analytical framework on corporate coordination, where social coordination mechanisms play an important role alongside authoritative and economic mechanisms.

organisations' capabilities and their relative success (Langlois and Foss 1997). That research builds on the resource-based view of the firm (Wernerfelt 1994) and the evolutionary conceptualisation of the firm found in Nelson and Winter (1982). In an article, where he stresses that knowledge resides within the individual, Grant (1996) speaks of a knowledge-based theory of the firm. In the same spirit, with my focus on management activities, I take the liberty to suggest that my work can be seen as a step *towards a management-based theory of the firm*. A theory which incorporates individualised information search and processing (and hence knowledge-building) and other management activities (such as communication, bargaining, decision-making and control) in an environment of interest conflicts between sub-units.

9. Appendix

In this appendix I show the first-order derivatives with respect to x_M, y_M and L under the different levels of delegation that I discuss in section 4. The first-order derivatives with respect to x_P and y_P are not shown, as these variables are decided by the central authorities under all levels of delegation.

I also suggest some sufficient conditions for the comparative statics results. These conditions are based on the general theory of Milgrom and Shannon (1994) on monotone comparative statics. The particular results that I use are due to Topkis (1978). In the last section of the Appendix I show why the theorems hold in my setting.

a) Centralisation

The first-order derivative of (5) with respect to x_M (due to the envelope theorem):

$$(23)\quad \sum_{\omega\in\Omega}\pi_1^L(x_M+x_P,L^*(\cdot);\omega)f(\omega)-C_1^M(x_M,y_M)-c_1(x_M,y_M)$$
$$-s_1^M(x_M,y_M)-r_1^P(x_M,y_M)-\sum_{\omega\in\Omega}PI_1(x_M,y_M,x_P,y_P,L^*(\cdot);\omega)f(\omega)$$

The first-order derivative of (5) with respect to y_M (due to the envelope theorem):

$$(24)\quad \sum_{\omega\in\Omega}\pi_1^G(y_M+y_P,1-L^*(\cdot);\omega)f(\omega)-C_2^M(x_M,y_M)-c_2(x_M,y_M)$$
$$-s_2^M(x_M,y_M)-r_2^P(x_M,y_M)-\sum_{\omega\in\Omega}PI_2(x_M,y_M,x_P,y_P,L^*(\cdot);\omega)f(\omega)$$

Where $L^*(x_M + x_P, y_M + y_P; \omega)$ is decided by the first-order condition:

$$(25)\quad \pi_2^L(x_M+x_P,L;\omega)=\pi_2^G(y_M+y_P,1-L;\omega)+PI_5(x_M,y_M,x_P,y_P,L;\omega)$$

for all $\omega \in \Omega$.

b) Partial Decentralisation

The first-order condition for L under Partial Decentralisation is given by (25), since the central authorities decide the variable, as under Centralisation.

The local investment level does not influence the central project research directly, since the central authorities under Partial Decentralisation do not observe local investment activities.

The first-order derivative of (7) with respect to x_M – using (25) – is then given by:

$$(26)\quad \sum_{\omega\in\Omega}\pi_1^L(x_M+x_P,L^*(\cdot);\omega)f(\omega)-C_1^M(x_M,y_M)-s_1^M(x_M,y_M)$$
$$+\sum_{\omega\in\Omega}\left[(1-\mu)\pi_2^L(x_M+x_P,L^*(\cdot);\omega)+\mu PI_5(x_M,y_M,x_P,y_P,L^*(\cdot);\omega)\right]\frac{\partial L^*(\cdot)}{\partial x_M}f(\omega)$$

Similarly, the first-order derivative of (7) with respect to y_M is given by:

$$(27)\quad \mu\sum_{\omega\in\Omega}\pi_1^G(y_M+y_P,1-L^*(\cdot);\omega)f(\omega)-C_2^M(x_M,y_M)-s_2^M(x_M,y_M)$$
$$+\sum_{\omega\in\Omega}\left[(1-\mu)\pi_2^L(x_M+x_P,L^*(\cdot);\omega)+\mu PI_5(x_M,y_M,x_P,y_P,L^*(\cdot);\omega)\right]\frac{\partial L^*(\cdot)}{\partial y_M}f(\omega)$$

The last terms of (26) and (27) are due to the fact that the envelope theorem does not hold, as the principal maximises a different objective function with respect to L. The expressions inside the square brackets are positive for sufficiently small μ, as $\pi_2^L(\cdot)>0$ while $PI_5(\cdot)<0$.

The expression in (26) is *larger* than the expression in (23) for identical investment levels when:

$$(28)\quad \sum_{\omega\in\Omega}\left[(1-\mu)\pi_2^L(x_M+x_P,L^*(\cdot);\omega)+\mu PI_5(x_M,y_M,x_P,y_P,L^*(\cdot);\omega)\right]\frac{\partial L^*(\cdot)}{\partial x_M}f(\omega)$$
$$+c_1(x_M,y_M)+r_1^P(x_M,y_M)+\sum_{\omega\in\Omega}PI_1(x_M,y_M,x_P,y_P,L^*(\cdot);\omega)f(\omega)\ >\ 0$$

where $PI_1(\cdot)$ and $PI_5(\cdot)$ can be of negative value. Remember that the first term is positive for sufficiently small μ. But the inequality may very well be satisfied also when μ is close to 1.

The expression in (27) is *smaller* than the expression in (24) for identical investment levels when (again using the first-order condition for L):

$$(29)\quad \mu<1-\frac{c_2(x_M,y_M)+r_2^P(x_M,y_M)+\sum_{\omega\in\Omega}\left\{PI_2(x_M,y_M,x_P,y_P,L^*(\cdot);\omega)+PI_5(x_M,y_M,x_P,y_P,L^*(\cdot);\omega)\frac{\partial L^*(\cdot)}{\partial y_M}\right\}f(\omega)}{\sum_{\omega\in\Omega}\left\{\pi_1^G(y_M+y_P,1-L^*(\cdot);\omega)-\pi_2^G(y_M+t_P,1-L^*(\cdot);\omega)\frac{\partial L^*(\cdot)}{\partial y_M}\right\}f(\omega)}$$

where the denominator is positive (since $\partial L^*(\cdot)/\partial y_M<0$). $PI_2(\cdot)$ and $PI_5(\cdot)$ can be of negative value, but $PI_5(\cdot)$ is multiplied by the negative $\partial L^*(\cdot)/\partial y_M$. The numerator is

therefore positive, and the critical μ is smaller than 1, unless the negative $PI_2(\cdot)$ dominates the positive terms of the numerator.

(28) and (29) are sufficient conditions for x_M to increase and y_M to decrease from Centralisation to Partial Decentralisation (see the last section of this appendix). They hold for sufficiently small μ.

(28) and (29) without the terms $c_1(\cdot)$ and $c_2(\cdot)$ are sufficient conditions for the active local manager to overinvest in x_M and underinvest in y_M compared to first-best under Partial Decentralisation. The conditions tend to hold for sufficiently small μ. For large μ, however, neither (28) nor (29) may hold in certain settings. Then the local manager will underinvest in x_M and overinvest in y_M. Under yet other circumstances, (28) can hold, while (29) does not, in which case one could have overinvestment in the research of both global and local projects.

c) Decentralisation

The first-order derivative of (9) with respect to x_M (due to the envelope theorem):

$$(30)\quad \tfrac{1}{2}\sum_{\omega\in\Omega}\left\{\pi_1^L(x_M+x_P,L=1;\omega)+\pi_1^L(x_M+x_P,L^D(\cdot);\omega)\right\}f(\omega)-C_1^M(x_M,y_M)\ -s_1^{M1}(x_M,y_M)$$

Similarly, the first-order derivative of (9) with respect to y_M:

$$(31)\quad \tfrac{1}{2}\nu\sum_{\omega\in\Omega}\pi_1^G(y_M+y_P,1-L^D(\cdot);\omega)f(\omega)-C_2^M(x_M,y_M)-s_2^{M1}(x_M,y_M)$$

$L^D(x_M + x_P, y_M + y_P; \omega)$ is given by the first-order condition for L under Decentralisation:

$$(32)\quad \pi_2^L(x_M+x_P,L;\omega)=\nu\pi_2^G(y_M+y_P,1-L;\omega)\quad \text{for all } \omega\in\Omega$$

where $\nu \le 1$. Under first-best optimisation it would have been given by

$$(33)\quad \pi_2^L(x_M+x_P,L;\omega)=\pi_2^G(y_M+y_P,1-L;\omega)+PC_5(x_M,y_M,x_P,y_P,L;\omega)$$

where $PC_5(\cdot) < 0$ (and $PC_{55}(\cdot) > 0$). To compare, it is also useful to have in mind the first-order derivative with respect to x_M under first-best optimisation (i.e. the derivative of (8)):

$$(34)\quad \sum_{\omega\in\Omega}\pi_1^L(x_M+x_P,L^*(\cdot);\omega)f(\omega)-C_1^M(x_M,y_M)\ -s_1^{M1}(x_M,y_M)$$
$$-r_1^{M2}(x_M,y_M,x_P,y_P)-\sum_{\omega\in\Omega}PC_1(x_M,y_M,x_P,y_P,L^*(\cdot);\omega)f(\omega)$$

And, similarly, the first-order derivative with respect to y_M under first-best optimisation:

$$(35)\quad \sum_{\omega\in\Omega}\pi_1^G(y_M+y_P,1-L^*(\cdot);\omega)f(\omega)-C_2^M(x_M,y_M)-s_2^{M1}(x_M,y_M)$$
$$-r_2^{M2}(x_M,y_M,x_P,y_P)-\sum_{\omega\in\Omega}PC_2(x_M,y_M,x_P,y_P,L^*(\cdot);\omega)f(\omega)$$

(30) is *larger* than (34) when the following inequality is satisfied:

$$(36)\quad \tfrac{1}{2}\sum_{\omega\in\Omega}\{\pi_1^L(x_M+x_P,L=1;\omega)+\pi_1^L(x_M+x_P,L^D(\cdot);\omega)\}f(\omega)$$
$$-\sum_{\omega\in\Omega}\pi_1^L(x_M+x_P,L^*(\cdot);\omega)f(\omega)+r_1^{M2}(x_M,y_M,x_P,y_P)$$
$$+\sum_{\omega\in\Omega}PC_1(x_M,y_M,x_P,y_P,L^*(\cdot);\omega)f(\omega)\ >\ 0$$

where $r_1^{M2}(\cdot)>0$, $PC_1(\cdot)\geq 0$ and $\pi_1^L(L=1)>\pi_1^L(L^D)$, due to positive cross derivatives.

(31) is *smaller* than (35) when

$$(37)\quad \sum_{\omega\in\Omega}\pi_1^G(y_M+y_P,1-L^*(\cdot);\omega)f(\omega)-\tfrac{1}{2}\nu\sum_{\omega\in\Omega}\pi_1^G(y_M+y_P,1-L^D(\cdot);\omega)f(\omega)$$
$$-r_2^{M2}(x_M,y_M,x_P,y_P)-\sum_{\omega\in\Omega}PC_2(x_M,y_M,x_P,y_P,L^*(\cdot);\omega)f(\omega)\ >\ 0$$

where $r_2^{M2}(\cdot)>0$ and $PC_2(\cdot)\geq 0$.

(36) and (37) are sufficient conditions for the active local manager to overinvest in x_M and underinvest in y_M compared to first-best under Decentralisation.

To compare Partial Decentralisation and Decentralisation consider the first-order derivatives under the two structures. Assume that μ = ½ν (so that arbitrary accounting effects are neutralised) and $s_j^{M1}(\cdot)=s_j^M(\cdot)$ for $j\in\{1,2\}$ (so that communication cost effects are neutralised). (30) is then *larger* than (26) when

$$(38)\quad \sum_{\omega\in\Omega}\{\pi_1^L(x_M+x_P,L=1;\omega)+\pi_1^L(x_M+x_P,L^D(\cdot);\omega)\}f(\omega)-2\sum_{\omega\in\Omega}\pi_1^L(x_M+x_P,L^*(\cdot);\omega)f(\omega)$$
$$>\sum_{\omega\in\Omega}[(2-\nu)\pi_2^L(x_M+x_P,L^*(\cdot);\omega)+\nu PI_5(x_M,y_M,x_P,y_P,L^*(\cdot);\omega)]\frac{\partial L^*(\cdot)}{\partial x_M}f(\omega)$$

And (31) is *smaller* than (27) when

$$(39)\quad \sum_{\omega\in\Omega}\{\pi_1^G(y_M+y_P,1-L^*(\cdot);\omega)-\pi_1^G(y_M+y_P,1-L^D(\cdot);\omega)\}f(\omega)$$
$$>\sum_{\omega\in\Omega}\left[\left(\tfrac{2}{\nu}-1\right)\pi_2^L(x_M+x_P,L^*(\cdot);\omega)+PI_5(x_M,y_M,x_P,y_P,L^*(\cdot);\omega)\right]\left(-\frac{\partial L^*(\cdot)}{\partial y_M}\right)f(\omega)$$

where $\partial L^*(\cdot)/\partial y_M < 0$ and $PI_5(\cdot) < 0$. (38) and (39) are sufficient conditions for x_M to increase and y_M to decrease, as an organisation goes from Partial Decentralisation to Decentralisation. Both conditions appear to be satisfied when the first-best implementation capacity share of global projects is significantly larger than the share that the local managers are likely to assign to these projects (L^D is larger than L^*).

But a large L^D compared to L^* will only take place when ν is small, see (32) and (33). In addition, the absolute value of $PC_5(\cdot)$ cannot be very large, which may indicate that the absolute value of $PI_5(\cdot)$ is small too. Both these factors increase the incentive problems under Partial Decentralisation. The question of whether, in fact, Decentralisation or Partial Decentralisation is worse with respect to $t = 0$ incentives remains therefore open.

Assume that the central benefits and costs associated with the global projects are unimportant, so that $\nu = 1$, $PC_5(\cdot) = PI_5(\cdot) = 0$, and $L^D = L^* < 1$. Then (38) simplifies to:

$$(40)\quad \sum_{\omega\in\Omega}\left\{\pi_1^L(x_M + x_P, L = 1;\omega) - \pi_1^L(x_M + x_P, L^*(\cdot);\omega)\right\}f(\omega) > \sum_{\omega\in\Omega}\pi_2^L(x_M + x_P, L^*(\cdot);\omega)\frac{\partial L^*(\cdot)}{\partial x_M}f(\omega)$$

and (39) simplifies to

$$(41)\quad \sum_{\omega\in\Omega}\pi_2^L(x_M + x_P, L^*(\cdot);\omega)\frac{\partial L^*(\cdot)}{\partial y_M}f(\omega) > 0$$

(40) can be satisfied for small L^*, while (41) is never satisfied, since $\partial L^*(\cdot)/\partial y_M < 0$. If (40) is not satisfied, the overall incentive problem is clearly less severe under Decentralisation than under Partial Decentralisation. If (40) is satisfied, however, the conclusion is uncertain. There is then a then a tendency for the overinvestment problem to increase, while the underinvestment problem decreases.

d) The comparative statics

In this section I explain why the conditions I have used in the Appendix are sufficient for the comparative results.

The maximisation problem with respect to x_M and y_M can be transformed to a general problem of the type studied by Milgrom and Shannon (1994).

This general problem would then include all the (additive) benefit and cost subfunctions that are used in one or another of the organisation designs, with each

subfunction being multiplied with a parameter, so that there in all are *m* such parameters. The shift from one level of delegation to another is then represented by a simultaneous shift in several of the parametric values (some being set to zero if the local manager ignores the subfunction entirely). In other words, we have a vector of parameters $\lambda = (\lambda_1, \ldots, \lambda_m)$, which can take three values λ^C, λ^{PD} and λ^D; under Centralisation, Partial Decentralisation and Decentralisation respectively.

The objective function Φ: $\mathbb{R}^2 \times \mathbb{R}^m \rightarrow \mathbb{R}$, can then be written as $\Phi(x_M, y_M, \lambda) = \Phi(x_M, -z_M, \lambda) = \Theta(x_M, z_M, \lambda)$, where $z_M = -y_M$. The new objective function $\Theta(\cdot)$ is *supermodular* in (x_M, z_M) when $\partial^2\Theta(\cdot)/\partial z_M \partial x_M = \partial^2\Theta(\cdot)/\partial x_M \partial z_M > 0$, according to Milgrom and Shannon's (1994) theorem 6, which is due to Topkis (1978). In my model, these cross-derivatives are positive, since the cross-derivatives of $\Phi(\cdot)$ with respect to x_M and y_M are negative (for $x_M, y_M > 0$). This is again due to the fact that an increase in one of the variables (x_M or y_M) will increase the marginal costs with respect to the other variable, because of management overload effects, while it will decrease the marginal benefits with respect to the other variable, through the change in L.

And, the objective function $\Theta(\cdot)$ has *increasing differences* going from Centralisation to Partial Decentralisation (i.e. λ^C is replaced by λ^{PD}), when the marginal returns to the activities x_M and z_M then increase (Milgrom and Shannon 1994 p. 164). This is the case when (38) and (39) are satisfied (as the marginal returns to x_M and y_M then increase and decrease respectively).

Then it follows directly from Milgrom and Shannon's (1994) theorem 5, which again is due to Topkis (1978), that x_M and z_M cannot decrease when the organisation moves from Centralisation to Partial Decentralisation. This implies that x_M never decreases and y_M never increases when the given inequalities are satisfied.

The same reasoning holds for the other comparative results in the Appendix.

Bibliography

Aghion, P. and P. Bolton (1992). "An Incomplete Contracts Approach to Financial Contracting." *Review of Economic Studies*. 59: 473-494.

Aghion, P. and J. Tirole (1995). "Some implications of growth for organizational form and ownership structure." *European Economic Review*. 39: 440-455.

Aghion, P. and J. Tirole (1997). "Formal and Real Authority in Organizations." *Journal of Political Economy*. 105(1): 1-29.

Alchian, A.A. (1970). "Information Costs, Pricing, and Resource Unemployment." In E.S. Phelps (ed.) *Microeconomic Foundations of Employment and Inflation Theory*. New York: Norton.

Alchian, A.A. and H. Demsetz (1972). "Production, Information Costs, and Economic Organization." *American Economic Review*. 62(5): 777-795.

Arrow, K.J. (1971). *Essays in the theory of risk bearing*. Chicago, IL.

Arrow, K.J. (1974). *The Limits of Organization*. New York: Norton.

Baker, G., R. Gibbons and K.J. Murphy (1997). "Implicit Contracts and the Theory of the Firm." NBER Working Paper 6177. http://www.nber.org/papers/w6177

Barnard, C. (1938). *The Functions of the Executive*. Cambridge, MA: Harvard University Press.

Bazerman, M. (1998). *Judgement in Managerial Decision Making*. 4th edition. New York: Wiley.

Binmore, K.G. (1998). "The Evolution of Fairness Norms." *Rationality and Society*. 10(3): 275-301.

Blackwell, D. (1951). "Comparison of Experiments." In J. Neymann (ed.) *Proceedings of the Second Berkeley Symposium on Mathematical Statistics and Probability*. University of California Press.

Blau, P.M. (1970). "A Formal Theory of Differentiation in Organizations." *American Sociological Review*. 35: 201-218.

Bolton, P. and M. Dewatripont (1994). "The Firm as a Communication Network." *Quarterly Journal of Economics*. 109(4): 809-839.

Bolton, P. and M. Dewatripont (1994). "The Firm as a Communication Network." *Quarterly Journal of Economics*. 109(4): 809-839.

Bolton, P. and M.D. Whinston (1993). "Incomplete Contracts, Vertical Integration, and Supply Assurance." *Review of Economic Studies*. 60: 121-148.

Bradach, J.L. and R.G. Eccles (1989). "Price, Authority and Trust: From Ideal Types to Plural Forms." *Annual Review of Sociology*. 15: 97-118.

Brown, J.D. (1986). "Evaluations of Self and Others: Self-enhancement Biases in Social Judgements." *Social Cognition*. 4(4): 353-376.

Chandler, A.Jr. (1962). *Strategy and Structure: Chapters in the History of the American Industrial Enterprise*. Cambridge, MA: MIT Press.

Choate, G. and Maser S. (1992). "The impact of asset specificity on single-period contracting." *Journal of Economic Behavior and Organization*. 18: 373-389.

Coase, R.H. (1937). "The Nature of the Firm." *Economica*. 4: 386-405.

Coleman, J.S. (1990). *Foundations of Social Theory*. Cambridge, MA: Belknap Press of Harvard University Press.

Cremer, J. (1986). "Cooperation in Ongoing Organizations." *Quarterly Journal of Economics*. 101: 33-49.

Cyert, R. and J. March (1963). *A Behavioral Theory of the Firm*. New Jersey: Prentice-Hall.

Deal, T.E. and A.A. Kennedy (1982). *Corporate Cultures: The Rites and Rituals of Corporate Life*. Reading, MA: Addison-Wesley.

Demsetz, H. (1995). *The economics of the business firm: Seven critical commentaries*. New York: Cambridge University Press.

Demski, J.S. (1980). *Information Analysis: Second Edition*. Reading, MA: Addison-Wesley.

Drucker, P.F. (1954). *The Practice of Management*. New York: Harper.

Elster, J. (1989). "Social Norms and Economic Theory." *Journal of Economic Perspectives*. 3(4): 99-117.

Etzioni, A. (1988). *The Moral Dimension: Toward a New Economics*. New York: Free Press.

Fama, E. (1980). "Agency Problems and the Theory of the Firm." *Journal of Political Economy*. 88(2): 288-307.

French, J.R.P. (1968). "The conceptualization and the measurement of mental health in terms of self-identity theory." In S.B. Sells (Ed.): *The definition and measurement of mental health*. Washington, DC: Department of Health, Education and Welfare.

Galbraith, J.R. (1973). *Designing Complex Organizations*. Reading, MA: Addison-Wesley.

Gibbons, R. (1996). "Incentives and Careers in Organizations." Mimeo, Johnson Graduate School of Management, Cornell University.

Goold, M., A. Campbell and M. Alexander (1994). *Corporate-Level Strategy: Creating Value in the Multibusiness Company*. New York: Wiley.

Grandori, A. (1997). "An Organizational Assessment of Interfirm Coordination Modes." *Organization Studies*. 18(6): 897-925.

Grandori, A. and G. Soda (1995). "Inter-firm Networks: Antecedents, Mechanisms and Forms." *Organization Studies*. 16(2): 183-214.

Grant, R. (1996). "Towards a Knowledge-Based Theory of the Firm." *Strategic Management Journal*. 17(S): 109-122.

Grossman, S.J. and O.D. Hart (1986). "The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration." *Journal of Political Economy*. 94: 691-719.

Halonen, M. (1994). "Reputation and Allocation of Ownership." Helsinki School of Economics, Department of Economics, Discussion Papers No 12.

Hanson, G. (1995). "Incomplete contracts, Risk, and Ownership." *International Economic Review*. 36(2): 341-363.

Hart, O. (1995). *Firms, Contracts, and Financial Structure*. Oxford: Clarendon Press.

Hart, O. and B. Holmstrom (1987). "The theory of contracts." In T. Bewley (ed.) *Advances in Economic Theory, Fifth World Congress*. Cambridge: Cambridge University Press.

Hart, O. and J. Moore (1990). "Property Rights and the Nature of the Firm." *Journal of Political Economy*. 98: 1119-1158.

Hart, O. and J. Moore (1999). "Foundations of Incomplete Contracts." *Review of Economic Studies*. 66: 115-138.

Hayek, F.A. (1945). "The Use of Knowledge in Society." *American Economic Review*. 35(4): 519-530.

Hickson, D.J., C.R. Hinings, C.A. Lee, R.E. Schneck, and J.M. Pennings (1971). "A Strategic Contingencies' Theory of Intraorganizational Power." *Administrative Science Quarterly*. 16: 216-29.

Holmstrom, B. (1999). "The Firm as a Subeconomy." *Journal of Law, Economics and Organization*. 15(1): 74-102.

Holmstrom, B. and P. Milgrom (1987). "Aggregation and Linearity in the Provision of Intertemporal Incentives." *Econometrica*. 55(2): 303-328.

Holmstrom, B. and P. Milgrom (1991). "Multitask Principal-Agent Analyses: Incentive Contracts, Asset Ownership, and Job Design." *Journal of Law, Economics and Organization*. 7(S): 24-52.

Holmstrom, B. and P. Milgrom (1994). "The Firm as an Incentive System." *American Economic Review*. 84(4): 972-991.

Holmstrom, B. and J. Roberts (1998). "The Boundaries of the Firm Revisited." *The Journal of Economic Perspectives*. 12(4): 73-94.

Holmstrom, B. and J. Tirole (1991). "Transfer Pricing and Organizational Form." *Journal of Law, Economics, and Organization*. 7: 201-228.

Hull, R.M., J.A. Mazachek and K.A. Ockree (1998). "Firm Size, Common Stock Offerings, and Announcement Period Returns." *Quarterly Journal of Business and Economics*. 37(3): 3-24.

Jensen, M. and W. Meckling (1976). "Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure." *Journal of Financial Economics*. 3: 305-360.

Jensen, M. and W. Meckling (1986). "Divisional Performance Measurement." Working paper presented at the Harvard Colloquium on Field Studies in Accounting, June 18-20, 1986. http://papers.ssrn.com

Kaplan, R.S. and D.P. Norton (1996). "Using the Balanced Scorecard as a Strategic Management System." *Harvard Business Review*. January-February 1996: 75-85.

Klein, B. (1996). "Why Hold-ups Occur: The Self-enforcing Range of Contractual Relationships." *Economic Inquiry*. 34(3): 444-463.

Klein, B., R.A. Crawford and A.A. Alchian (1978). "Vertical Integration, Appropriable Rents, and the Competitive Contracting Process." *Journal of Law and Economics*. 21: 297-326.

Kreps, D.M. (1990). "Corporate Culture and Economic Theory." In J. Alt and K. Shepsle (eds.) *Perspectives on Positive Political Economy*. Cambridge: Cambridge University Press.

Kreps, D.M. (1996). "Markets and Hierarchies and (Mathematical) Economic Theory." *Industrial and Corporate Change*. 5(2): 561-595.

Laffont, J.J. (1993). *The Economics of Uncertainty and Information*. Translated by J.P. Bonin and H. Bonin. Cambridge, MA: MIT Press.

Langlois, R. and N. Foss (1997). "Capabilities and Governance: the Rebirth of Production in the Theory of Economic Organization." Danish Research Unit for Industrial Dynamics, Working Paper No. 97-2.

Lazear, E.P. and S. Rosen (1981). "Rank-Order Tournaments as Optimum Labor Contracts." *Journal of Political Economy*. 89(5): 841-864.

Lee, I., S. Lochhead, J. Ritter and Q. Zhao (1996). "The Costs of Raising Capital." *Journal of Financial Research*. 19(1): 59-74.

March, J.G. and J.P. Olsen (1976). *Ambiguity and Choice in Organizations*. Bergen, Norway: Universitetsforlaget.

March, J.G. and H.A. Simon (1958). *Organizations*. New York: Wiley.

Marschak, J. and R. Radner (1972). *Economic Theory of Teams*. New Haven, CT: Yale University Press.

Maskin, E. and J. Tirole (1999a). "Unforeseen Contingencies and Incomplete Contracts." *Review of Economic Studies*. 66: 83-114.

Maskin, E. and J. Tirole (1999b). "Two Remarks on the Property-Rights Literature." *Review of Economic Studies*. 66: 139-149.

Meyer J. and B. Rowan (1977). "Institutionalized Organizations: Formal Structure as Myth and Ceremony." *American Journal of Sociology*. 83: 340-63.

Milgrom, P. and J. Roberts (1988). "An Economic Approach to Influence Activities in Organizations." *American Journal of Sociology*. 94(S): 154-179.

Milgrom, P. and J. Roberts (1990a). "Bargaining Costs, Influence Costs, and the Organization of Economic Activity." In J. Alt and K. Shepsle (eds.) *Perspectives on Positive Political Economy*. Cambridge: Cambridge University Press.

Milgrom, P. and J. Roberts (1990b). "The Economics of Modern Manufacturing: Technology, Strategy and Organization." *The American Economic Review*. 80(3): 511-528.

Milgrom, P. and J. Roberts (1992). *Economics, Organization and Management*. Englewood Cliffs. NJ: Prentice-Hall.

Milgrom, P. and C. Shannon (1994). "Monotone Comparative Statics." *Econometrica*. 62(1): 157-180.

Mintzberg, H. (1983). *Structure in Fives: Designing Effective Organizations*. New Jersey: Prentice-Hall.

Mintzberg, H. (1998). *The Strategy Process (Revised European Edition)*. Hertfordshire: Prentice-Hall.

Morgan, P. and R. Manning (1985). "Optimal Search." *Econometrica*. 53(4): 923-644.

Nault, B. (1998). "Information Technology and Organization Design: Locating Decisions and Information." *Management Science*. 44(10): 1321-1335.

Nelson, R. and S. Winter (1982). *An Evolutionary Theory of Economic Change*. Cambridge, MA: Harvard University Press.

Parsons, T. (1960). *Structure and Process in Modern Societies*. Glencoe, Ill.: Free Press.

Perrow, C. (1986). *Complex Organizations: A Critical Essay*. New York: Random House.

Peters, T.J. and R.H. Waterman (1982). *In Search of Excellence*. New York: Harper & Row.

Pfeffer, J. (1981). *Power in Organizations*. Marshfield, MA: Pitman.

Pfeffer, J. (1997). *New Directions for Organization Theory: Problems and Prospects*. New York: Oxford University Press.

Porter, M.E. (1987). "From Competitive Advantage to Corporate Strategy." *Harvard Business Review*. May-June 1987: 43-59.

Radner, R. (1992). "Hierarchy: The Economics of Managing." *Journal of Economic Literature*. 30: 1382-1415.

Radner, R. (1996). "Bounded Rationality, Indeterminacy, and the Theory of the Firm." *The Economic Journal*. 106: 1360-1373.

Rajan, R.G. and L. Zingales (1998). "Power in a Theory of the Firm." *Quarterly Journal of Economics*, 113(2): 387-432.

Sah, R.K. and J.E. Stiglitz (1986). "The Architecture of Economic Systems: Hierarchies and Polyarchies." *American Economic Review*. 76(4): 716-727.

Schelling, T. (1960). *The Strategy of Conflict*. Cambridge, Mass.: Harvard University Press.

Scott, W.R. (1998). *Organizations: Rational, Natural, and Open Systems*. New Jersey: Prentice-Hall.

Segal, I. (1999). "Complexity and Renegotiation: A Foundation for Incomplete Contracts." *Review of Economic Studies*. 66: 57-82.

Simon, H. (1947). *Administrative Behavior*. New York: Macmillan.

Simon, H. (1951). "A Formal Theory of the Employment Relationship." *Econometrica*. 19: 293-305.

Simon, H. (1991). "Organizations and Markets." *Journal of Economic Perspectives*. 5(2): 25-44.

Smith, A. (1976). *The Wealth of Nations*. Edited by R. H. Campbell, A. S. Skinner and W. B. Todd. Oxford: Oxford University Press.

Stigler G.J. (1961). "The Economics of Information." *Journal of Political Economy*. 69(3): 213-225.

Stigler G.J. (1962). "Information in the Labor Market." *Journal of Political Economy*. 70S(5:2): 94-105.

Taylor, S.E. (1989). *Positive Illusions: Creative Self-Deception and the Healthy Mind*. New York: Basic Books.

Taylor, S.E. and J.D. Brown (1988). "Illusion and Well-Being: A Social Psychological Perspective on Mental Health." *Psychological Bulletin*. 103(2): 193-210.

Teece, D.J. (1982). "Towards an Economic Theory of the Multiproduct Firm." *Journal of Economic Behavior and Organization*. 3: 39-63.

Thomas, E.J. and C.F. Fink (1963). "Effects of Group Size." *Psychological Bulletin*. 60: 371-384.

Thompson, J.D. (1967). *Organizations in Action*. New York: McGraw-Hill.

Tirole, J. (1988). *The Theory of Industrial Organization*. Cambridge, MA: MIT Press.

Tirole, J. (1999). "Incomplete Contracts: Where do we Stand?" *Econometrica*. 67(4): 741-781.

Topkis, D.M. (1978). "Minimizing a Submodular Function on a Lattice." *Operations Research*. 26: 305-321.

Tversky, A. and D. Kahneman (1986). "Rational choice and the framing of decision." *Journal of Business*. 59(S): 251-294.

Tyler, T. and R. Hastie (1991). "The Social Consequences of Cognitive Illusions." In M.H. Bazerman, R.J. Lewicki and B.H. Sheppard (eds.): *Research on Negotiation in Organizations*. 3: 69-98.

Wernerfelt, B. (1984). "A resource-based view of the firm." *Strategic Management Journal*. 5(2): 171-180.

Williamson, O.E (1975). *Markets and Hierarchies: Analysis and Antitrust Implications*. New York: Free Press.

Williamson, O.E. (1985). *The Economic Institutions of Capitalism*. New York: Free Press.

Williamson, O.E. (1993). "Calculativeness, Trust, and Economic Organization." *Journal of Law and Economics*. 36: 453-86.

Williamson, O.E. (1996). *The Mechanisms of Governance*. New York: Oxford University Press.

Wilson, R. (1968). "The Theory of Syndicates." *Econometrica*. 36(1): 119-132.