
Trust, Opportunism and Governance: A Process and Control Model

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Abstract

In this paper a process and control model is developed for the analysis and design of inter-firm relations, in which both opportunism and trust play a role. Its aim is to develop a tool for the analysis, diagnosis and design of inter-firm partnerships. It takes into account the value of the partner, relative to alternatives, and the risk of the relation. Risk depends on the incentives that the partner may have towards opportunism, his opportunities for opportunism and his 'propensity' towards opportunism. The latter is related to trust. A partner's incentives towards opportunism depend on the uniqueness of the value that he offers, on one's own switching costs and on the partner's dependence on the relation. The underlying theory employs both transaction cost economics and social exchange theory. On the basis of the model, values and risks can be balanced in different ways: there are adversarial strategies that jeopardize value, and cooperative strategies that build value. The model can be used to explore viable sequences of strategies of governance, depending on different conditions. As an illustration, it is used for an analysis of ways to initiate a relation.

Descriptors: transaction cost economics, governance, trust, inter-firm alliances, inter-firm partnerships.

Introduction

The purpose of the present paper is to set up a process and control model for the analysis of the process of development of inter-firm relations, and the design of their control ('governance'), in which allowance is made for both opportunism and trust. This aligns with the conclusion by Smith Ring and Van de Ven (1994: 113) that:

'As the uncertainty, complexity, and duration of economic transactions within and between firms increase, it becomes increasingly important for scholars and managers to understand developmental processes of how equity, trust, conflict-resolution and procedures and internal governance structures emerge, evolve, and dissolve over time.'

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As Joag (1995: 406) noted concerning vertical relations between suppliers and users:

'Even though marketing aims at understanding, explaining, predicting and influencing exchanges in human society (Bagozzi 1975; Dwyer et al. 1987), most research has been concentrated only on steps leading to choice . . . that end in the selection of suppliers (Webster and Wind 1972), thus leaving all processes beyond unmentioned.'

Taking such views into account, we focus on the process of development and governance after an exchange relation has been started. Transaction costs comprise costs of search and evaluation, costs of setting up governance prior to transactions and costs of control and redesign of the relation. Here, we focus on the third kind.

The question arises of how the present study fits in the growing literature on institutions, and in particular how it relates to transaction cost economics (TCE). TCE, as developed by Williamson (1975, 1985), has been called 'new institutionalist' economics, but shortcomings have been identified from a 'neo-institutionalist' perspective, which harks back to the older American institutionalists like Veblen, Commons and Mitchell (see, e.g. Johanson and Mattson 1987; Dietrich 1993; Foss 1993; Hodgson 1993; Nooteboom 1992, 1993b; Pitelis 1993, 1994). We position the present paper in terms of the differences between these schools of thought.

The 'new-institutionalism' of TCE maintains important parts of the core of neo-classical economics, while 'neo-institutionalist' economics includes perspectives from sociology. Some of the characteristic differences between the two schools are summarized in Table 1. Emboldened material in the table indicates the perspective of the present paper, and shows that it goes beyond traditional perspectives of mainstream economics, into the neo-institutionalist branch.

We aim to develop a model for studying the process of developing institutional arrangements between firms, which takes into account the possibility of trust next to the possibility of opportunism, allowing for the possibility that the relations between the firms may get locked into

Table 1
New and Neo-
institutionalist
Economics

Neo-institutionalism	New Institutionalism
Emphasis on explanation of the institutional environment (norms, habits)	Emphasis on institutional arrangements (governance between and within firms)
<i>Homo socialis</i> ; methodological interactionism	<i>Homo economicus</i> ; methodological individualism
Trust may build up	Opportunism prevails; trust is an irrelevant category
Emphasis on process	Emphasis on outcomes
There is path dependency , which may yield inefficient outcomes	Evolutionary pressures guarantee convergence on efficient outcomes
Preference formation and learning are inherent to the process	Preferences and knowledge are given

Cf. Nooteboom (1992), Groenewegen and Vromen (1995).

efficient or inefficient paths. It should yield a tool to explore balances and imbalances of dependence between parties, mixes of trust and opportunism, and of formal and informal forms of governance. It should also serve to identify instruments for governance, and to select them in relation to events that might trigger action. The ultimate objective, beyond the present paper, is to employ the model as a basis for simulation studies of the evolution of relations, and for applications of game theory in the analysis of governance. For the use of game theory in an attempt to reconstruct different generic forms of supplier-user relations ('Western, Japanese and a third way'), see Nooteboom (1994).

In contrast with TCE, we accept the relevance of sociological categories such as trust, power, social cohesion and social exchange, but we also acknowledge possible inclinations towards opportunism, and we preserve notions concerning governance from TCE.

In game-theoretic terms, this paper does not take the perspective of cooperative games, in the usual sense employed in the literature, that agreements are assumed to be binding from the start. The challenge is to show *how* agreements can be made binding; how cooperation can be achieved in spite of opportunities and possible inclinations towards opportunism. So, we are oriented towards cooperation as something to be explained rather than assumed (cf. Hargreaves et al. 1995: 38).

The basic analysis, in the present paper, is applicable to relations in general, including both horizontal relations between competitors and vertical relations of subcontracting, or even entirely different relations, such as marriages, but subcontracting forms the main intended area of application.

Trust and Opportunism

Transactions are to be seen as being embedded in relations that develop in time, while these relations in turn are socially embedded in their environment (Granovetter 1985). It is a peculiar thing in TCE that, on the one hand, passage of time is crucial, but on the other, relevant parameters are seen as timeless. According to TCE, a crucial condition for dependence is that time is required, with repeated transactions, to recoup transaction-specific investments, and allowance is made for the emergence of unpredictable contingencies that preclude closed contracts. On the other hand, TCE implicitly assumes the continuation of *ex ante* inability to judge propensities towards opportunism, unchanged supply and demand conditions (in which no novel and perhaps more attractive customers or suppliers appear on the scene), productive competencies and abilities to monitor partner's actions. But surely, ongoing interaction will modify those parameters? It is reasonable to say that prior to transaction one is uncertain about the partner's potential opportunism, and hence should take opportunism into account. Once one

takes time into account, in ongoing transactions, it is unreasonable to ignore the formation of perceptions about propensities towards opportunism, and the possibility of building trust.

In spite of Williamson's acknowledgement of 'atmosphere' as a relevant factor in transactions, he neglects issues of trust and power. The view of the present paper is that these issues are important, and that a dynamic treatment of ongoing relations allows for the building of trust. To study this, we need contributions from sociology and anthropology on trust and social exchange (Homans 1961; Blau 1964; Luhmann 1979, 1988; Granovetter 1982, 1985; Gambetta 1988a).

The view that transactions are embedded in relations that develop in time has been advocated for a number of years in marketing and purchasing by the International Marketing and Purchasing Group (IMP; Hakansson 1982, 1987; Hagg and Johanson 1983; Easton 1989) and others (Jarillo 1988; Semlinger 1991; Lamming 1993). Exchange leads to mutual adaptation, which entails investment in a relation. As a result of this, bonding between the actors develops, trust is generated and a lasting relation emerges (Johanson and Mattson 1987, Easton 1989). A comparable attempt towards a process approach was recently published by Smith Ring and Van de Ven (1994).

However, if the IMP view can be taken to imply a rejection of the TCE view as a whole, it runs the risk of throwing away the baby with the bathwater. Doubtless, in present conditions of turbulence, firms require interactions in networks. Trust forms an important dimension in such relations, and, as pointed out by Hirschmann (1984), trust may increase with its usage. However, there are risks as well: trust is not unbounded, it cannot be taken for granted and it may break down. As Dasgupta (1988: 54) put it: 'If the incentives are right a trustworthy (untrustworthy) person may be relied upon to be untrustworthy (trustworthy)'. 'Golden opportunities' of defection are tempting, even to the trustworthy.

TCE has contributed greatly by specifying rigorously what the nature and extent of risk in transactions is: *to the extent that* agents are inclined towards opportunism, and if bounded rationality makes it impossible to foresee it and to foreclose its undesirable consequences, then one runs the risk of loss of investment to the extent that investments are relation specific, or of 'hold-up' situations as a consequence of that risk. Next, TCE has supplied indications of how to construct schemes for 'governing' transactions in such a way that risks are reduced: in bilateral private ordering, the use of different guarantees to compensate for one-sided, transaction-specific investments (symmetrical specific investments, cross-ownership of specific assets, hostages, guaranteed price, volume or period of purchase), and countermeasures to guard against invalid use and expropriation of such guarantees. In infrequent transactions: trilateral governance, with some third party acting as an arbitrator. These concepts are of theoretical and practical use, and it is unwise to ignore them.

Transaction on the basis of trust, with its implicit, pre-existing and unspecified conditions for cooperation, economizes on the specification and monitoring of contracts and material incentives for cooperation. This makes it not only cheaper (and to the taste of many, also more agreeable), but also makes for greater flexibility. With detailed formal contracts it is more difficult (slow and costly) to modify terms for changed conditions. Apart from its own worth, trust pays, but it also carries a risk of betrayal. One cannot simply buy into trust. If it is not already in place prior to transaction, trust has to be built up. It is as much the result of cooperation as a condition for it. All one can do is to select conditions that are conducive to the emergence of trust, such as placing not too much focus on mistrustful means of governance.

It is a long-standing argument in economics that optimal behaviour prevails among firms, not because agents are calculatively competent, but because the pressures of selection in markets extinguish sub-optimal behaviour, either because it loses its resources for survival to agents with more optimal conduct, or because it turns around to emulate more optimal conduct. It is, in fact, questionable whether this mechanism is indeed always so rigorous as to allow only the 'single exit' (Latsis 1980) of optimal behaviour. There may be slack due to lack of competition, due to mono- or oligopoly and lack of contestability of markets, or due to product differentiation. But that is not an issue we will discuss here.

The argument also appears in transaction cost economics (TCE). Williamson (1975, 1985) argued that among alternative governance structures (market, 'hierarchy', forms 'between market and hierarchy') one will survive which is optimal, i.e. minimizes the sum of production, transaction and organization costs, in a given technological and institutional environment. The argument was carried further by Hill (1990). He argued that since trust economizes on the cost of governance, the selection pressures of markets will lead to the prevalence of trust, so that 'in the long run' we can forget about opportunism.

However, the argument is flawed in the same way as, more often, arguments for group selection are flawed: it neglects the tension between collective and individual interest. While it is clearly in the interest of a group as a whole for everyone to be trustworthy and trusting, since that would greatly reduce transaction costs for all, individuals may be tempted to defect and be opportunistic while pretending to be trustworthy. The extent of this temptation increases as more people are trustworthy, and it further depends on the efficiency and reliability by which such defection can be detected and communicated, and the ensuing risk of a loss of reputation that is detrimental to future partnerships.

Nooteboom (1995) developed a model to analyse the issue. It is concluded that even if loss of reputation becomes infinitely costly, there still arises some non-zero equilibrium value of the percentage of opportunistic agents. If we allow only for self-interest, opportunism will not disappear, and Williamson remains correct on this, if not on other

points: there is always a chance that a transaction partner may be opportunistic. Nevertheless, it helps considerably if, next to self-interest, there are other sources of cooperation in the institutional environment in which firms are embedded. Norms and values of conduct may mitigate inclinations towards opportunism; they may cause people to forego opportunities for opportunism, at least within reasonable bounds (short of 'golden opportunities' that are too tempting to resist). Here, Hill's (1990) argument carries conviction: societies with such institutional mitigation of opportunism have a competitive advantage over societies that do not, and they may thereby have a better chance of surviving in world markets.

We conclude that both trust and opportunism are likely to arise in transaction relations. Neither should be ignored, and we should find a way of systematically exploring their joint occurrence. Therefore, in spite of the differences between economics and sociology, we should seek to integrate them.

Dimensions of Trust

The concept of trust is subtle, diffuse and elusive. One feels some sympathy for the economist's inclination to evade the issue, but we cannot afford to do that. Here, I try to employ the concept with all the subtleties found for it in the literature (Gambetta 1988a).

Since our focus is on relations between organizations, the question arises as to what the relation is between the conduct of individuals and the conduct of firms: the 'micro-micro' problem. As argued by Smith Ring and Van de Ven (1994), these two sets of conduct are related by roles to which individuals are assigned in organizations. Conduct '*qua persona*' is restricted and guided by organizational roles and alignment between the two can be a problem. If cooperation is founded on trust based on personal bonding, problems may arise concerning the exigencies of organizational role. Personal loyalty may deviate from organizational interest, and may even lead to corruption or embezzlement. Too strong personal ties may need to be prevented by turnover of personnel across roles. Conversely, personnel change may lead to a breakdown of relations based on personal trust. Such considerations should be part of governance.

Trust may concern a partner's *ability* to perform according to agreements (competence trust), or his *intentions* to do so (goodwill trust). Here, we focus on the latter type of trust. Of course, risks due to failures of competence are important in subcontracting relations, but they do not form the focus here. The focus is on the relations between goodwill trust and cooperation. Whenever we use the term 'trust', this denotes goodwill trust.

According to Williams (1988), cooperation requires willingness to accept dependence, which requires assurance that other, non-dependent

(or less dependent) parties will not defect in the cooperation. According to Dasgupta (1988), trust is associated with expectations regarding the other's choice of actions that have a bearing on one's own choice of action. Such expectations may have a strong or a weak basis, ranging from assurance from objective facts and logical reason, through belief which is less firmly based on experience and argument, to unsubstantiated faith. Gambetta (1988b: 217) summarized different views on trust as the subjective probability that one assigns to action by another agent (or group of agents) which affects one's own action. Luhmann (1988) emphasized that in trust there is an element of choice. If there is no choice, and one simply has to surrender to the powers that be, the belief that no harm will occur is a matter of confidence, not trust. Trust entails an action that one has a choice to conduct, and that one may later regret. One may or may not trust a potential business partner, and accept or refuse him as a partner. If it goes wrong, one attributes blame also to oneself for engaging in the relation. One has confidence or not in the law, or the political system, or God, without a choice as to whether or not to participate in them. If one is treated unjustly, the blame is on the system; not one's own choice.

Williams (1988) distinguished between macro and micro, and between egotistic and non-egotistic sources of cooperation. Micro sources depend on the specific relation at hand, while macro sources apply more generally. This yields four sources of cooperation, as indicated in Table 2.

Table 2
Sources of
Cooperation

	Macro	Micro
Egotistic	Coercion or fear of sanctions from authority (God, law)	Material advantage or 'interest'
Non-egotistic	Ethics: values/norms of proper conduct	Bonds of friendship, kinship or empathy

Williams argued that none of these sources suffices by itself, and that in cooperation some mix will always be operative, while no universally best mix, regardless of specific conditions, can be specified. As set out by Gambetta (1988b), the Mafia employs all four sources, in ways that mutually reinforce each other. Cooperation is forced by violent means, is materially rewarded, is enhanced by bonds of friendship and pseudo family relationships (Mafia 'families', brotherhood, godfathers, etc.) and an ethic of non-betrayal ('*omerta*').

If trust is associated with a subjective probability that a partner will not misuse one's dependence, without further qualifications, then anything that contributes to such subjective probability would belong to trust. However, trust is generally not associated with motives of self-interest; at least not self-interest in a restricted material, economic sense.

We trust someone if he is likely to cooperate, even if he is not coerced to do so and has no direct material interest in doing so. Thus, trust is associated with the non-egotistic sources of cooperation; with loyalty to a partner due to ethics or bonds of friendship or kinship rather than coercion or material self-interest. The Mafia needs to employ coercion and the lure of material interest because trust will not suffice as a basis for cooperation. Conversely, material self-interest and coercion are seldom sufficient as a basis for cooperation; one needs trust to the extent that one cannot fully control the partner's conduct by threat and reward (cf. Deutsch 1962, quoted in Zand 1972).

One can object that the narrower concept of trust, when based on ties of ethics or kinship, is not really beyond self-interest, because they constitute social coercion rather than choice. In friendship or, more weakly, in relations of empathy or familiarity, trust in the sense of non-obligational and non-material sources of cooperation appears to be most 'thick'. But even there, one can argue that it is based on self-interest, in the form of the 'emotional utility' derived from it. One could argue, therefore, as economists do, that in the last analysis, motivation on the basis of norms, bonding, social exchange, kinship, friendship or whatever, is also egotistic. In fact, anything that anyone does can be interpreted as 'revealed preference'. One objection to this view is that it has made itself unfalsifiable, but there are two other objections.

The first objection is taken from social exchange theory (Blau 1964). In addition to an economic dimension (extrinsic utility), exchange often has a social dimension (intrinsic utility). Economists tend to think of value in exchange as something that exists independently from the transaction. As formulated by Murakami and Rohlen (1992: 70); 'The value of the relationship itself is typically ignored and the impersonality of the transaction is assumed'. In intrinsic utility, the exchange process itself matters, in addition to the economic surplus and its division that the exchange yields. People may *prefer* to transact on the basis of trust and its concomitants of ethics, kinship, friendship or empathy. Social exchange relies more on unspecified, implicit obligations, which depend on shared systems of meaning, belief and ethics. The idea that exchange includes non-contractual elements, of course, goes back (at least) to Durkheim (1893). The economist will answer that there are apparently two dimensions of utility (extrinsic and intrinsic), and if one prefers to transact with party X in spite of higher extrinsic returns from a transaction with party Y, apparently intrinsic utility dominates extrinsic utility, but self-interest as a driver of conduct remains in the seat. Be that as it may, the point is that economists tend to neglect intrinsic utility and its implication that it does matter who the transaction partner is. What matters is that personality and social embeddedness enter as dimensions of transactions.

The second, more general, objection is that there is often tension between private material interest (monetary gain) and interest in ethical norms, social cohesion, kinship, friendship and the like. There is a real

issue of sacrificing one for the sake of the other. This goes beyond material interest in the form of maintaining reputation as a basis for future material benefit. One should include in one's investigation how these conflicts are resolved, and how one dimension may mitigate the effect of the other. How opportunism may be mitigated by trust, and how loyalty may be broken by some 'golden opportunity' to defect.

Trustworthiness varies between agents. It is to some extent personal, in bonds of kinship and friendship, but also to some extent impersonal, when a person observes a given ethic or set of behavioural routines. When the agent is a firm, its trustworthiness is associated with ethics and behavioural routines, which are part of an organization's culture. Again, firm and individual are connected by organizational roles, and again, the alignment between a person *qua persona* and his organizational role may not be perfect. That depends, among other things, on the care in role allocation and discipline in role observance that the firm exercises. Variability of trustworthiness, and hence of its opposite propensity towards opportunism, underlines the need to extend TCE with considerations of trust. If not, everyone is equally opportunistic; then, in the selection of a partner and in governing a relation with him, one should try to establish his particular propensity towards opportunism (cf. Noorderhaven 1995).

Social exchange, by its nature, is restricted to insiders: people with whom one shares the basis for trust. Trust requires familiarity and mutual understanding, and hence depends on time and context.

Definition of Trust

On the basis of the above, we adopt the following conceptualization:

X is willing to engage in cooperation with *Y* (i.e. enter upon cooperation or continue it), even if it makes *X* dependent, if *X* has a more or less well-grounded belief, in the form of a subjective probability, that *Y* will cooperate in the sense of not mis-using such dependence. This belief may be based on (perceived) available **opportunities** for misuse on the part of *Y*, *Y*'s **incentives** towards misuse and *Y*'s **propensity** to employ the opportunities. Propensity to use opportunities for defection is related to trust, which has its basis in ethics, kinship, friendship or empathy.

My **definition of (goodwill) trust** would now be as follows:

X trusts *Y* to the extent that *X* chooses to cooperate with *Y* on the basis of a subjective probability that *Y* will choose not to employ opportunities for defection that *X* considers damaging, even if it is in the interest of *Y* to do so. The trustworthiness of *Y* depends on *Y*'s true propensity to employ those opportunities. (1)

Note that (1) indicates that:

– *X* and *Y* have a choice: to engage upon cooperation, at the risk of dependence (*X*), and to forego opportunities to misuse such dependence (*Y*). This distinguishes trust from confidence.

- there are two mutually dependent types of choice: a choice of whether to enter upon a relation of cooperation and to continue with it, and a choice of whether or not to misuse dependence of one's partner in the relation (called 'defection')
- the second type of choice (defection) is based on a combination of opportunities for defection, interest in defection and propensity not to employ opportunities for defection
- trust relates to the last factor: the partner's choice not to defect in spite of both a motive and an opportunity to do so
- trust is related to a propensity, not a certainty: it may not be resistant to golden opportunities.

Defection is closely related to the concept of opportunism, as employed in TCE: 'interest seeking with guile', and to make the connection with TCE we will equate the two. Thus, we will speak of 'opportunities for opportunism', and the 'propensity' to employ them. We may define power as opportunities to act against someone's interest in a way that he cannot control. Then power is close to opportunities for opportunism. Trust is then associated with the voluntary submission to power, on the belief that it will not be exercised.

In the case of an organization, the subjective probability associated with trust depends on an assessment of: the ethical stance and routines that form part of the culture of the firm, the 'tightness' with which individuals are tied to it in their organizational roles, relevant characteristics of the individual one is dealing with (his personal ethics, bonding) and the net effect on his propensity towards opportunism.

Now, is reputation a basis for trust, or is it part of interest? It can be either or both. In economics, the rationale for reputation is that it is built upon investments in the form of opportunities for opportunism foregone. To behave opportunistically is to surrender the investment, if opportunism is both detected and communicated at large, and this yields a rational basis for people to rely on reputation, at least to some extent (reputation may be surrendered when a 'golden opportunity' presents itself). A complication is that reputation may be based on the rational calculation of its benefit, as indicated, but may also be based on genuine trustworthiness in the sense of a non-egotistic propensity to forego opportunities for opportunism (on the basis of ethics, kinship, friendship, empathy). While both may be sensitive to temptation, trustworthiness is more robust than calculation. It is less sensitive to the condition of detectability and communicability of a breach, and is less likely to unravel when the end of a relation is in sight. The difference may not be easy to establish: that may require some minimum degree of experience and familiarity with a partner, or joint membership of a social community with sufficiently strong norms and values of cooperation.

In our study there are two fundamental questions:

- A. On the basis of what motives will agents enter upon and maintain a relation?

B. How will agents act and react within that relation? They may be jockeying for advantage, short of breaking up the relation. This question can be broken down into two questions:

B1. How do agents behave in a relation, i.e. in a setting with given parameters of the relation? For example: when will they act opportunistically?

B2. How do they behave in trying to change the relation, i.e. change the parameters of the relation? For example: how can they balance risk and value?

The answer to question A seems simple: people engage upon a relation because it yields value, which may have many (extrinsic and intrinsic) dimensions. In this paper we focus on question B. We consider question B1 in the next section, and question B2 in the one after that.

Model of Conduct

Relations of cooperation are incurred from an expectation of value. Thus, the value to X of a partner Y (V_{YX}) is a key variable. Here, it is specified as value relative to the next best alternative, which becomes negative when a more attractive partner presents himself. This allows for the event of a more attractive alternative partner emerging on the scene, and the analysis of its consequences for the relation.

This concept of the value of a partner in relative terms (excess value with respect to the next best alternative) is not present, at least not explicitly, in TCE. TCE, as developed by Williamson, assumes that for contracting out, there is a specialized supplier who offers value in terms of an ability to produce more efficiently, because he produces in larger volumes for more than one user. The search for a focal user, and the evaluation of such a partner's worth, is not part of the analysis (in contrast with Coase, who does pay attention to transaction costs in the form of search). One could perhaps argue that, implicitly, such an evaluation is nevertheless present in Williamsonian TCE, in the possibility of new contingencies ('external uncertainty'), that may arise which a partner might exploit opportunistically. However that may be, we need to make it explicit, for two reasons. First, to deal with the risk that a relation will become destabilized due to the emergence of a novel, more attractive alternative for one of the partners. Second, to allow for investments for the increase of value, on either or both sides of the relation. Both are part of the project of making TCE dynamic, by looking at the evolution of relations in the light of changing conditions, learning, etc.

Value may include many dimensions, such as: efficiency, developmental capability, flexibility, adherence to specifications, network position, value as a source of learning, international presence, continuity. It has been suggested by a reviewer that there is redundancy here: that value of *the partner to you* and *your switching costs* can be collapsed

into a single variable from the beginning. However, analytically, it is useful to maintain the distinction. First of all, switching costs are related to specific investments that *cause* value. Second, they primarily contribute to one's *own value to the partner*, rather than his value for you. Value also includes competence trust: an assessment of the partner's capability to perform and to achieve goals of quality, service, delivery time, knowledge transfer, payment, etc.

Value is assessed not only in the present, but also on the basis of potential for the future. This is taken to imply some assessment of the probability that the relation will proceed in the future. As is well known from repeated games (Axelrod 1984), this is crucial: a rational decision to defect opportunistically is then based on a trade-off between advantage now and possible loss of value from an ongoing relation in the future. In particular, opportunism affects perceived probabilities of an ongoing relation. Renunciation of opportunities for opportunism will enhance trust. This may contribute directly to value by increasing intrinsic value, and indirectly by increasing perceived probabilities of an ongoing relation.

The other side of the coin is risk, due to dependence, and as a result of that: the size of damage that the partner may do, and the probability that he will do it:

$$LOX = SLX \times PRLX \quad (2)$$

where: LOX = possible loss for X ; SLX = size of the loss for X ; $PRLX$ = probability of loss for X .

The damage may consist of several things:

- Loss of extrinsic value, in the economic surplus from the exchange (due to neglect or accident). This may include disasters, with a cost that exceeds (one's share in) the value of the surplus.
- Redistribution of the economic surplus (due to opportunism).
- Damage due to a break of the relation (which may be non-intentional, e.g. when the partner goes bankrupt).
- Loss due to spill-over of proprietary information.
- Loss of intrinsic value.

Spill-over of sensitive information to competitors, via the partner, is a risk to the extent that knowledge is transferred, but while the relation lasts, the partner has an interest in preventing it. The risk is particularly high if the relation is broken opportunistically; on purpose rather than by accident. In fact, sensitive information may be treated as a 'hostage'.

The loss for X due to a break of the relation equals switching costs (SWX) plus the relative value of the partner Y (VYX). The cost of breakage determines dependence on cooperation in the sense of the 'captiveness' of X ($CAPX$): damage due to the redistribution of surplus cannot systematically exceed the damage due to a break of the relation, because if it did, X would be likely to break the relation. Disasters,

however, could exceed that limit. Like the accidental damage of breakage, they are associated with competence trust rather than goodwill trust.

Switching costs (*SWX*) include the costs associated with specific investments that are typical of TCE: e.g. specific investments that one has oneself incurred; guarantees given to cover the risk of specific investments by the partner; the value to *X* of hostages supplied, etc.

If we look only at goodwill trust and ignore disasters, risk depends wholly on the possibility of opportunism. In formula:

$$SLX < CAPX = SWX + VYX \quad (3)$$

The probability of damage to (*PLX*) then equals the probability of opportunism by *Y*, and depends on:

- incentives towards opportunism by *Y* (*IOY*)
- opportunities for opportunism by *Y* (*OOY*)
- propensity towards opportunism by *Y* (inverse of trustworthiness — *POY*).

(4)

Here, we recognize the sources of cooperation from Table 2.

Each of the above form a necessary condition for opportunistic acts, which is expressed by the following multiplicative specification:

$$PLX = IOY \times O O Y \times P O Y \quad (5)$$

where: *IOY*, *OOY* and *POY* are normalized to take values between 0 and 1 — *OOY* = 0 for a closed contract and =1 for the absence of any formal constraints on action; *POY* is the probability that *Y* will utilize opportunities for opportunism.

There is similarity here to the notion in TCE that there are transaction costs only if there are specific assets *and* there is bounded rationality *and* there is opportunism. As we shall argue, specific assets yield switching costs and hence captivity and hence an incentive to opportunism; bounded rationality precludes closed contracts with perfect monitoring and thereby opens opportunities for opportunism; the possibility of opportunistic conduct is here reconstructed as 'propensity towards opportunism'.

Incentives towards opportunism (*IOY*) belong to the dimension of interest as a source of cooperation (Table 2), and are associated with what in TCE is called 'private ordering' or 'relational contracting'. It depends on the captiveness of *X* (*CAPX*), and hence on the value of *Y* to *X* and on switching costs. The first depends on the degree to which *Y* has adapted to the specific demands of *X*, which is likely to yield specific assets (but not necessarily — flexible production technology allows for specific products with non-specific assets, see Nooteboom 1993c), and the latter on how the risks of specific investments are distributed, for example, by cross-ownership or guarantees, exchange of hostages, etc. The incentive for *Y* also depends on pressures from competition or

owners/shareholders on *Y* to utilize opportunities for short-term profit or saving.

An earlier prototype of the model was discussed with representatives from several industries. One was the automobile industry, at a time of declining sales (1993), which yielded great competitive pressure, and consequently high pressure on suppliers. Here, our ideas concerning the role of trust met with scepticism bordering on ridicule: trust was something they could not afford to build on. Other representatives were from the firm that has a monopoly in the exploration and production of natural gas. They balked at our discussion of potential opportunism: they had easy, amicable, generous relations with their suppliers. Unlike the automobile industry, they could easily afford to.

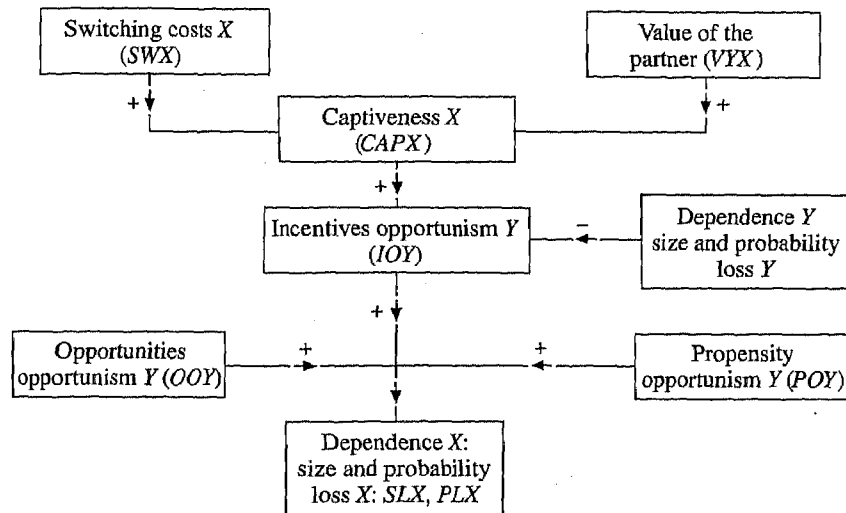
Y's incentives towards opportunism also depend on the extent to which *Y* perceives himself to be dependent on *X*: if *Y* is more dependent on *X* than vice versa, it is in *Y*'s interest to be careful about opportunism. *Y* should also take into account the effect that opportunistic action may have on the intrinsic value of the relation and on perceived probabilities of an ongoing relation, and hence future value and particularly if he takes into account the possible retaliation by *X*, which may yield a downward spiral of mutual retaliation. *Y* should take into account the risk of breakdown of the relation, yielding complete loss of the relative value of his partner, switching costs, loss of hostages, spill-over to competitors.

Note that this part of our model (*JOY*) incorporates what is studied in game-theoretic studies of the *outcomes* of interaction, except that here we set up a framework for reproducing the *process* of strategic interaction. The literature (Axelrod 1984) demonstrates that there is an infinite number of equilibria in the repeated prisoner dilemma game. Rather than taking any of these for granted, we want to reproduce the emergence of sequences of choices and their effects on further choices.

Opportunities for opportunism (*OOY*) belong to the source of coercion (Table 2), by contractual, legally enforceable restrictions on *Y*'s conduct, or what in TCE is called 'legal ordering'. As recognized in TCE, they also depend on the occurrence of unforeseen contingencies ('external uncertainty'), which arise to the extent that the environment is volatile (shifts in technologies or markets, for example). They also depend on *X*'s ability to monitor *Y*'s actions ('asymmetric information'), and on *Y*'s competence to utilize the opportunities. In connection with this, they are also related to firm size: due to a greater spread of activities over more products and wider markets, larger firms have more diversified partnerships and thereby are better able to spread risk and cross-subsidize activities (Nooteboom 1993a).

Propensity towards opportunism belongs to the category of trust: norms/values, ethics, customs and bonds of kinship or friendship. Trust tends to grow as the relation proceeds successfully, because bonds of empathy may get stronger, or because habituation occurs. The setting up of a

Figure 1
Determinants of
Risk of
Opportunism for
X



common cognitive base (getting to know who is who in each other's organizations, mutual understanding, development of procedures and routines) can be seen as mutual specific investments.

The results so far are illustrated in Figure 1. Note that through the basic variables in Figure 1, opportunism may be triggered or lessened by external events (not created by the partners), such as (the list is not exhaustive):

- emergence of a new potential partner for X, lessening the relative value of Y (VYX), and possibly reducing switching costs for X (SWX), thereby reducing the captiveness of X
- some unexpected situation presents a novel opportunity for Y to exercise opportunism (OOY)
- the information X has for monitoring changes, perhaps due to a change of technology (OOY)
- a change of law or regulation affects opportunities for opportunism (OOY)
- appearance of a novel competitor puts pressure on Y to utilize opportunities for opportunism (IOY)
- Y is taken over by a more or a less aggressive firm or the contacts of X at Y are replaced (POY).

Note also that the arrows from IOY, OOY and POY intersect, rather than going directly to the outcome of opportunistic conduct. This is designed to reflect the possibility of interaction effects. A large value of X's captivity (CAPX) determines the gain that Y may take from opportunism ['golden opportunity', see (3)], and this may affect his incentive to grasp the opportunity (IOY). The incentive interacts with propensity towards opportunism (POY), in that it may exceed the boundaries of Y's trustworthiness. If X seeks to restrict Y's opportunities by detailed legal contracts and close monitoring (OOY ↓), this may

antagonize trust and Y 's propensity to opportunism may increase ($POY \uparrow$). Restrictions on Y 's conduct signal to Y that X has no trust, which may suggest to Y that X himself is not trustworthy, so that Y is more inclined to take countermeasures of limiting X 's actions. Thus, we may arrive at a cycle of mutual limitation and breakdown of trust.

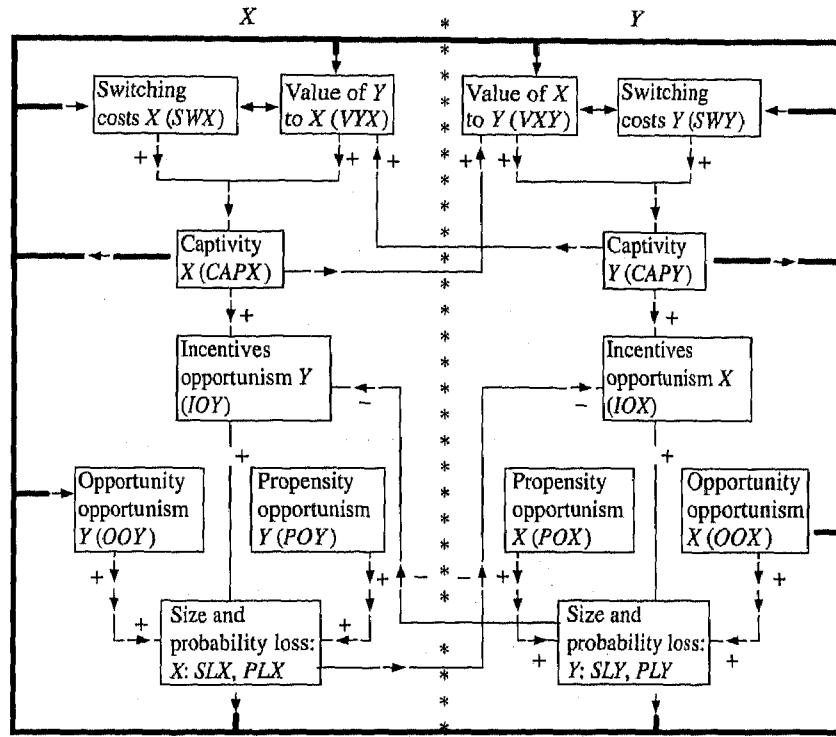
This scheme has been tested in empirical research (Berger et al. 1995; Nooteboom et al. 1995), and has been used for preliminary attempts to diagnose buyer-supplier relations in practice. The empirical research was aimed at testing the model on the basis of surveys. Psychometric techniques were used for measuring variables, and these were fed into econometric models to test hypotheses derived from Figure 1. The first study (Berger et al. 1995) involved a survey of 80 suppliers to a producer of state-of-the-art photocopying machines. The second (Nooteboom et al. 1995) involved 10 customer relations each for 10 suppliers of sub-assemblies to end-producers of electrical/electronic apparatus. Examples of the exploratory use of the model in practice will be discussed in the text. Below is an illustration.

Analysis of the relation between a supplier of hard/software (Y) to a consortium of firms that develop worldwide telecom services (X) showed that the buyer was extremely dependent on the supplier: it was their single supplier (in our model: causing high VYX), and switching costs (SWX) were extremely high, thus yielding high captivity ($CAPX$). On the other hand, the supplier had multiple customers, suggesting a modest relative value of the buyer (VXY), faced limited switching costs (SWY), thus yielding low captivity ($CAPY$). This suggested a danger of one-sided dependence of the buyer, in terms of the size of possible loss (SLX). The buyer recognized this, and was contemplating a switch to dual suppliership, in spite of the enormous duplication of costs involved. On the basis of the model, we found that, nevertheless, dependence was balanced in that the buyer supplied such a unique opportunity for the supplier to penetrate fast-growing world markets in telecom that the supplier would have absolutely no interest in exploiting the one-sided dependence of the buyer (low incentive IOY) and, furthermore, was large enough not to run the risk of default. As a result, the extent and size of possible loss to the buyer (SLX) was compensated by a low probability (PLX). The buyer decided not to go for dual sourcing, for the time being.

Model of Governance

So far, we have considered the implications of given parameter values in the relation. Now we turn to the possibilities of control by modifying the parameters. Figure 1 applies to both sides of a relation, as illustrated in Figure 2. For governance (control), we must add a control loop, whereby partners can redesign the relationship to lessen dependence. This yields actions which constitute events that are internal to the relation, and may call forth reactions by the other side, and so on, perhaps until some equilibrium arises, possibly in the nature of a Nash equilibrium. In Figure 2, single lines indicate effects of parameters; double

Figure 2
Interaction
between X and Y



lines in the control loop indicate governance by change of parameters. Note that we include the (negative) effect of one's own perceived dependence on one's incentives towards opportunism. Trust-related variables, such as ethics, habituation and bonding determine the propensity towards opportunism. We again take an illustration from practice.

In a relation between a supplier of specialty chemicals (Y) to a producer of semi-conductors (X), there appeared to be extreme captiveness of the buyer (single supply, yielding high VYX, and high investments dedicated to receiving the specific products and services from the supplier, yielding high SWX). The supplier, on the other hand, had many alternative customers (ostensibly yielding modest VXY) and limited switching costs (SWY), due to limited specific investments. On further inspection, VXY turned out to be higher, since the buyer was yielding the supplier access and prestige in a vital growth market. This might yield balance of dependence, but it seemed to be wearing off: the supplier seemed to have learned most of what there was to learn, and was already cashing in on the prestige. Meanwhile, the dependence of the buyer was only increasing, with an ostensible increase of both size and probability of loss (SLX, PLX). On the other hand, the relation was characterized by extreme openness. In our analysis we conducted interviews at both sides, with a proposal for holding answers to certain potentially sensitive questions secret from the other side, but this offer was rejected by both sides. We were encouraged

to present our analysis, including opportunities for opportunism, etc., without holding anything back, in a meeting with representatives from both sides. Both sides acknowledged that our analysis was valid, and they would certainly use that kind of thinking in other relations, but in this particular relation there was no need, because 'both sides fully trusted each other'. The relation had developed over a protracted period of time, with great mutual benefit, and strong bonding and social exchange had developed. Thus, there seemed to be a very low propensity towards opportunism on both sides (low *POY* and *POX*), which also appeared to reduce the probability of loss for the buyer. Yet, we felt more confident when we heard that the next stage in the development of the relation involved a much higher level of specific investments (notably high location specificity) on the part of the supplier (yielding higher *SWY*).

Figure 2 shows that if one is concerned about risk, there are two basic options for redesign of the relation:

Modify the causative parameters of risk for X in Figure 2:

VYX = value of the partner. Lessen dependence by decreasing the value of the partner, by developing alternatives (remember that value is relative to the next best alternative).

SWX = one's switching costs. This can be changed by reducing the specificity of investments, or of the underlying technology; demanding more guarantees; redistributing their ownership; changing guarantees given to the partner; adding or retracting hostages, etc.

OOY = the partner's opportunities for opportunism. This can be changed by changing contractual terms or one's capacity for monitoring, or by trying to stabilize the environment that generates unforeseen contingencies.

IOY = the partner's incentives towards opportunism. This can be reduced above all by increasing his perceived dependence. We return to this later.

POY = the partner's propensity towards opportunism. This is the most difficult to change directly: it is dependent on the growth of trust in time, which one can try to affect by building friendship or empathy, and trying to develop further joint ethics, procedures or routines.

One can also modify the parameters in the scheme that structures risk for one's partner *Y*, in the mirror image of Figure 2. There, *SLY* indicates the size of the loss for *Y* due to opportunism by *X*, and *PLY* its probability.

Modify the causative parameters affecting partner Y's risk:

VXY = one's value to the partner. This can be increased, by investing in one's capabilities, or by eliminating alternatives for the partner (remember that one's value is relative to *Y*'s alternative partners).

SWY = the partner's switching costs. These can be changed analogously to the change of one's own switching costs, discussed before.

OOX = one's opportunities for opportunism. These can be changed by changing contractual terms, affecting the partner's capability of monitoring (e.g. closing oneself off from scrutiny), or creating a more turbulent environment, in which novel opportunities may arise.

IOX = one's own incentives towards opportunism. This can be changed especially by changing one's dependence.

POX = one's propensity towards opportunism. Relevant here is the propensity as perceived by the partner. This may be affected by signalling: either to exaggerate or to hide true propensity. One may also redistribute roles of personnel, e.g. by replacing trusted long-term contacts by new ones, replacing technical personnel by legal formalists, etc.

Note that apparently perverse acts of governance may be rational for the sake of committing oneself and thereby facilitating participation by the partner. For example, one may bind oneself with an increase of switching costs (*SWX*), thereby increasing one's dependence, aligning it better, for example, with high dependence of the partner, due perhaps to high specific investments. This may be done by participating in their ownership, or by giving hostages.

This yields an interpretation of the previous illustration. The chemical supplier was willing to increase his specific investments at the plant of the buyer, both for further improvement of mutual value, but also to redress an imbalance of dependence that was in his favour, but might jeopardize the buyer's confidence.

Another noteworthy strategy is the following. If one's captivity becomes negative ($CAPX < 0$), perhaps because one has found a more attractive alternative partner (with an excess of value greater than switching costs), a plausible action would be to try and get out of the relation at the lowest possible cost. However, there is the alternative of investing in one's partner (increasing *VYX*) to such an extent that one no longer wants to get out.

When analysing actions and their triggers, we should consider the possibility of imperfect perception. The most crucial problem of limited perception pertains to the partner's propensity towards opportunism (*POY*). This seems so basic to the issue that it cannot be ignored. One will form an opinion on the partner's propensity on the basis of:

- true propensity, to the extent that one can infer such propensity directly, on the basis of experience or reputation;
- actual opportunistic behaviour.

For modelling purposes, one might envisage a Bayesian procedure, whereby prior estimates of propensity towards opportunism are adapted as a function of events. If no opportunism is perceived, the subjective probability of the partner's taking advantage of opportunities for opportunism may decline; when opportunism is perceived, it will increase.

A further complication arises when something happens to the detriment of *X*, but *Y* claims that it is due to some mishap beyond his control. Is this true or is *Y* trying to mask opportunism?

Parameters concerning value (*VYX*, *VXY*), switching costs (*SWX*, *SWY*), opportunities for opportunism (*OOY*, *OOX*) and incentives for opportunism (*IOY*, *IOX*) may more reasonably be assumed to be observable, with some qualifications:

- Note that *OOY/OOX* include the possibly limited capacities of mon-

itoring. In assuming that *OOY/OOX* are known, we also assume that partners are aware of each other's limitations in monitoring.

- The assessment of value includes expectations about a prolonged relationship, which depend on imperfectly perceived propensities of the partner. Furthermore, since the values of partners are relative, they presume knowledge about alternative partners and their value, which presupposes an ongoing collection of information on such alternatives. It is possible that this is, in fact, neglected.

A striking illustration of this latter point is offered by Joag (1995).

'A firm that made the transition from customary multiple, price-oriented sourcing to single sourcing aimed at cooperation in development, on the basis of long term contracts, failed to monitor the performance of the single sources relative to outside producers, and thereby made it too easy for them to relax and concentrate on other more demanding and competitive customer relations. After seven years the firm found out by coincidence that its suppliers had seriously lagged behind potential competitors.'

Generic Strategies

We have generated quite a rich structure of interaction. To maintain grasp of complexity we now reduce the multitude of possible actions of governance to a small set of 'generic strategies', in Table 3.

Note that there are adversarial and cooperative means of increasing a partner's captivity (*CAPY* ↑). Cooperative: increase one's value relative to the partner (*VXY* ↑) by investing in further adaptation to the partner, and thereby incurring specific investments; invite hostages in the form of information about the partner's technology in order to improve cooperation in development of his products or processes (*SWY* ↑). Adversarial: increase one's relative value (*VXY* ↑) by blocking *Y*'s access to alternative partners; demand 'improductive hostages', without adding value for *Y* (*SWY* ↑).

We now have an instrument for exploring time paths of relations: sequences of actions that affect the parameters of the relation in response to outside events or internal events in the form of actions of the partner that influence the parameters of the relation. We could do that by simulation, on the basis of assumed perceptions, behavioural routines (responses to different types of perceived phenomena, in terms of attempts to change the parameters of the relation) and their possible adaptation. We could also employ game theory, using backward induction to see what (sub-game perfect) equilibria may appear.

Many situations can be set up for analysis, but for the purpose of illustration we will discuss only one particularly interesting situation: the beginning of a relation. At the beginning of a relation, a key problem, as indicated also in TCE, is that, *ex ante*, it is difficult to judge propensity towards opportunism. Then, as argued in TCE, one should take the

Table 3
Typology of
Strategy (for X)

	Fastening	Loosening
Adversarial	Constrain partner ($CAPY \uparrow$, $OOY \downarrow$) Block alternatives Unproductive hostages Restrict actions Close monitoring → <i>binding</i>	Reduce own constraints ($SWX \downarrow$, $OOX \uparrow$) reduce values ($VYX \downarrow$, $VXY \downarrow$) decrease own bonding ($POX \uparrow$) → <i>breaking up</i>
Cooperative	Increase values ($VYX \uparrow$, $VXY \uparrow$) Increase bonding ($POX \downarrow$, $POY \downarrow$) Increase own constraints ($SWX \uparrow$, $ROX \downarrow$) Productive hostages ($SWX \uparrow$, $SWY \uparrow$) → <i>making attractive</i>	reduce switching costs ($SWX \downarrow$, $SWY \downarrow$) decrease bonding partner ($POY \uparrow$) → <i>setting free</i>

A cooperative strategy is also: *submission*; i.e. accept an aggressive strategy (binding, breaking up) of the partner, e.g. by accepting constraints ($OOX \downarrow$, $SWX \uparrow$).

possibility of opportunism into account. According to Table 3, fastening can occur by 'binding' or by 'making attractive'. Which, though, is preferable in view of the partner's likely reactions? How do choices of strategy affect the development of trust under different conditions of external events, availability of information, etc.? Should one begin with formal, contractual measures until trust has been built up to relax them, or vice versa: build trust first and formalize later? How should one set the ball rolling? Many readers will have more or less informal experience in this case. We have not yet constructed a systematic empirical case that may serve as an illustration, but our theoretical analysis is given below.

Suppose that X chooses binding. If this takes the form of tying Y down in a formal detailed contract ($OOY \downarrow$), the danger is that this may antagonize any inclination towards trust that Y may have, or may create the impression that, in his expectation of opportunism, X himself is inclined towards it. The first may increase Y's propensity towards opportunism ($POY \uparrow$), and the second may cause Y to retaliate with restrictive measures ($OOX \downarrow$). There is a danger of a vicious cycle of distrust and mutual restrictions. Game theory also teaches us that it is unwise to demand that the precise date of terminating the relation be set in advance, as part of formal, legal ordering, because then, cooperation may unravel before it can properly start. Jockeying for the best exit condition rather than exploring novel potentialities then determines the relation. Private ordering is also cheaper, and allows for greater flexibility. Thus, this approach is ill-advised if X wants to develop the relation. Other adversarial measures of binding, such as blocking the partner's access to alternatives or demanding unproductive hostages, likewise invites retaliation and a closing rather than opening of the relation. Y would be unwise to react by using the alternative strategy

of 'making attractive', since that would make him extremely vulnerable, given *X*'s adversarial orientation, and *Y* would be virtually forced to retaliate with the same actions of binding.

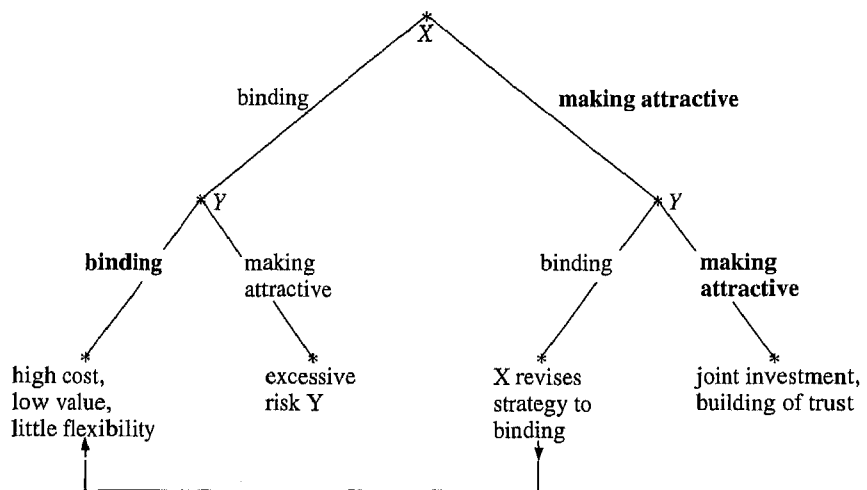
Alternatively, *X* could choose 'making attractive'. He could invest in his value to the partner by engaging in modest initial specific investments ($V_{XY} \uparrow$). This would contribute to fastening: the partner becomes more captive ($CAPY \uparrow$). This argument is also present in TCE. *X* may also offer productive hostages in the form of information about his technology, for the purpose of helping *Y* to develop his competence. A particularly interesting form of doing this is to invite specialists from *Y* to develop his competence. A particularly interesting form of doing this is to invite specialists from *Y* for a stay at *X*'s facilities. This simultaneously yields improvement of *Y*'s monitoring of *X* ($OOX \downarrow$). Conversely, *X* may supply specialists for a stay at *Y*, which increases *X*'s monitoring of *Y* ($OOY \downarrow$). The possible conflict between people '*qua persona*' and their organizational roles presents a complication here. People stationed at *Y* may establish personal bonds beyond the interest of *X*. Their value for monitoring, for example, may become void.

Y would be very unwise not to respond in the same fashion if he is interested in developing the relation. He would thereby forego the opportunity of a virtuous circle of mutual investment and the development of trust that promises to increase extrinsic, as well as intrinsic, value. If he reacted with binding, then so would *X*, with the negative results discussed above.

Note that the exchange of hostages in the form of information about one's technology carries the risk of spill-over (that is what makes it a hostage). Some guarantees are then required that the partner will be careful to control accidental spill-overs.

In view of uncertainty about propensities to opportunism, this build-up

Figure 3
Starting a
Relation
($V_{YX} > 0$;
 $V_{XY} > 0$)



of the relation under private rather than legal ordering should proceed cautiously, and step by step. In the process, if parties refrain from opportunism, trust may grow, on the basis of bonding and habituation, and perhaps the development of a joint ethic. This game is illustrated in Figure 3, where italicized material indicates preferred strategies, forming a unique sub-game perfect equilibrium.

In a similar fashion, we could analyse the perhaps more difficult issue of ending a relation, but this would require too much space. The analysis has been conducted, and applied, by way of experiment, to ways of divorce.

Further Studies

The use of the model can be taken further, and the model can be developed in more detail. Both are under way. To give an example: a particularly interesting avenue of study is to see what the effects are of increased turbulence of technology and markets. If conditions are turbulent, in the sense that there is much entry and exit of firms, relative value is subject to shifts that may destabilize a relation. We have already indicated the cost of adjustment, the inflexibility of formal contracts and the greater relative attraction of trust, when changes in demands upon the relation are to be expected. On the other hand, if trust is based on close personal bonds, this can yield a conflict with organizational roles and tasks, particularly when the relation needs to be stopped, and replacement of personnel may be required. When technology progresses to become more flexible, and enables differentiated production at low costs of switching between products, the level of specificity of investments declines, resulting in lower switching costs and less need to control the hold-up risk. The first may destabilize a relation, and the latter may stabilize it.

Some issues can best be studied with the help of game theory, in a loose or formal way, and others by means of simulating the development of the relation. In comparison to simulation, game theory is useful for its analytical parsimony, but it leaves questions of how, and by what paths, Nash equilibria may be reached. In repeated interaction, parameters are likely to shift along the way, such as the build-up of trust and shifting goals, and analysis by repeated games may be either unrealistic (not taking into account such shifts) or no longer soluble analytically (cf. Gilbert 1989). For the evolution of relations, it might be better to resort to simulation, particularly if we want to investigate the robustness of a strategy under different conditions, events and parameter shifts. The problem with simulation is often that it generates too much complexity in terms of numbers of potential parameter constellations. Perhaps the two methods can be combined, with game theory to provide benchmarks to give some order and direction to simulation to test how Nash equilibria may be achieved. For practical purposes of the dia-

gnosis and design of relations, complexity should be reduced by setting parameters to values that represent the case at hand. Whether this works will be further explored using case studies of firms.

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