Morten Lier
Eivind Thorsrud Willard

BI Norwegian Business School-Thesis

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Supervisor:
Christian Riis

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Abstract

Network form of economic organization is subtle compared to markets and hierarchies, due to the importance or social interactions. Based on a literature review we establish *complex exchange ties*; a set of behavioral patterns decisive in network form of economic organization. Further, an agency problem where complex exchange ties are implemented is analyzed. We discuss the effects of complex exchange ties as both preferences and external motivations. We find that under some circumstances one can reach improved second best outcomes. It becomes harder to improve outcomes as the social structure become more complex, however.

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1. Introduction

Numerous economic models assume that economic actors solely pursue their own material wealth, with no concern for the social implications of their actions. This can in many cases be correct, but model predictions with this assumption can also be refuted due to the fact that human behavior tend to be more complex. The "ultimatum game", an experimental game first studied by Güth, Schmittberger et al. (1982), has proven useful to study deviations from the assumption that economic actors are purely self-interested. Ultimatum game studies show that people tend to distribute their wealth differently, and make other choices than predicted by the neoclassical approach (Camerer, Loewenstein, and Rabin 2004). One can argue that neoclassical theory can be scant in the agent behavioral scope; it does not specify whether economic agents care about other things than what is included in the model. It does not rule out the possibility that this can in fact be the case; the possibility is simply left out of the analysis. Fairness and social preferences are two characteristics of human behavior which behavioral economists believe can improve the realism of economic models, and make them more reflective of psychological mechanisms in economic agents' behavior. By adding such considerations to economic thinking, a possible result is to supplement existing results with more efficient outcomes.

Agency theory is one of the large literatures where the analytical framework is, in many cases, founded on the neoclassical approach and its assumptions. Principal-agent models can be very simple, addressing complex coordination problems with only a few variables, still with an analysis complex enough. Agency-problems are important to economic life, and they reflect coordination problems observable in various situations in everyday life. Examples might be interaction between a firm and its workers; team work at the university; and an elementary school teacher and a pupil. Accordingly, it seems pertinent to discuss additional behavioral patterns when the social interaction per se is an important part of the economic problem, like in agency theory.

Research indicate that behavioral norms and decisions can rely on the context and culture they materialize in (Camerer, Loewenstein, and Rabin 2004). Network form of economic organization is an economic environment that seems to facilitate more complex behavioral patterns. Thus, when economic activity is organized in network form, many of the behavioral assumptions in neoclassical frameworks might not fit.

Accordingly, the intention with this thesis is to address the behavioral patterns identified in network form of economic organization, and discuss them in the light of a simple neoclassical principal-agent model. The analysis will depend on recent advances in behavioral economics, together with research on network form of economic organization. First of all, a literature review of relevant theories and reasoning is presented. Based on this, some core behavioral mechanisms prevalent in network form of economic organization is identified and defined as *complex exchange ties*. Further, three theoretical approaches is identified before we present our research question.

In the second part of the thesis, complex exchange ties are included in the analysis of a simple principal-agent model. A common approach from behavioral economics is used; the model is extended with some additional variables which allow the model to capture behavioral mechanisms that previously was ignored. The model is analyzed in three stages: To begin with only the agent is assigned with complex exchange ties. In this section we find that, if the agent has some utility from complex exchange ties, it improves the second best outcome to the contract problem. As we discuss in the literature review, complex exchange ties rest on interdependence between actors. Hence, modeling complex exchange ties as a preference only to the agent is not sufficient. Therefore, bilateral complex exchange ties are considered in the following section.

This section consist of two complementary discussions: First, we assign the principal with complex exchange ties. In this part we find that, if the principal has preferences to complex exchange ties there will, under some specifications of the principal’s preferences, be an improved second best outcome. Second, we inquire to what extent the strategic economic environment in fact can alter the agent's behavioral judgments. Now we allow the agent's utility from complex exchange ties to be dependent on the actions chosen by the principal. In this case it becomes harder to achieve a better second best outcome from complex exchange ties. Two reasons can explain this: The fact that the economic environment need to alter the agent's behavioral judgments, which depends on the distribution of actor preferences and eventually the social norms; preference dependency reduce possible outcomes, which improve the second best outcome when the principal and the agent differ in their complex exchange ties preferences.

In the last part we consider the agent's ability to deter the principal's decision of not acting according to the social norm, in a two period game. From the analysis it is clear that the agent have a limited ability to deter the principal's deviation from the social norm. The principal is however under some conditions better off behaving according to the agent's preferences.

2. Literature review

2.1. Principal-agent theory

Incentives are at the core of economic thinking. Using incentives, economists describe actors anticipated behavior and solve coordination problems. Ross (1973), among others, aligned incentives and economic coordination. He analyzed what he considered as "the principal's problem"; a universal problem where different objectives and asymmetric information, between the principal and the agent, give rise to a coordination problem when the principal delegate some task to the agent. This contributed to the principal-agent model, a broad framework where the principal's use of some payoff structures helps to motivate the agent, such that the coordination problem is solved.

A major part of the principal-agent and contract theory literature is focused on the moral hazard issue, the nature of the problem is stated by Mas-Colell, Green, and Whinston (1995, 477):

> *The hidden action case, also known as moral hazard, is illustrated by the owner's inability to observe how hard his manager is working…*

Due to the very nature of task delegation, the principal is no longer able to observe the actions chosen by the agent. Since actions are not observable, nor verifiable, they cannot be contracted upon; the principal is now faced with moral hazard (Laffont and Martimort 2002). Mirrlees (1999) shows that self-interest and unobservable behavior can restrain Pareto-optimality in agency relationships. This implies costs higher than in first-best implementation of the agent's actions. Consequently, as proposed by Grossman and Hart (1983, 14): "there exists a second best optimal action … and a second-best optimal incentive scheme …". In general, second-best best implementation is less desirable than first-best; there is a variety of different model classes of agency problems which make the various second-best implementations differ, however. In any way, one can define agency cost as:

The agency cost is the expected net payoff for the Principal under full information [first best] less what it is in the second-best situation (Cowell 2006, 364).

Several principal-agent models share the same set of assumptions. The intention is to simplify the models, so it becomes possible to predict outcomes in a specific economic environment. To succeed with this it is necessary to place restrictions on economic actors and how they will behave. A fundamental model assumption is economic utilitarianism, that all principals and agents are concerned with utility maximization (Wright, Mukherji, and Kroll 2001). Noreen (1988, 360) draws the link between utilitarianism and self-interest, which he argue leads to opportunistic behavior: "Utilitarian ethical behavior, […], has to do with voluntary compliance with rules that are, in some sense, in the individual's own self-interest". Summarized, economic agents are assumed to be fully-law abiding, opportunistic, and self-interested. In order for the model to say anything at all, agent behavior also needs to be rationale, i.e. predictable.

From assumptions, one is allowed to discover important mechanisms in the agency relationship. It can be argued that assumptions need to be present due to the complexity of contractual problems. Williamson (1981, 553) implies that:

There is a tendency, however, to accept this fact [complexity] as given rather than inquire into the reason for it. [-And that-] What is needed, I submit, is more self-conscious attention to "human nature as we know it".

Accordingly, Wright, Mukherji, and Kroll (2001) argue that agency theory has its limitation of being narrow due to its assumptions, which the authors claim, makes it less reflective of realities in economic relationships. More precise (Wright, Mukherji, and Kroll 2001, 414):

…the restrictive assumptions of agency theory discount the possibility that diverse individuals in various situations may behave differently.

2.1.1. Agency theory and transaction cost economics

Agency theory, as stated above, is a universal framework applicable to various types of transactions. Classical contract law is the governing mean in a market transaction; mainstream economic theory is to a large extent founded on this. Here one finds "thick" markets in which: "…individual buyers and sellers bear no dependency relation to each other. Instead, each party can go its own way at negligible cost to another" (Williamson 1991, 271). Transactions in "thick" markets will in an ideal world be: "sharp in by clear agreement; sharp out by clear performance" (Macneil 1974, 738). This reflects the character of the contract; very legalistic, hard bargaining, strict enforcement with autonomous agents.

A firm can be thought of as a continuation of the market relation; however the mean to govern the contractual relations is that of forbearance (Williamson 1991). An illustration can be the comparison of a seller and a buyer with an employer and employee. The former transaction will take place in a market and the latter in a hierarchy. The point being that the properties in the contractual respect is comparable; however, the contractual law differs. Ultimately, the firm can be described as a "nexus of contracts" where the hierarchy is its own court of law (Williamson 1991). Transaction cost economizing is not subject to discussion in this thesis report. The underlying principles in how agents relate to the transaction and the contracting situation are important, however.

In both markets and hierarchies many of the underlying assumptions in the transaction, and especially the contracting difficulties, are the same. In this sense agency theory has applicability to individuals, group and firm contexts, and accordingly to both forms of economic organization described above (Wright, Mukherji, and Kroll 2001).

2.2. Network form of economic organization

Williamson (1985, 1975) distributes economic transactions in what can be interpreted as a continuum, where he identifies markets and hierarchies as two "poles" in how economic transactions are organized. He later complements his theory with a hybrid mode, something in-between markets and hierarchies (Williamson 1991). From his theories, several aspects can be inferred: First, Williamson implies that markets are the point of departure for economic transactions. From this, one can raise the question if transactions always emerge from the attributes and mechanisms decisive in markets. Second, distributing transactions along this continuum might place restrictions on possible extensions to relevant assumptions. Such a mechanical interpretation of economic exchange can limit the understanding of complex realities in transactions. Querying the critique above, Powell (1990) introduced networks as a distinct way of organizing economic activity.

Powell (1990) discuss in his seminal paper how networks function as a distinctive way of coordinating economic activity. That is, a form of economic organization different from both markets and hierarchies. The argument proposed by Powell (1990, 303) is:

> *In network models of resource allocation, transactions occur neither through discrete exchanges nor by administrative fiat, but through networks of individuals engaged in reciprocal, preferential, mutually supportive action.*

Podolny and Page (1998, 59) characterizes network form of organization accordingly:

> *We define a network form of organization as any collection of actors (N≥ 2) that pursue repeated, enduring exchange relations with one another and, at the same time, lack a legitimate organizational authority to arbitrate and resolve disputes that may arise during the exchange.*

Based on Podolny and Page (1998)'s definition, it is evident that network form of economic organization can include various agreements: Everything from joint ventures and strategic alliances on one hand, and relational contracts on the other.

Continuation of the discussion above, Powell (1990) presents in his paper a stylized comparison of the different forms of economic organization. The key takeaways is listed in the table below, and summarized in the text.

Table 1: Stylized Comparison of Forms of Economic Organization

	Forms		
Key features	*Market*	*Hierarchy*	*Network*
Normative Basis	Contract – Property rights	Employment relationship	Complementary strengths
Means of communication	Prices	Routines	Relational
Methods of conflict resolution	Haggling – resort to courts for enforcement	Administrative fiat – supervision	Norm of reciprocity – reputational concerns
Amount of commitment among the parties	Low	Medium to high	Medium to high
Actor preferences or choices	Independent	Dependent	Interdependent

Source: Powell (1990, 300)

Contrasting networks with markets and hierarchies, Powell (1990) argues that transactions in the first rely on complementary strengths and interdependence between the agents. In addition, they have relational means of communication, together with reputational concerns. Aligning the stylized comparison with the stated definition proposed by Powell (1990), it is obvious that social ties between agents involved in the exchange is important. The key differences which is important to our discussion is what shape opportunities and expectations; namely the structure and quality of exchange ties. Economic relations are no longer cool and atomistic as in market transactions, but embedded in a more complex set of variables. According to Uzzi (1996, 674) embeddedness refers to:

> *...the process by which social relations shape economic action in ways that some mainstream economic schemes overlook or misspecify when they assume that social ties affect economic behavior only minimally or, reduce the efficiency of the price system.*

Uzzi (1996) makes several empirically supported inferences about embedded networks. Network structures can be something between loose and close-knit inter-firm connections. Hence, the level of embeddedness is not constant, but can vary from weak to strong. Further, this imply that the social structure enable or constrain the actions available to agents, something which is particular to network form of economic organization (referred to as embedded networks from now on). Consequently, it should no longer be peripheral that social relations affect economic performance, opposed to the predictions of neo-classical economic models. Indeed, Uzzi (1996) shows that research participants differ in their perceptions about arms-length transactions and transactions within networks. Their behavior is closely linked to the functions and features of embedded ties. In particular embedded networks facilitate reciprocity, inter-firm coordination and joint problem-solving. This is coherent with Powell (1990)'s observations of reciprocity, interdependence and mutual interests when exchange is organized in networks.

Noticeably, the underlying principles in how agents now relate to the transaction differ compared to standard economic models. In neoclassical theory, regardless of how transactions are organized, many of the above discussed behavioral assumptions seem to be prevailing. Presumably, as exchange ties move from absent or weak towards a stronger and more complex set of social variables, these assumptions need to be relaxed. To what extent the agent plays the cooperative game, acts selfish, is pure or bounded in rationality, can depend on the social structure of the network (Uzzi 1997). Uzzi (1997, 57) suggests the following proposition:

The greater the level of embeddedness in an organization's network, the more likely are Pareto-improved solutions to coordination problems.

A natural question is whether this adds complexity to economic models of exchange, such as agency theory.

2.3. Social preferences and incentives

To what extent social and relational considerations add complexity to economic models, and in particular agency theory, is a question of understanding how such mechanisms work as incentives. We know that the understanding of explicit material incentives, and how they guide economic actors' actions and choices, is important in economics. A consequence of the neo-classical assumptions is that economic law-abiding actors care less, or not at all, about social consequences (Kahneman, Knetsch, and Thaler 1986b). This is not necessarily a realistic assumption.

Behavioral experiments show that our behavior is more complex than the canonical model described in section 2.1. Rabin (1993) discuss how social and relational considerations have economic implications in altruistic behavior, however that altruism is more complex than uniformly kindness, as explained by Fehr and Gachter (2000, 160) : "Altruism is a form of *unconditional* kindness; that is, altruism given does not emerge as a response to altruism received". The *form* can change, i.e. if it applies in general or is more targeted. In any case, it is founded on the simple hypothesis that economic actors care about the wellbeing of others (Rabin 2002).

Departures from self-interest is to a large extent confirmed by Henrich et al. (2001). Henrich et al. (2001, 73-74) found in cross-social and cross-cultural ultimatum game experiments that: "the canonical model is not supported in any society"; "group level differences in economic organization … explain a substantial portion of the behavioral variation across societies"; "behavior in the experiments is generally consistent with economic patterns of everyday life". In other words, to use stringent assumptions and ignore social and relational considerations need not be the only right. The important point is not to reject the parsimony of standard economic models, but to highlight that those additional considerations might have implications on fundamentals of economic actions.

A common approach in the literature is to incorporate social and relational consideration as social preferences. As stated by Fehr and Fischbacher (2002, 2):

> *A person exhibits social preferences if the person not only cares about the material resources allocated to her but also cares about the material resources allocated to relevant referent agents.*

Experimental studies show that a fraction between 44 and 60 percent of subjects exhibit such social preferences and, contrary to what stated above, 20 to 30 percent behave completely selfish (Fehr and Gachter 2000). Fehr and Gachter (2000) conclude that there seems to be conformity among experimental researchers on the concept of social preferences as a behavioral response, the sources of its occurrence diverges, however. Charness and Rabin (2002) find that social-welfare preferences outperform some other possible sources. Sources of social preferences is not subject to this thesis, but the following analysis is based on two possible results of social preference: As suggested by Rabin (1993), (i) that individuals act in response to kind or hostile intensions, in the literature known as reciprocal behavior; (ii) That individuals respond to what type they are faced with (not behavior or intentions) (Levine 1998).

Fehr, Gachter, and Kirchsteiger (1997)'s experimental results show that social preferences can have a significant effect as a contract enforcement device. They find a strong impact on both demanded and enforced effort, resulting in higher rents to both parties. What is not that obvious is how to contract such intrinsic incentives, and the interaction with explicit incentives. In fact, Fehr and Gachter (2000) show that explicit incentive contracts yield lower average effort levels.

This is supported by the findings of Fehr and Schmidt (2000, 1061): "(i) The average effort under the implicit contract is much higher than under the explicit contract. (ii) The average bonus payment is always positive". From this, one can understand that implicit contracts are not only successful in eliciting effort from the agent, but also that the principal *do* in fact fulfill the implicit contract. Other papers also conclude that social preferences and reciprocal behavior can be a source to efficiency gains. One instance is under the provision of incomplete labor contracts – when both workers and firms can be better off when they entrust stable bilateral reciprocity considerations (Fehr et al. 1998).

2.4. Embeddedness and agency theory

Agency costs will arise in any cooperative effort, even if the principal-agent relationship seems concurrent (Jensen and Meckling 1976). In other words, it is unrealistic to imagine a transaction without any information asymmetries or conflicts in terms of what action to be carried out by the agent. Regardless if transactions take place in embedded networks, the variables which influence positively the agent's level of production can also generate a disutility for the agent; in that way, most likely, result in a conflict between the agent and the principal despite their mutual interests. This is stressed to demonstrate that problems of moral hazard should not be extraneous in embedded networks. Considering that firms become less autonomous when transactions are organized in such way, agency theory should be highly relevant. Most of all due to the delegation of activities; the principal loses the ability to control actions when they are no longer observable.

Presumably, the contracting situation might be different under embeddedness compared to that of arms-length, and intuitively one can expect the analysis to grow more complex as social structures in the transaction changes.

3. Thesis objective

Following the previous discussion, the goal with the rest of the thesis report is to apply a simple principal-agent framework on embedded networks.

Due to the very differences in the basic model assumptions and the features of embedded networks, some adjustments to the model are necessary. In order to extend a standard principal-agent model, a sensible approach proposed by Diamond and Vartiainen (2007), is to query when its basic assumptions are violated. This will enable us to establish useful facts and intuition on how to extend the chosen model. The following subsections will for that reason define complex exchange ties; a set of behavioral assumptions which capture the essence in embedded networks. At a later stage, the consequences of complex exchange ties will be analyzed in the modeling-framework. This can be summarized in our thesis objective:

Thesis objective: *To analyse the implications of complex exchange ties on the coordination problem between the principal and the agent.*

Three possible approaches seem plausible to why economic actors might behave differently compared to what mainstream economics usually would predict:

I. Individuals gain some utility from altruism, reciprocity and other social preferences. However, economic actors are still behaving utility maximizing, and simply optimize their behaviour with respect to such considerations.

II. Behavioural judgements are influenced by some external motivations. Agents no longer behave solely based on their utility maximization, but are assigned additional behavioural patterns, i.e. change their behaviour, due to some social norms or other forms of environmental policies.

III. Individuals behave according to some external motivations as in (II), not because these motivations alter the actor's behavioural judgments; but for the reason that deviating from them imposes some costly consequences on the actor which makes him worse off, compared to not deviating.

Research question: *Using (I), (II) and (III) as fundamentals in complex exchange ties; are the different approaches likely to change the outcome compared to the initial model?*

3.1. Defining complex exchange ties (CET)

As discussed in section 2.2, assumptions in simple principal-agent models can be in conflict with the fundamentals of embedded networks. In defining CET, inspiration is found in behavioral economics and social preferences, i.e. agents are no longer necessarily exclusively pursuing their self-interest.

It is necessary to align social preferences with interdependence and cooperation, as a key feature of embedded networks, in order to fully explain CET. What is distinctive with cooperative problems and social preferences is how the economic environment shapes the relationship between the actors and their preferences. This is transferable to embedded networks, where the institutional properties cause behavioral effects (Larson 1992). Fehr and Fischbacher (2002) states that:

> *…reciprocal subjects are willing to cooperate if they are sure that the other people who are involved in the cooperation problem will also cooperate.*

Such conditional cooperation is depending on several ideas. First, beliefs about the social norm and social interaction seem to be important (Fehr and Fischbacher 2002). If you believe that other members in your network put forth cooperative behavior, you are more likely to do the same. Second, when selecting network members in order to induce cooperation, the “right” people are chosen – and shirking actors will be fired. According to Fehr and Fischbacher (2002), this is efficient in establishing internal equality so that cooperation will not unravel. Accordingly, we get definition one – which is coherent with (II) above:

Definition one: *Complex exchange ties emerge from the peculiar interaction between social preferences, cooperative effort and the economic environment.*

In section 2.2 we learned from Uzzi (1997), that behavior of economic actors in embedded networks is affected by the social structure in the network. Further, that this has implications on what kind of game the agent plays. More precise:

> *…the level of embeddedness in a network increase with the density of embedded ties. Conversely, networks with a high density of arm’s-length ties have low embeddedness and resemble an atomistic market (Uzzi 1997, 48).*

Accordingly, CET is allowed to vary from weak to strong as the social structures changes, i.e. as the embeddedness changes. Hence, we get definition two which can apply to all three (I), (II), and (III):

Definition two: *Complex exchange ties get stronger as the network becomes more embedded.*

An important feature for embedded networks, thus also an important ingredient in CET, is reciprocal behavior. Reciprocity can simply be described as fair actions. If someone acts in a good manner, you act in a reciprocal good manner back; if someone treats you bad, you treat that person bad in return. Rabin (1993, 1282) establishes some stylized facts on reciprocity, or fairness:

> *(A) People are willing to sacrifice their own material well-being to help those who are being kind.*

(B) People are willing to sacrifice their own material well-being to punish those who are being unkind.

Definition three follows, and is coherent with (I):

Definition three: *When economic actors are concerned with complex exchange ties, they are willing to sacrifice some material well-being in order to reciprocate the behavior of network members.*

From table 1, we know agents in embedded networks have reputational and relational concerns. Accordingly we assume that agents with CET will have some intrinsic values in contributing in the network; from building relations to other agents and improving the network reputation. At the same time agents will gain from the complementary strengths in other network members. Consequently, this result in definition four which is also related to (I):

Definition four: *Complex exchange ties include intrinsic value considerations on network reputation and complementary strengths.*

4. A principal-agent model with complex exchange ties

In this part of the thesis, CET will be implemented into a simple moral hazard model.

To reduce the complexity of the analysis, the mechanisms emerging from the network are generalized in to a simple principal-agent relationship; even though, the network contains more than one principal and one agent. Accordingly, the network considerations will be captured in actors' values and preferences, i.e. CET will be adopted into the analysis. The intention with the analysis is to capture the effect of CET related to the task delegation. Further, it is assumed that the design of the contract between the principal and the agent is independent of *all* other network members.

According to the definitions in chapter three, it will be assumed that an agent can obtain utility from some intrinsic values related to social ties in the embedded network he belongs to. Fehr (1997) observes that intrinsic values, especially reciprocity, have an effect on firm behaviour. In harmony with the stylized facts on reciprocity, and definition three, firms reward agents when they fulfil the contract in the case of strong reciprocity considerations. Based on definition three and four, economic actors with CET have additional concerns other than the material transfers they receive. Initially we will consider the case when only the agent cares about CET, before in 4.3 allowing the principal such preferences. Finally, in 4.4, we will consider a two period situation where an agent with CET is faced with a self-interested principal.

4.1. Theoretical framework

Our analysis will be founded on a moral hazard model with effort and production, in which the agent's action is not directly observable to the principal. The basics of the model are described below. The initial model and notations in the following subsection will be similar to what is used by Laffont and Martimort (2002, 150-163).

Consider an agent with an effort, denoted e. The agent has either none or positive effort, normalized to zero or one: e in $[0,\ 1]$. Effort is costly and generates a disutility for the agent equal to $\varphi(e)$, where $\varphi(0) = \varphi_0 = 0$ and $\varphi(1) = \varphi_1 = \varphi$.

The agent will receive a transfer t from the principal for exerting effort. This implies the following separable utility function: $U = u(t) - \varphi(e)$ with $u'(.) > 0$ and $u''(.) < 0$. The stochastic production level $\tilde{q}$ can either take a low or high value $\left[\underline{q}, \bar{q}\right]$, and production increases in effort level. The stochastic influence of effort on production is given by probability π_0 and π_1, with $\pi_1 > \pi_0$. Where, $(\Delta\pi = \pi_1 - \pi_0)$.

Further, the principal has a utility function which is increasing in performance, thus he prefers production with a positive effort level ($e = 1$). The agent's effort is not observable to the principal, thus he offer the agent a contract contingent the random output $\tilde{q}$. Reward to the agent is linked to output with the function $\{t(\tilde{q})\}$. Thus, the realized production level $\underline{q}$ or $\bar{q}$ yields accordingly $\underline{t}$ or $\bar{t}$.

A risk-neutral principal and a risk-averse agent are considered.

4.2. Extensions to the basic model: An agent with complex exchange ties

In addition to transfer $\underline{t}$ or $\bar{t}$ from the principal, as stated in definition four, the agent receives some intrinsic value from CET; in contributing to a good network reputation, the constant v_c, and gaining from complementary strengths of others in the network, the constant v_g. To what extent the agent is concerned with CET, is captured in the strength parameter θ which is ≥ 0. The agent's utility is increasing in θ if he has a preference for CET. For an agent with no preference for CET, $\theta = 0$ and this brings us back to the initial model. The total utility gain from being a part of the embedded network, and having CET is $\theta(v_c + v_g)e$. It is assumed that CET only applies if a positive effort level is exerted by the agent. This is due to the nature of CET; if the agent exerts zero effort he will not have an utility increase from contributing to the network, since he do not contribute per se. This extension to the model is to be considered as additional preferences in the agent's utility function, as discussed under thesis objective, in (I).

The agent's extended utility function is then (1):

$$U = u(t) - \varphi(e) + \theta(v_c + v_g)e \qquad (1)$$

For the agent to participate, utility from exerting effort less the corresponding disutility he faces cannot be negative. Also, for a positive effort level the utility cannot be lower compared to the case with zero effort. The following incentive (2) and participation (3) constraint ensures this.

$$\pi_1 u(\overline{t}) + (1-\pi_1)u(\underline{t}) - \varphi + \theta(v_c + v_g) \geq \pi_0 u(\overline{t}) + (1-\pi_0)u(\underline{t}) \qquad (2)$$

$$\pi_1 u(\overline{t}) + (1-\pi_1)u(\underline{t}) - \varphi + \theta(v_c + v_g) \geq 0 \qquad (3)$$

The principal expects the following utility functions (4) and (5):

$$V_1 = \pi_1(S(\overline{q}) - \overline{t}) + (1-\pi_1)(S(\underline{q}) - \underline{t}) \qquad (4)$$

when $e = 1$, and

$$V_0 = \pi_0(S(\overline{q}) - \overline{t}) + (1-\pi_0)(S(\underline{q}) - \underline{t}) \qquad (5)$$

if $e = 0$.

The timing of this contracting game is straight forward. (t=0): The principal offer the agent a contract. (t=1): The contract is accepted or refused by the agent. (t=2): An effort level is provided by the agent. (t=3): The lottery realizes the outcome. (t=4): Contract is executed.

Laffont and Martimort (2002, 159)'s approach is used, where $u(\underline{t}) = \underline{u}$ and $u(\overline{t}) = \overline{u}$. Equivalently, $\underline{t} = h(\underline{u})$ and $\overline{t} = h(\overline{u})$. This assures concavity in $[\overline{u},\ \underline{u}\,]$, since $h(.)$ is strictly convex.

S denotes the benefit the principal receive when the contract is executed. $S(\overline{q})$ and $S(\underline{q})$ is simplified to $\overline{S}$ and $\underline{S}$ respectively. The problem for the principal is then (6):

$$\max_{\{(\overline{u},\underline{u})\}} \pi_1\left(\overline{S} - h(\overline{u})\right) + (1-\pi_1)\left(\underline{S} - h(\underline{u})\right) \qquad (6)$$

subject to (2) and (3).

Solving the maximization problem (7) denoting λ and μ as the non-negative multipliers: (Appendix A)

$$\max_{\{(\overline{u},\underline{u})\}} \pi_1\left(\overline{S}-h(\overline{u})\right)+(1-\pi_1)\left(\underline{S}-h(\underline{u})\right)$$
$$+\lambda\left(\pi_1\overline{u}+(1-\pi_1)\underline{u}-\varphi+\theta\left(v_c+v_g\right)-\pi_0\overline{u}-(1-\pi_0)\underline{u}\right)$$
$$+\mu\left(\pi_1\overline{u}+(1-\pi_1)\underline{u}-\varphi+\theta\left(v_c+v_g\right)\right) \tag{7}$$

F.O.C. writes:

$$-\pi_1 h'\left(\overline{u}^{SB}\right)+\lambda\Delta\pi+\mu\pi_1=0 \tag{8}$$
$$-(1-\pi_1)h'\left(\underline{u}^{SB}\right)-\lambda\Delta\pi+\mu(1-\pi_1)=0 \tag{9}$$

Rearranging equation (8) and (9); in addition, use of previous definition yields:

$$\frac{1}{u'\left(\overline{t}^{SB}\right)}=\mu+\lambda\frac{\Delta\pi}{\pi_1} \tag{10}$$
$$\frac{1}{u'\left(\underline{t}^{SB}\right)}=\mu-\lambda\frac{\Delta\pi}{1-\pi_1} \tag{11}$$

In the parentheses, denominator on LHS, of equation (10) and (11) are the second best optimal transfers $\overline{t}^{SB}, \underline{t}^{SB}$.

The variables $\overline{t}^{SB}, \underline{t}^{SB}, \lambda\ and\ \mu$ are solutions to equation (2), (3), (10) and (11). Further, combining equation (10) and (11), results in an expression (12) which ascertains that participation constraint (3) is binding.

$$\mu=\frac{\pi_1}{u'\left(\overline{t}^{SB}\right)}+\frac{1-\pi_1}{u'\left(\underline{t}^{SB}\right)}>0 \tag{12}$$

Parameter λ needs to be strictly positive, and by combining equation (10) and (12), an expression with λ writes:

$$\lambda = \frac{\pi_1(1-\pi_1)}{\Delta\pi}\left(\frac{1}{u'\left(\bar{t}^{SB}\right)} - \frac{1}{u'\left(\underline{t}^{SB}\right)}\right) \qquad (13)$$

Since $\bar{u}^{SB} - \underline{u}^{SB} \geq \frac{\psi}{\Delta\pi} > 0$, which can be confirmed by rearranging the incentive constraint (2), thus, $\bar{t}^{SB} > \underline{t}^{SB}$ and the term within the brackets of equation (13) must be positive. In (13), the expression $\frac{\pi_1(1-\pi_1)}{\Delta\pi}$ is the principal's information problem. A crucial link can be drawn between the information problem and the incentive constraint (2). First, by looking at the rearranged incentive constraint $\bar{u}^{SB} - \underline{u}^{SB} \geq \frac{\psi}{\Delta\pi}$, one can observe that a smaller $\Delta\pi$ reduces the distance between $\bar{u}^{SB} - \underline{u}^{SB}$. When $\Delta\pi$ reduces, the information problem increases and for the principal it becomes harder to induce a high effort, as argued by (Laffont and Martimort 2002, 163): " …differences in utilities $\bar{u}^{SB} - \underline{u}^{SB}$ necessary to incentivize the agent gets larger".

Laffont and Martimort (2002, 160) reach also the following proposition, similar to what discussed in chapter 2.1:

> *When the agent is strictly risk averse, the optimal contract which induces effort saturates both the agent's participation constraint and incentive constraint. This contract does not provide full information.*

Since the contract does not provide full information, is there some second best transfers which induce the agent to a positive effort level.

From calculations, the corresponding second best transfers (14 and 15) writes: (Appendix B)

$$\bar{t}^{SB} = h(\bar{u}) = h\left(\varphi - \theta(v_c + v_g) + (1 - \pi_1)\left(\frac{\varphi - \theta(v_c + v_g)}{\Delta\pi}\right)\right) \qquad (14)$$

and,

$$\underline{t}^{SB} = h(\underline{u}) = h\left(\varphi - \theta(v_c + v_g) - \pi_1\left(\frac{\varphi - \theta(v_c + v_g)}{\Delta\pi}\right)\right) \qquad (15)$$

To better analyze the results one can specialize the model. Accordingly it is assumed that $h(u) = u + \frac{ru^2}{2}$, where $r > 0$ is a measure of the agent's degree of risk aversion. From the second best transfers one can now determine the principal's second best cost (19):

Define C_{CET}^{FB} and C_{CET}^{SB}, as respectively first best and second best cost expressions when only the agent exerts CET.

$$C^{SB} = \pi_1 \bar{t}^{SB} + (1 - \pi_1)\, \underline{t}^{SB} \qquad (16)$$

$$C^{SB} = \pi_1\left(\bar{u} + \frac{r\bar{u}^2}{2}\right) + (1 - \pi_1)\left(\underline{u} + \frac{r\underline{u}^2}{2}\right) \qquad (17)$$

Define $\alpha = \theta(v_c + v_g)$, which represent the agent's CET.

$$C_{CET}^{SB} = \pi_1\left(\varphi - \alpha + (1 - \pi_1)\frac{(\varphi - \alpha)}{\Delta\pi} + \frac{r\left(\varphi - \alpha + (1 - \pi_1)\frac{(\varphi - \alpha)}{\Delta\pi}\right)^2}{2}\right)$$
$$+ (1 - \pi_1)\left(\varphi - \alpha - \pi_1\frac{(\varphi - \alpha)}{\Delta\pi} + \frac{r\left(\varphi - \alpha - \pi_1\frac{(\varphi - \alpha)}{\Delta\pi}\right)^2}{2}\right) \qquad (18)$$

Rearrange (18), and insert for α yields (19): (Appendix C)

$$C_{CET}^{SB} = \varphi - \theta(v_c + v_g) + \frac{r\left(\varphi - \theta(v_c + v_g)\right)^2}{2} + \frac{r\left(\varphi - \theta(v_c + v_g)\right)^2 \pi_1(1 - \pi_1)}{2(\Delta\pi)^2} \tag{19}$$

From (19) it is clear that the principal's cost increases with the agent's risk aversion. In addition, the information problem, $\frac{\pi_1(1-\pi_1)}{\Delta\pi}$, induce some cost to the principal. This is already established knowledge in the contract theory literature. What is distinctive with (19) is that CET have a reducing effect on the principals cost, i.e. for a higher level of CET, the principal incurs less cost. This is simply because CET allows the principal to reduce his transfer to the agent. Looking at cost in the first best situation, this is even more clearly.

Since first best cost under full information is simply the agent's disutility $h(\varphi)$, first best cost is equal to (20):

$$C_{CET}^{FB} = \varphi - \theta(v_c + v_g) + \frac{r\left(\varphi - \theta(v_c + v_g)\right)^2}{2} \tag{20}$$

The whole information problem is gone, and for a risk neutral agent it is the agent's disutility (φ) and CET that determines first best cost.

From C_{CET}^{SB} (19) and C_{CET}^{FB} (20), the agency cost can be calculated:

$$AC^{complex} = C_{CET}^{SB} - C_{CET}^{FB} = \frac{r\left(\varphi - \theta(v_c + v_g)\right)^2 \pi_1(1 - \pi_1)}{2(\Delta\pi)^2} \tag{21}$$

From (21), one can observe what creates the agency cost: The level of risk aversion, to what extent the principal is able to verify the stochastic output, and the level of CET.

4.2.1. Implications of CET as an additional preference

From the model derivation we encounter several interesting findings; findings that clarify some of the initial questions, but also findings which raises new questions and guide us further in the process. The first evident limitation of this model is the difficulty to capture the mechanisms from a network in a model with only one principal and one agent. Nevertheless, our intention in this stage of the thesis is to identify agent behavior when additional properties are assigned, compared to the initial model. Considering the agent's utility function, it is obvious that for any positive intrinsic valuation of the network membership an agent will get increased utility for a positive effort level, as long as $\theta > 0$. Since the intrinsic preferences are linked to the initial effort level, CET are necessarily also a function of effort.

The effect from CET can be straight forward: CET have a dampening effect on disutility. A natural question arises: Is it necessary to model CET as an additional term in the utility function? Since CET are intrinsic preferences, it needs to be queried whether these value considerations are likely to be endowed to the agent, together with disutility. Accordingly, if the disutility parameter implicit capture this dampening effect per se. It can be argued that the answer is twofold. If you consider the network as a static network, and at the same time consider the dampening effect on disutility from network contribution as exogenous given and endowed to the agent, then the answer is no. Henrich et al. (2001) find from a series of behavioral economic experiments that economic preferences are much more likely to be shaped by day to day economic and social interactions, than being exogenous determined. Following Henrich et al. (2001)'s suggestions, the answer to the question above can in fact be yes. Since organizations exchange ties can shape own behavior (Gulati, Nohria, and Zaheer 2000), the size of θ in this case, it is more likely that CET need to be separated from disutility. Consequently, CET is dynamic, and takes into account a changing economic environment. However, CET is in the model considered as constants, thus it cannot change in any of the game sequences, unless this is specified.

Aligning this with Powell (1990)'s theory, our CET parameter, θ, can vary as the conflict resolution method in within the network change. Stronger CET treatment implies stronger intrinsic network valuation. Further, as the normative basis is more concerned with complementary strength and agent's become more interdependent, gain and contribution from and in the network will increase, v_g and v_c respectively. Speculating, this is presumably the case when the network gets more embedded and CET grows stronger. Following the same reasoning, our agent will have lower utility gain for the same actions as the network becomes weaker and provides less of a benefit to its members.

Comparing our findings with the initial model (22), it is clear that as long as the agent has emphasis on CET the principal has lower agency cost, given the same level of effort.

$$AC^{complex} = \frac{r\left(\varphi - \theta(v_c + v_g)\right)^2 \pi_1(1-\pi_1)}{2(\Delta\pi)^2} < \frac{r\varphi^2\pi_1(1-\pi_1)}{2(\Delta\pi)^2} = AC^{initial} \quad (22)$$

Accordingly, agency cost is decreasing as CET gets stronger (Appendix D):

$$\frac{\partial AC^{complex}}{\partial\theta} = -\frac{\pi_1(1-\pi_1)(v_c + v_g)r\left(\varphi - \theta(v_c + v_g)\right)}{\Delta\pi^2} < 0 \quad (23)$$

So far, we have established a more or less intuitive result in proposition one:

Proposition one: *If CET is treated as an additional preference, it yields a higher utility for a maximizing agent if* $\theta > 0$. *Everything else equal, CET reduces agency cost and improves the second best outcome.*

This result has additional implications important to our analysis. If the only effect is that agency cost is reduced, the principal extracts the whole material value emerging from the network, i.e. the reduced agency cost. This can be in conflict with the very fundamentals of embedded networks. One distinction is important to make however; it is not the lack of material reward in itself (additional transfers due to reduced agency cost) that breaks with reciprocity, but the lack of reciprocal behavior per se. Recall definition three, and how economics of reciprocity discuss how individuals no longer are concerned with purely selfish behavior. To clarify (Fehr and Gachter 2000, 160):

> *…in the case of reciprocity, the actor is responding to friendly or hostile actions even if no material gains can be expected.*

However, from the theoretical framework, the only possibility the principal has to award the agent, because of CET, is from an additional transfer, as a "bonus". When the principal extracts the whole benefit he is clearly a self-interested utility maximizing actor with no altruism at all. The fact that the principal is not allowed to reward the agent in the current model, guides us further in the analysis. In this sense, the model needs additional extensions to better reflect CET. We will now analyze a situation where the principal can in fact reciprocate towards the agent.

4.3. Extensions to the basic model: Bilateral complex exchange ties

In this section the same theoretical framework is used, but with some additional modifications. Bilateral CET is now considered. Both the principal and the agent are now allowed to increase their utility with CET. This is more likely to reflect the reality in embedded networks, since the mean of communication is relational, and actor preferences is argued to be interdependent (Powell 1990).
First of all, consider $AC^{complex}$ and $AC^{initial}$ from (22) which is the change in agency cost for the principal. This is straight forward and defined as:

$$\Delta_{AC} = AC^{initial} - AC^{complex} \tag{24}$$

Now, let us assume that if the principal is concerned with CET, he will act in a reciprocal manner towards the agent based on a constant sharing-rule ω. This, allows him to split the reduced agency cost with the agent. Further, for an altruistic principal $\omega = 1$, and for a self-interested principal $\omega = 0$. However, ω can also have intermediate values representing a principal ranging between self-interested and altruistic, preferring reciprocal actions accordingly. Sharing some of the saved agency cost with the agent, gives the principal additional utility if $\omega > 0$, and the transfer to the agent therefore becomes either $\underline{t} + \omega\Delta_{AC}$ or $\bar{t} + \omega\Delta_{AC}$.

If the principal has preferences of CET, then the following utility functions (25) and (26) applies, and he faces the following maximization problem (27):

$$V_1 = \pi_1(S(\bar{q}) - \bar{t}) + (1 - \pi_1)\left(S\left(\underline{q}\right) - \underline{t}\right) + \omega\Delta_{AC} \tag{25}$$

when $e = 1$, and

$$V_0 = \pi_0(S(\bar{q}) - \bar{t}) + (1 - \pi_0)(S\left(\underline{q}\right) - \underline{t}) \tag{26}$$

$$\max_{\{(\bar{u},\underline{u},)\}} \pi_1\left(\bar{S} - h(\bar{u})\right) + (1 - \pi_1)\left(\underline{S} - h(\underline{u})\right) + \omega\Delta_{AC} \tag{27}$$

subject to (2) and (3). The timing of the game is equivalent to the previous maximization problem.

Define $C^{SB}_{CET_B}$, as the cost second best expression for bilateral CET.

The corresponding new second best cost function writes (28):

$$C^{SB}_{CET_B} = \varphi - \theta(v_c + v_g) + \frac{r\left(\varphi - \theta(v_c + v_g)\right)^2}{2} + \frac{r\left(\varphi - \theta(v_c + v_g)\right)^2 \pi_1(1 - \pi_1)}{2(\Delta\pi)^2} + \omega\Delta_{AC} \tag{28}$$

We see from the maximization problem (27) that there will be no change to the explicit transfers needed to elicit effort from the agent, since F.O.C. (8 and 9) remains unchanged.

It is assumed that the principal ex post output realization can estimate his gain from CET. This allows him to observe his change in agency cost Δ_{AC} (calculated using expression (24)), which in the specialized model is equal to (29):

$$\Delta_{AC} = \frac{r\varphi^2\pi_1(1-\pi_1)}{2(\Delta\pi)^2} - \frac{r\left(\varphi-\theta(v_c+v_g)\right)^2\pi_1(1-\pi_1)}{2(\Delta\pi)^2} = \frac{r\left(\theta(v_c+v_g)\right)^2\pi_1(1-\pi_1)}{2(\Delta\pi)^2} \tag{29}$$

The *last term* on RHS of (29) indicates the cost reduction due to CET.

4.3.1. Implications of CET as an additional preference

From the expression below (30) one can observe that whether the agency cost is different from the initial model, depends on the principals' sharing rule ω.

$$AC^{complex} + \omega\Delta_{\text{AC}} = \frac{r\left(\varphi - \theta(v_c + v_g)\right)^2 \pi_1(1-\pi_1)}{2(\Delta\pi)^2}$$

$$+\omega\frac{r\left(\theta(v_c + v_g)\right)^2 \pi_1(1-\pi_1)}{2(\Delta\pi)^2} \leq \frac{r\varphi^2\pi_1(1-\pi_1)}{2(\Delta\pi)^2} = AC^{initial} \tag{30}$$

The optimal choice of the sharing-rule ω, depends on what type the principal really is; If he gets utility from CET or not. A self-interested principal will always have $\omega = 0$. As demonstrated in section 4.2.1, he can then extract the whole benefit emerging in the network. On the other hand, if the principal is completely altruistic he will have $\omega = 1$ for maximized utility. When $\omega = 1$ the agent will receive the principal's whole benefit from CET, i.e. all saved agency cost due to CET will be transferred to the agent. For an altruistic principal, comparing costs, the principal's material wellbeing is equal to what it is in the initial model, as shown below (31). From (25) one can see that his utility is higher, however.

$$\Delta_{\mathrm{AC}} - \omega\Delta_{AC} = \frac{r\left(\theta\left(v_c + v_g\right)\right)^2 \pi_1(1-\pi_1)}{2(\Delta\pi)^2} - \omega\frac{r\left(\theta\left(v_c + v_g\right)\right)^2 \pi_1(1-\pi_1)}{2(\Delta\pi)^2}$$

$$= \frac{r\left(\theta\left(v_c + v_g\right)\right)^2 \pi_1(1-\pi_1)}{2(\Delta\pi)^2}(1-\omega) \tag{31}$$

From expression (31), one can observe that $\Delta_{\mathrm{AC}} - \omega\Delta_{AC}$ is positive whenever $\omega < 1$. Hence, in a delegation situation where both the agent and principal have preference on CET; the following proposition can be inferred.

Proposition two: *From (31) we see that as long as the principal has $\omega < 1$, i.e. do not behave completely altruistic, there will be a Pareto improvement from CET since $AC^{complex} < AC^{initial}$, and neither the agent nor the principal are worse off.*

The subtle with this model analysis, is that the principal's cost and utility goes in opposite directions, but the principal will never be worse for any value of ω. If $\omega = 1$ there will be no efficiency gain, since the principal give away the whole benefit from CET. On the other hand, the full efficiency gain will be in the case of a self-interested principal, which give the following proposition:

Proposition three: *The social optimum occurs when the self-interested principal extracts the whole reduction in agency cost, when $\omega = 0$.*

An additional point to make is that a self-interested agent will never have anything to gain from mimicking CET. Recall the principal's benefit from CET:

$$\Delta_{AC} = \frac{r\left(\theta\left(v_c + v_g\right)\right)^2 \pi_1(1-\pi_1)}{2(\Delta\pi)^2} \tag{32}$$

If the agent mimics CET there will be no change in agency cost, hence $\Delta_{AC} = 0$. Consequently, the agent will not benefit from this, since $\omega\Delta_{AC} = 0$. This makes it evident that a self-interested agent can in fact crowd out a principal concerned with CET. Simply since $\omega\Delta_{AC} = 0$, even if $\omega > 0$.

Proposition four: *An agent without CET will crowd out a principal's CET.*

4.3.2. Implications of CET as external motivations from the economic environment

So far, the agent and the principal have unconditionally exerted CET, not depending on each other's type. Consider now instead the following scenario:

Both the principal and the agent can communicate their CET to each other. This is done by sending out a simple signal, which the other part can pick up. The signal contains information to what extent the actor is concerned with CET, but it is not binding neither to the principal nor the agent. In other words, committing to CET is voluntarily and reflects the actor's type and behavioral responses to the economic environment. We assume that the agent can increase his utility from CET; however his utility is conditioned on the principal's commitment to CET. If the principal does not commit to CET it will impose a disutility to the agent. However, if the principal commits to CET the agent will have a utility increase from CET. Hence, the agent is still a utility maximizing agent. However, he has a choice whether to exert CET or not based on the signal from the principal. We will not consider the corresponding adverse selection problem, but discuss the possibility where the agent finds the signal credible due to the economic environment, as discussed in (II) on page 13. The principal's preference to CET is initially unknown, but ω can be ≥ 0. Consider now the agent's utility function, and the according conditions:

$$U = u(t) - \varphi(e) + \theta(v_c + v_g)e \qquad (33)$$

Where,

$\theta \geq 0$, in (t=0)

However, in (t=5):

$\theta < 0$, if observed $\omega = 0$

$\theta > 0$, if observed $\omega > 0$

The following timing applies to this game:

(t=0): The principal offers the agent a contract with the transfers $\underline{t}$ and $\overline{t}$. (t=1): The agent accepts or refuses the contract. (t=2): The agent signals θ to the principal, and the principal signals ω to the agent. However, the principal's real ω is not yet observable to the agent. (t=3): The agent exerts an effort conditioned on the explicit contract. The agent needs to choose if he behaves according to CET or not, based on the signal from the principal in (t=2). (t=4): Outcome is realized. (t=5): The principal executes the contract with the transfer $\underline{t} + \omega\Delta_{AC}$ or $\overline{t} + \omega\Delta_{AC}$; the agent observes ω and gets a utility according to U, dependent on θ.

The agent's challenge is to determine the credibility of the signal he receives from the principal. Ex ante contract execution the agent can never be sure the principal will actually commit to CET. The principal can mimic CET to reduce his agency cost, hence take advantage of the agent's CET. Since CET is not a credible condition there is obviously a risk of moral hazard from the principal's side, now facing the agent. From section 4.2.1, we know that $AC^{complex} < AC^{initial}$ when the agent has preference on CET. Thus, it will always be optimal for the principal also to signal CET, no matter what type he is. If the principal mimics CET he can always extract the reduced agency cost, and the fair principal can on the other hand reward the agent, as discussed in the previous section. In other words, it is optimal to both a committing and mimicking principal to respond to the agent's signal with a positive ω. This reasoning is supported by Fehr and Schmidt (2000), which find evidence in their data on implicit versus explicit contractual choices.

Despite the credibility problem, "bonus contracts" with a voluntarily bonus payment is a familiar approach in behavioral economics (see (Fehr, Klein, and

Schmidt 2001). The reason can be, as discussed in (II); individuals' optimal behavior can be altered due to some external influence.

In section 4.2.1, the agent is more or less altruistic since he unconditionally reduces the principal's agency cost. Due to the uncertain credibility of the principal's signal, the agent is faced the question: Will the principal commit to CET? Related to the credibility problem, is the difficulty of governing CET. Kahneman, Knetsch, and Thaler (1986a)'s principle of how *dual entitlements*[1] govern community standards of fairness can guide us in this discussion. If we apply the principal, not to a reference transaction or reference profit but to reference behavior, this can explain how network form of organization can be governed. Also, the behavioral decisions made by economic agents. A history of CET practice can serve as a reference behavior in the community. Kahneman, Knetsch, and Thaler (1986a, 731) state that:

> *…people expect a substantial level of conformity to community standards – and also that they adapt their views of fairness to the norms of actual behavior.*

Consequently, pro-social behavior can function as a norm which actors expect and behave according to. In this sense, principals concerned with CET need to be present, before behavior according to such preferences is considered as a norm. As shortly commented in section 2.3, the presence of fair principals is to a large extent confirmed by experimental research. Fehr and Schmidt (2000, 1058) state that:

> *First of all, and most importantly, the presence of fair principals implies that the promised bonus does not merely represent cheap talk because fair principals can and do in fact condition the bonus payment on the effort level.*

[1] *"A firm is not allowed to increase its profits by arbitrarily violating the entitlement of its transactors to the reference price, rent or wage" (Kahneman, Knetsch, and Thaler 1986a, 729-730).*

Further, Akerlof (1980) shows how fair wages can explain involuntarily unemployment, i.e. how social customs which is not necessarily individually optimal will sustain, if the damage from possible reputational consequences is severe enough. Akerlof (1980)'s findings might explain how the reputational concerns can sustain the code of behavior in embedded networks.

Aligning this with the governing mechanisms in networks form of economic organization from table 1, reputational concerns and reciprocal actions, it can be argued that the agent is likely to believe that the principal signal his real behavior, thus he will commit to CET with $\omega > 0$. Generalizing Larson (1992, 98)'s statement on entrepreneurial network dyads, can underpin this inference:

> *They were governed in important ways by social controls arising from norms of trust and reciprocity. Governance was explained in large part by understanding the subtle control of interdependent and self-regulated players engaged in and committed to mutual gains. An explanation of governance is captured by certain aspects of institutional theory that acknowledge patterned histories of interaction that create mutual expectations.*

Another possibility is that a self-interested principal will crowd-out agent's with CET. Fehr and Schmidt (2000) show that this can be the case when the economic environment consists of both fair and un-fair actors. It turns out that fair agent's are afraid that the principals will not commit to the implicit contract. Therefore, they choose an effort level no higher than needed to fulfill the explicit contract. From the agent's utility function (33) and according conditions, it will then be optimal for the agent to choose $\theta = 0$ in (t=2).

The two arguments create a possibility where implicit contracts also can too be founded on the social norm in the economic environment, and is less likely to have an effect in isolated cases. In particular, Fehr and Schmidt (1999) shows that the strategic economic environment and the distribution of preferences is important to the outcome. If a fraction of the members care for fair outcomes it can crowd in such considerations to other, and in some cases to all, actors in the environment – just as fair preferences can be crowded out by self-interest. In this sense, it can be argued that CET emerging in embedded networks can be modeled as an implicit argument, and still have an effect on the outcome. This reasoning depends on the idea that the strategic economic environment can in fact alter individual behavior. Accordingly, despite the risk of moral hazard which will result in a lower utility, the agent exerts CET.

Conjecture one: *The presence of network members with CET can establish such preferences as a social norm, and thereby induce the agent to behave according to CET preferences.*

Contrasting the outcomes from the previous model specifications in section 4.3.1, we see it is harder to achieve Pareto-improvements in the latter. Also that such improvements rest on behavioral judgments that are not considered optimal for the mainstream economic actor.

Proposition five: *When conjecture one applies, proposition two is valid if* $\omega > 0$.

However, if the principal has no preference to CET, despite the social norm, we observe from (33) that CET will make the agent worse off than compared to the initial model. Consequently, since $\omega = 0$ and $\theta < 0$.

Proposition six: *If conjecture one is valid, the agent is worse off with CET preferences if* $\omega = 0$*, and the principal's self-interests is consequently Pareto-damaging.*

4.4. Two periods and punishment

In this part of the analysis we take into account fully reciprocal actions, as stated in definition three; the fact that a reciprocal agent is willing to punish unfair behaviour. The following discussion also applies to (III) in our thesis objective; that individuals optimize according to the consequences of a possible punishment due to behavioural deviations. This reasoning follows equilibrium strategy specifications in game theory; where a deviation from equilibrium will be punished – accordingly, a potential punishment deter such behavior (Sobel 2005). However, due to definition three in the thesis objective, a crucial behavioral assumption is that a punishment will occur even if it is not a multiple equilibrium outcome.

In the case of a mimicking principal, the agent will be willing to forego some material wealth to punish the principal. It is assumed that the agent will not have a utility from punishing the principal; his behaviour judgement is now based on reciprocity. In other words, the agent will punish the principal despite the fact that this is costly to him. Contrasted to a pure utility maximizing agent, this punishment will never be optimal. Due to the timing of the game, the only opportunity the agent has to punish the principal is in a later period. Therefore, a two period game is now considered. It is assumed that the principal has no outside options during the two periods. This is perhaps an unrealistic assumption, but it can also reflect that organizing economic activity in embedded networks make the total and individual output dependent on the network's distribution of asset-specific know-how. Not having access to the network's know-how anymore can, practically speaking, limits the production possibility set. Also, one can argue that such an assumption is realistic, based on Powel (1990, 305)'s statement:

> *Parties to network forms of exchange have lost some of their ability to dictate their own future and are increasingly dependent on the activities of others.*

An additional assumption is that the agent needs to verify the principal's commitment to CET. Again, due to the model setup, the only way the principal can commit to CET is by sharing some of the saved agency cost. It is assumed that agency cost is private information to the principal. A problem is now the agent's unawareness of the actual agency cost. Due to this uncertainty, the agent will not necessarily succeed to reveal a principal that mimics CET. It is assumed that this uncertainty only applies when the principal mimics CET. Therefore, the principal does not face the possibility of being wrongly punished in a later period. This assumption is based on the following reasoning: A principal with CET will be more transparent in his information handling, compared to a self-interested principal. Thus, a principal with CET want to share his private information, like agency cost, with the agent. However, this is not something the principal is obligated to do. Therefore, the agent cannot assume that a principal with CET will do this. However, it should be in the CET concerned principal's interest to do so; to secure the possible benefits from CET. Consequently, the agent will recognize a committing principal if he observes one, however he do not know this ex ante.

According to definition two, the strength of the CET is still considered as dynamic. A more embedded network yields stronger CET, however CET remain constant during the game. Uzzi (1997) finds that a higher level of embeddedness facilitate more fine grained information transfers between economic actors. Such fine-grained information is claimed to be more detailed, tacit and holistic than price data. Due to this, we assume that for more fine-grained information transfers, it is easier for the agent to estimate the principal's agency cost. Consequently, the agent is more likely to determine the principal's agency cost as the network become more embedded, and vice versa. To reflect this in the analysis, we assume that the principal is faced with a probability whether the agent will be able to determine his agency cost or not. If the agent can determine the agency cost he will be able to reveal the principal's real type. It is therefore assumed; when the principal mimics CET the agent will reveal his type with the probability ρ. Based on the discussions above we assume that a more embedded network increases the probability ρ.

In addition, the agent has a perception of what is fair behavior. From experimental research with ultimatum game, it is evident that there is usually some minimum level which the participant considers as fair. Translating this into our setting, the principal cannot choose a positive but neglectable low ω to satisfy CET. Further, the size of ω, or the level of commitment to CET from the principal, needs to be perceived as fair from the agent's point of view. The agent can signal this perceived level to the principal. We define this as the *minimum fairness constraint* $\frac{1}{\beta}$, where $\beta > 0$ (34). Hence, $\frac{1}{\beta}$ gives the minimum value of the sharing rule ω, which the agent will consider as a commitment to CET. The *minimum fairness constraint* writes:

$$\omega \geq \frac{1}{\beta} > 0, \text{ where } \beta > 0 \tag{34}$$

The following analysis applies to the case when an agent with CET preferences is faced with a self-interested principal. Since a principal committing to CET will never be subject to punishment, this is not relevant to analyse.

Consider again the principal's initial utility functions:

$$V_1 = \pi_1(S(\overline{q}) - \overline{t}) + (1 - \pi_1)\left(S\left(\underline{q}\right) - \underline{t}\right) \tag{35}$$

and,

$$V_0 = \pi_0(S(\overline{q}) - \overline{t}) + (1 - \pi_0)(S\left(\underline{q}\right) - \underline{t}) \tag{36}$$

If the self-interested principal commits to CET his utility will instead be $V_1 + \Delta_{AC}(1 - \omega)$, if we isolate Δ_{AC} from $\overline{t}$ and $\underline{t}$. The principal's net benefit from CET is $\Delta_{AC}(1 - \omega)$ since he only obtains increased utility from the material benefit, not from acting fair per se, like in chapter 4.3.

The agent's utility function is:

$$U = u(t) - \varphi(e) + \theta\left(v_c + v_g\right)e \tag{37}$$

Where,

$\theta \geq 0$, in (t=0)

However, in (t=5) period one:

$\theta < 0$, if observed $\omega\Delta_{AC} = 0$

$\theta > 0$, if observed $\omega\Delta_{AC} > 0$

The agent will have the same utility in period two as in the end of period one. This makes the incentive feasible contract more costly to the principal if $\theta < 0$.

The new element in this part, as discussed above, is that the principal can be punished by the agent's reciprocal behavior. A punishment has the following consequences: The agent will punish the principal in the second period. The only way the agent can punish the principal is to deliberately play the zero-effort game, despite the incentive feasible contract offers. Therefore, the principal is faced with the problem if he should mimic or commit to CET.

Consider now the following timing of this game:

Period one:

(t=0): The principal offers the agent a contract with the possible transfers $\underline{t}$ and $\overline{t}$. (t=1): The agent accepts or refuses the contract. (t=2): The agent exerts an effort. (t=3): Outcome is realized. (t=4): The principal executes the contract with the transfer $\underline{t} + \omega\Delta_{AC}$ or $\overline{t} + \omega\Delta_{AC}$ if he commits to CET, or $\underline{t}$ or $\overline{t}$ if he mimic's CET. (t=5): The agent learns the principal's type if he commits. If the principal mimics, the agent reveal his type with the probability ρ.

Period two:

(t=0): The principal offers the agent the same incentive feasible contract with the transfers $\underline{t}$ and $\overline{t}$. (t=1): The agent accepts or refuses the contract. (t=2): The agent decides whether to exert CET or punish the principal, based on (t=5) in period one. The agent exerts an effort conditioned on (t=2) period two. (t=3): Outcome is realized. (t=4): The principal executes the contract with the transfer $\underline{t} + \omega\Delta_{AC}$ or $\overline{t} + \omega\Delta_{AC}$ if he commits to CET, or only $\underline{t}$ or $\overline{t}$ if he mimics CET.

The principal is still maximizing his problem, (6), w.r.t. (2) and (3), but in addition he needs to decide whether he should commit to CET or not in (t=4) period one. In other words, the principal want to maximize the discounted sum of two single period payoffs. Consequently the principal will choose the outcome which gives him the highest expected value over both periods. We assume that the consequence of his actions, choice of $\omega\Delta_{AC}$, on the agent's utility function is public information. The principal will commit to CET if this gives him a higher value than if he mimics CET. In formal terms, if:

$$V^{mimick} < V^{commit} \qquad (38)$$

If the principal decides to mimic CET his value function (39) writes as follow:

$$V^{mimick} = \rho(V_1 + \Delta_{AC} + \sigma V_0) + (1-\rho)\big((1+\sigma)(V_1 + \Delta_{AC})\big) \qquad (39)$$

The principal will be revealed with the probability ρ. If this is the case, the principal will in the first period obtain the utility $V_1 + \Delta_{AC}$. However, in the next period the agent are willing to forego some material value to punish the principal due to his unfair behavior. To punish the principal the agent deliberately plays the zero-effort game in the next period, despite his incentive feasible contract offers. Denoting the principals discount factor with $\sigma = \frac{1}{1+r}$, where r is the discount rate, gives the principal a utility of σV_0 in the following period. On the other hand, the agent does not succeed in revealing the principal's type with the probability $(1-\rho)$, and the principal receives V_1 $+\Delta_{AC}$ in both periods.

4.4.1. Commitment in two periods

We discuss the principal's choice based on two different scenarios. First, we consider a case where the principal will commit to CET in both periods, before we in the next subsection inquire commitment only in one period.

If the principal commits to CET he will receive utility from V_1 in addition to his net benefit from CET, $\Delta_{AC}(1-\omega)$, in both periods: Denoting V^{commit_2}, as committing in both periods.

$$V^{commit_2} = \big(V_1 + \Delta_{AC}(1-\omega)\big)(1+\sigma) \tag{40}$$

Based on inequality (38), it is optimal for the principal to commit to CET if (39) < (40):

$$\rho(V_1 + \Delta_{AC} + \sigma V_0) + (1-\rho)\big((1+\sigma)(V_1 + \Delta_{AC})\big) < \big(V_1 + \Delta_{AC}(1-\omega)\big)(1+\sigma) \tag{41}$$

Solve inequality (41) w.r.t. ω yields (42): (Appendix E)

$$\omega < \frac{\rho}{\Delta_{AC}} \frac{\sigma}{(1+\sigma)} (V_1 + \Delta_{AC} - V_0) \tag{42}$$

Since a self-interested principal will never choose a higher ω than strictly necessary we can consider (34) with equality, thus we get:

$$\frac{1}{\beta} < \frac{\rho}{\Delta_{AC}} \frac{\sigma}{(1+\sigma)} (V_1 + \Delta_{AC} - V_0) \tag{43}$$

From (43) it is clear that the principal will commit to CET, if the share of saved agency cost he needs to forgo is lower than the probability weighted loss from being punished relative to the saved agency cost. His expected payoff is then (40), and his net benefit from the agent's CET is $\Delta_{AC}(1+\sigma)(1-\omega)$.

Proposition seven: *The principal commits to CET if the minimum-fairness constraint is less costly than the expected loss from punishment.*

We see from (43), that a higher level of embeddedness in the network, consequently also a higher probability ρ, will increase the RHS. This because more fine-grained information transfers make it more likely that the agent will be able to revile his type, hence the probability weighted loss becomes larger. We see from (44) that this can induce the principal to commit to CET since the RHS side of (43) increase with ρ (Appendix F).

$$\frac{\partial}{\partial \rho}\left(\frac{\rho}{\Delta_{AC}}\frac{\sigma}{1+\sigma}(V_1+\Delta_{AC}-V_0)\right)=\frac{\sigma(\Delta_{AC}+V_1-V_0)}{\Delta_{AC}(1+\sigma)}>0 \qquad (44)$$

On the other hand, from (45) it is clear that there is a negative relationship between saved agency cost and the principal's willingness to commit to CET. This can be explained from the fact that the more the principal saves in agency cost today, the more he is willing to accept a punishment tomorrow. From (45) it is evident that the expected loss relative to the saved agency cost decreases and make it less attractive to commit to CET (Appendix F).

$$\frac{\partial}{\partial \Delta_{AC}}\left(\frac{\rho}{\Delta_{AC}}\frac{\sigma}{1+\sigma}(V_1+\Delta_{AC}-V_0)\right)=-\frac{\rho\sigma(V_1-V_0)}{\Delta_{AC}(1+\sigma)}<0 \qquad (45)$$

A present oriented principal put weight on the future happenings with a low discount factor. On the other side, a future oriented principal will put weight on the future happenings with a high discount factor. Thus, for an increasing discount factor the principal puts more weight on the possible loss due to the punishment from the agent. From (46) we see that a higher discount factor can induce the principal to commit to CET (Appendix F).

$$\frac{\partial}{\partial \sigma}\left(\frac{\rho}{\Delta_{AC}}\frac{\sigma}{1+\sigma}(V_1+\Delta_{AC}-V_0)\right)=\frac{\rho(V_1+\Delta_{AC}-V_0)}{\Delta_{AC}(1+\sigma)^2}>0 \qquad (46)$$

One can also observe from (43) that a bigger difference between $V_1+\Delta_{AC}$ and V_0, i.e. a more painful punishment, makes it more attractive for the principal to commit to CET, since the RHS of (43) increases.

4.4.2. Commitment in one period

Now, let's allow the principal to change his choice from period one to period two. Intuitively, this should be desirable to the principal since he can in period two mimic CET without the risk of facing any punishment from the agent.

In this case, the principal faces the following value function (47) from committing to CET: Denoting V^{commit_1}, as committing in one period.

$$V^{commit_1} = V_1(1+\sigma) + \Delta_{AC}\big((1-\omega) + \sigma\big) \tag{47}$$

Now the inequality $V^{mimic} < V^{commit_1}$ writes (39) < (47):

$$\rho(V_1 + \Delta_{AC} + \sigma V_0) + (1-\rho)\big((1+\sigma)(V_1 + \Delta_{AC})\big) < V_1(1+\sigma) + \Delta_{AC}\big((1-\omega) + \sigma\big) \tag{48}$$

Solve the inequality (48) w.r.t. ω yields (49): (Appendix G)

$$\omega < \frac{\rho\sigma}{\Delta_{AC}}\big(V + \Delta_{AC_1} - V_0\big) \tag{49}$$

With the *minimum fairness constraint* (34):

$$\frac{1}{\beta} < \frac{\rho\sigma}{\Delta_{AC}}(V_1 + \Delta_{AC} - V_0) \tag{50}$$

If (50) holds, his expected payoff is (47), and his net benefit from the agent's CET is $\Delta_{AC}(1+\sigma) - \omega\Delta_{AC}$. Propositions seven and the discussed effects of changes in Δ_{AC}, ρ and σ applies also to (50).

From (51) we see what is also intuitive, that the value of commitment is larger in the case where the principal is allowed to change his type from period one to period two, hence $V^{commit_1} > V^{commit_2}$, simply because he extracts the whole benefit from CET in period two.

$$V_1(1+\sigma) + \Delta_{AC}\big((1-\omega) + \ \sigma\big) > \big(V_1 + \Delta_{AC}(1-\omega)\big)(1+\sigma) \qquad (51)$$

When comparing (43) and (50) in (52) we find that; if the principal is allowed to commit only in the first period and then mimics in the second period, it is more probable that he in fact will commit in period one. This, because he expects a higher payoff in period two than if he commits only in one period, compared to committing in both. Due to this, the net loss from the agent's punishment is more severe. So, to secure $V_1 + \Delta_{AC}$ in the second period he commits in period one if (50) holds.

$$\frac{\rho}{\Delta_{AC}}\frac{\sigma}{1+\sigma}(V_1 + \Delta_{AC} - V_0) < \ \frac{\rho\sigma}{\Delta_{AC}}(V_1 + \Delta_{AC} - V_0) \qquad (52)$$

From the analysis we can infer that a utility maximizing principal can always mimic CET in the second period. Thus, the agent has only the ability to affect the principal's behavior in the first period. However, as discussed in section 4.3.2, the principal can be induced to behave according to CET due to some external motivations.

Proposition eight: *A punishment from the agent can induce the principal to commit to CET in the first period only.*

5. Conclusion

In this thesis, we combine fundamental behavioural assumptions in network form of economic organization and a principal-agent model framework. We use theory from both mainstream economics and behavioural economics, to compare and contrast the possible outcomes. From behavioural economics two different approaches is used: We model extra preferences in the utility functions and discuss possible deviations from what would usually be optimal behaviour due to some external motivation.

Extending the initial model framework, according to the definitions of CET, we find that agency-problems in network form of economic organization yield improved second-best outcomes. Compared to what the initial model yields in a traditional market transaction, incorporating additional psychological mechanisms can make the model more applicable to embedded networks. Improved second best outcomes are first and foremost due to the prevailing mechanisms in embedded networks: Social preferences, interdependences and influence of social norms. Aligning our results, we see that it becomes harder to obtain improved second-best results as we move from independent to interdependent preferences. The case with the least possible improved outcomes is when the economic environment can influence the agent's behaviour. In addition, we see that the agent's possible influence on the principal's preference for CET is not straight forward, and is likely to be limited.

Our results show that extra modelling can in fact improve the outcome of the coordination problem, however one need to be aware of several shortcomings. Following our approach, it is more or less possible to model in various aspects, as long as you have a sound argument to do so. This reduces the validity of such an analysis. Also, to what extent our results are verifiable through statistical testing is debatable. We generalize quite complex psychological and behaviour mechanisms into a few variables, which probably make it difficult to reproduce the outcome with other methods. Another limitation concerning our analysis is the fact that we only use two possible effort levels, 0 and 1. An "extra" effort due to social preferences is perhaps more likely to reflect reality, and is more consistent with general findings in behavioural economics. We made a decision to use two effort levels because of the mathematical and conceptual complexity of an analysis with continuous effort levels. From the perspective in this thesis, few negative aspects of embedded networks have been considered. In particular, one feature of embedded networks is important to economic analysis: Uzzi (1996)'s finding that there exists some threshold. Surpassing this, negative returns can emerge from the network, which in turn undermine the discussed benefits in embedded networks.

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Appendix A

Calculations related to the principals maximization problem:

F.O.C. writes the following:

$$-\pi_1 h'\left(\overline{u}^{SB}\right) + \lambda\Delta\pi + \mu\pi_1 = 0$$

$$-(1-\pi_1)h'\left(\underline{u}^{SB}\right) - \lambda\Delta\pi + \mu(1-\pi_1) = 0$$

Rearrange the F.O.C. yields:

$$\frac{1}{u'\left(\overline{t}^{SB}\right)} = \mu + \lambda\frac{\Delta\pi}{\pi_1} \quad (1)$$

$$\frac{1}{u'\left(\underline{t}^{SB}\right)} = \mu - \lambda\frac{\Delta\pi}{1-\pi_1} \quad (2)$$

Multiplying equation (1) with π_1, and (2) with $(1-\pi_1)$:

$$\pi_1\frac{1}{u'\left(\overline{t}^{SB}\right)} = \mu\pi_1 + \lambda\Delta\pi \quad (3)$$

$$(1-\pi_1)\frac{1}{u'\left(\underline{t}^{SB}\right)} = \mu(1-\pi_1) - \lambda\Delta\pi \quad (4)$$

Combining equation (3) and (4), and solving for μ:

$$\mu = \frac{\pi_1}{u'\left(\overline{t}^{SB}\right)} + \frac{1-\pi_1}{u'\left(\underline{t}^{SB}\right)} > 0 \quad (5)$$

Finding an expression for λ with use of equation (5), inserted for μ, in either (1) or (2):

$$\frac{1}{u'\left(\overline{t}^{SB}\right)} = \frac{\pi_1}{u'\left(\overline{t}^{SB}\right)} + \frac{1-\pi_1}{u'\left(\underline{t}^{SB}\right)} + \lambda\frac{\Delta\pi}{\pi_1} \quad (6)$$

Rearrange equation (6) and multiply with π_1, and solving for λ:

$$\lambda\Delta\pi = \pi_1\frac{1-\pi_1}{u'\left(\overline{t}^{SB}\right)} - \pi_1\frac{1-\pi_1}{u'\left(\underline{t}^{SB}\right)}$$

$$\lambda = \frac{\pi_1(1-\pi_1)}{\Delta\pi}\left(\frac{1}{u'\left(\overline{t}^{SB}\right)} - \frac{1}{u'\left(\underline{t}^{SB}\right)}\right)$$

Appendix B

Calculating the expressions for $\bar{t}^{SB}$ *and* $\underline{t}^{SB}$:

Incentive constraint:

$$\pi_1\bar{u} + (1-\pi_1)\underline{u} - \varphi + \theta(v_c + v_g) \geq \pi_0\bar{u} + (1-\pi_0)\underline{u} \quad (1)$$

Participation constraint:

$$\pi_1\bar{u} + (1-\pi_1)\underline{u} - \varphi + \theta(v_c + v_g) \geq 0 \quad (2)$$

Solving for $\bar{u}$, using the incentive constraint (1):

$$\pi_1\bar{u} - \pi_0\bar{u} - \pi_1\underline{u} + \pi_0\underline{u} - \varphi + \theta(v_c + v_g) = 0$$

$$\Delta\pi\bar{u} - \Delta\pi\underline{u} - \varphi + \theta(v_c + v_g) = 0$$

$$\bar{u} = \frac{\varphi - \theta(v_c + v_g)}{\Delta\pi} + \underline{u} \quad (3)$$

Inserting $\bar{u}$, into the participation constraint (2):

$$\pi_1\left(\frac{\varphi - \theta(v_c + v_g)}{\Delta\pi} + \underline{u}\right) + (1-\pi_1)\underline{u} - \varphi + \theta(v_c + v_g) = 0$$

Define: $\alpha = \varphi - \theta(v_c + v_g)$

$$\pi_1\left(\frac{\alpha}{\Delta\pi} + \underline{u}\right) + (1-\pi_1)\underline{u} - \alpha = 0$$

Multiplying with $\Delta\pi$, and solving for $\underline{u}$:

$$\pi_1\alpha + \Delta\pi\pi_1\underline{u} + \Delta\pi(1-\pi_1)\underline{u} - \Delta\pi\alpha = 0$$

$$\pi_1\alpha + \Delta\pi\underline{u} - \Delta\pi\alpha = 0$$

$$\underline{u} = \alpha - \pi_1\frac{\alpha}{\Delta\pi} \quad (4)$$

Inserting for $\underline{u}$ into (3), and solve for $\bar{u}$:

$$\bar{u} = \frac{\alpha}{\Delta\pi} + \alpha - \pi_1\frac{\alpha}{\Delta\pi}$$

$$\bar{u} = \alpha + (1-\pi_1)\frac{\alpha}{\Delta\pi} \quad (5)$$

Final expressions, inserted for α into (4) and (5), based on defined concepts ($u(\underline{t}) = \underline{u}$ and $u(\overline{t}) = \overline{u}$. Equivalently $\underline{t} = h(\underline{u})$ and $\overline{t} = h(\overline{u}$)) yields:

$$\overline{t}^{SB} = h\left(\varphi - \theta(v_c + v_g) + (1 - \pi_1)\left(\frac{\varphi - \theta(v_c + v_g)}{\Delta\pi}\right)\right)$$

$$\underline{t}^{SB} = h\left(\varphi - \theta(v_c + v_g) - \pi_1\left(\frac{\varphi - \theta(v_c + v_g)}{\Delta\pi}\right)\right)$$

Appendix C

Calculating the second best cost expression:

Assume that $h(u) = u + \frac{ru^2}{2}$. Further, inserted for expressions $\bar{t}^{SB}$ and $\underline{t}^{SB}$ (Appendix B) and definition that $\alpha = \varphi - \theta(v_c + v_g)$, the cost second best function writes:

$$C_{CET}^{SB} = \pi_1 h\left(\alpha + (1-\pi_1)\frac{\alpha}{\Delta\pi} + \frac{r\left(\alpha + (1-\pi_1)\frac{\alpha}{\Delta\pi}\right)^2}{2}\right) + (1-\pi_1)h\left(\alpha - \pi_1\frac{\alpha}{\Delta\pi} + \frac{r\left(\alpha - \pi_1\frac{\alpha}{\Delta\pi}\right)^2}{2}\right)$$

$$C_{CET}^{SB} = \alpha + \pi_1\frac{r\left(\alpha + (1-\pi_1)\frac{\alpha}{\Delta\pi}\right)^2}{2} + (1-\pi_1)\frac{r\left(\alpha - \pi_1\frac{\alpha}{\Delta\pi}\right)^2}{2}$$

$$C_{CET}^{SB} = \alpha + \frac{\pi_1 r\alpha^2}{2} + \frac{\pi_1 r\big((1-\pi_1)\alpha\big)^2}{2(\Delta\pi)^2} + \frac{r\alpha^2}{2} + \frac{r(-\pi_1\alpha)^2}{2(\Delta\pi)^2} - \frac{\pi_1 r\alpha^2}{2} - \frac{\pi_1 r(-\pi_1\alpha)^2}{2(\Delta\pi)^2}$$

$$C_{CET}^{SB} = \alpha + \frac{r\alpha^2}{2} + \pi_1\frac{r\alpha^2}{2(\Delta\pi)^2} + \pi_1\frac{r(-\pi_1\alpha)^2}{2(\Delta\pi)^2} - \pi_1\frac{r(-\pi_1\alpha)^2}{2(\Delta\pi)^2} + \frac{r(-\pi_1\alpha)^2}{2(\Delta\pi)^2}$$

$$C_{CET}^{SB} = \alpha + \frac{r\alpha^2}{2} + \pi_1\frac{r\alpha^2}{2(\Delta\pi)^2} + \frac{r(-\pi_1\alpha)^2}{2(\Delta\pi)^2}$$

$$C_{CET}^{SB} = \alpha + \frac{r\alpha^2}{2} + \frac{r\alpha^2\pi_1(1-\pi_1)}{2(\Delta\pi)^2}$$

Final expression cost second best inserted for α writes:

$$C_{CET}^{SB} = \varphi - \theta(v_c + v_g) + \frac{r\left(\varphi - \theta(v_c + v_g)\right)^2}{2} + \frac{r\left(\varphi - \theta(v_c + v_g)\right)^2\pi_1(1-\pi_1)}{2(\Delta\pi)^2}$$

Appendix D

Derivation of $AC^{complex}$ w.r.t. θ:

$$AC^{complex} = \frac{r\left(\varphi - \theta\left(v_c + v_g\right)\right)^2 \pi_1(1-\pi_1)}{2(\Delta\pi)^2}$$

$$\frac{\partial AC^{complex}}{\partial\theta} = \frac{r\left(\varphi - \theta\left(v_c + v_g\right)\right)^2 \pi_1(1-\pi_1)}{2(\Delta\pi)^2} = 0$$

Solving the derivation problem:

$$\frac{2r\left(\varphi - \theta\left(v_c + v_g\right)\right) * -\left(v_c + v_g\right) * \pi_1(1-\pi_1) * 2(\Delta\pi)^2 - u * 0}{(2(\Delta\pi)^2)^2}$$

Final expression:

$$\frac{\partial AC^{complex}}{\partial\theta} = -\frac{\pi_1(1-\pi_1)\left(v_c + v_g\right)r\left(\varphi - \theta\left(v_c + v_g\right)\right)}{\Delta\pi^2} < 0$$

Appendix E

Solving the principals optimal ω with use of the inequality $V^{mimick} < V^{commit_2}$:

The principal's value functions with mimicking CET and committing CET:

$$V^{mimick} = \rho(V_1 + \Delta_{AC} + \sigma V_0) + (1-\rho)\big((1+\sigma)(V_1 + \Delta_{AC})\big)$$

$$V^{commit_2} = \big(V_1 + \Delta_{AC}(1-\omega)\big)(1+\sigma)$$

Solving ω:

$$\rho(V_1 + \Delta_{AC} + \sigma V_0) + (1-\rho)\big((1+\sigma)(V_1 + \Delta_{AC})\big) < \big(V_1 + \Delta_{AC}(1-\omega)\big)(1+\sigma)$$

Dividing with $(1+\sigma)$:

$$\frac{\rho(V_1 + \Delta_{AC} + \sigma V_0)}{(1+\sigma)} + (1-\rho)(V_1 + \Delta_{AC}) < \big(V_1 + \Delta_{AC}(1-\omega)\big)$$

Multiplying out the parentheses and moving ω to the LHS:

$$\Delta_{AC}\omega < \rho V_1 + \rho\Delta_{AC} - \frac{\rho(V_1 + \Delta_{AC} + \sigma V_0)}{(1+\sigma)}$$

Factor out ρ and $(1+\sigma)$. In addition, dividing with Δ_{AC} final expression writes:

$$\omega < \frac{\rho}{\Delta_{AC}}\frac{\sigma}{(1+\sigma)}(V_1 + \Delta_{AC} - V_0)$$

Appendix F

Derivation of expression related to chapter 4:

Derivation w.r.t. ρ:

$$\frac{\partial}{\partial\rho}\left(\frac{\rho}{\Delta_{AC}}\frac{\sigma}{(1+\sigma)}(V_1+\Delta_{AC}-V_0)\right)=0$$

$$\frac{\sigma(V_1+\Delta_{AC}-V_0)*\Delta_{AC}(1+\sigma)-\rho\sigma(V_1+\Delta_{AC}-V_0)*0}{\left(\Delta_{AC}(1+\sigma)\right)^2}=0$$

$$\frac{\partial}{\partial\rho}=\frac{\sigma(\Delta_{AC}+V_1-V_0)}{\Delta_{AC}(1+\sigma)}>0$$

Derivation w.r.t. Δ_{AC}:

$$\frac{\partial}{\partial\Delta_{AC}}\left(\frac{\rho}{\Delta_{AC}}\frac{\sigma}{(1+\sigma)}(V_1+\Delta_{AC}-V_0)\right)=0$$

$$\frac{\rho\sigma*\Delta_{AC}(1+\sigma)-\rho\sigma(V_1+\Delta_{AC}-V_0)*(1+\sigma)}{\left(\Delta_{AC}(1+\sigma)\right)^2}=0$$

$$\frac{\partial}{\partial\Delta_{AC}}=-\frac{\rho\sigma(V_1-V_0)}{\Delta_{AC}(1+\sigma)}<0$$

Derivation w.r.t. σ:

$$\frac{\partial}{\partial\sigma}\left(\frac{\rho}{\Delta_{AC}}\frac{\sigma}{(1+\sigma)}(V_1+\Delta_{AC}-V_0)\right)=0$$

$$\frac{\rho(V_1+\Delta_{AC}-V_0)*\Delta_{AC}(1+\sigma)-\rho\sigma(V_1+\Delta_{AC}-V_0)*\Delta_{AC}}{\left(\Delta_{AC}(1+\sigma)\right)^2}=0$$

$$\frac{\partial}{\partial\sigma}=\frac{\rho(V_1+\Delta_{AC}-V_0)}{\Delta_{AC}(1+\sigma)^2}>0$$

Appendix G

Solving the principal's optimal ω, with use of the inequality $V^{mimick} < V^{commit_1}$:

The principal's value functions with mimicking CET, and change in period two committing CET:

$$V^{mimick} = \rho(V_1 + \Delta_{AC} + \sigma V_0) + (1-\rho)\big((1+\sigma)(V_1 + \Delta_{AC})\big)$$

$$V^{commit_1} = V_1(1+\sigma) + \Delta_{AC}\big((1-\omega) + \sigma\big)$$

Solving ω:

$\rho(V_1 + \Delta_{AC} + \sigma V_0) + (1-\rho)\big((1+\sigma)(V_1 + \Delta_{AC})\big) < V_1(1+\sigma) + \Delta_{AC}\big((1 -$
$\omega + \sigma$

Multiplying out the parentheses and moving ω to the LHS:

$\omega\Delta_{AC} < -\rho\sigma V_0 + \rho\sigma V_1 + \rho\sigma\Delta_{AC}$

Factor out ρ and σ. In addition, dividing with Δ_{AC} final expression writes:

$$\omega < \frac{\rho\sigma}{\Delta_{AC}}(V_1 + \Delta_{AC} - V_0)$$

Morten Lier
Eivind Thorsrud Willard

Preliminary Thesis Report

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Summary

The intention with this preliminary thesis report is to give a brief introduction to our research subject with an aim to boil the discussion down to a research question. We will give a brief account of the format of our thesis in terms of methodology and further work progress.

Our overall interest lies in agent behavior in economic transactions. We therefore start out by describing how economic transactions are organized in either markets or in hierarchies founded on the work of Coase (1937) and later extended by Williamson (1975). Agents are identified as economic utilitarian's, where some are subject to opportunistic behavior. Thus, the agents seek to get "the largest piece of the pie". These problems are often analyzed in terms of agency theory which later will be our theoretical tool for analysis. According to Hart (1995) agency theory is not concerned with firm boarders and has applicability in various contexts. This has implications for the future thesis.

Powell (1990) introduces network as a form of economic organization which differ from markets and hierarchies. When firms are embedded in such networks interdependence and relationships play a larger role, and it's claimed that agency costs are reduced. The strategic implications of this are not considered, but the discussion is aligned with economic theory.

The second part of the report completes the link between embedded networks and agency theory. An economic model with incentive feasible contracts in a moral hazard environment is presented, before we conclude with a research question. At last, some remarks about similar approaches and motivation.

Foundations in transaction cost economics

In economic analysis and other scholar disciplines studying social and organizational behavior it is well known that contracting situations is likely to induce costs on to the agents involved. Costs ascend from designing the contract as well from enforcement (Williamson 1981). In his classic article *"The Nature of the Firm"* Coase (1937) argues that contracting difficulties is at the very core of firm existence. Discovery of prices, i.e. costs related to bargaining and conclusion of contracts will be internalized in the firm rather than being transaction specific. Thus, organizing exchange transactions in firms rather than markets reduce contractual costs and change the character of the contract. Williamson (1991) identifies markets and firms as governance structures that are supported by different forms of contract law. It can be understood that contractual law is the mean to govern transactional relations between agents. In other words: the character of the contract.

Classical contract law is the governing mean in a market transaction; much economic theory is founded on this. Here we find "thick" markets in which "…individual buyers and sellers bear no dependency relation to each other. Instead, each party can go its own way at negligible cost to another" (Williamson 1991, 271). Transactions in "thick" markets will in an ideal world be "sharp in by clear agreement; sharp out by clear performance" (Macneil 1974, 738). This reflects the character of the contract; very legalistic, hard bargaining, strict enforcement with autonomous agents.

A firm can be thought of as a continuation of the market relation; however the mean to govern the contractual relations is that of forbearance (Williamson 1991). An illustration can be the comparison of a seller and a buyer with an employer and employee. The former transaction will take place in a market and the latter in a hierarchy. The point being that the properties in the contractual respect is comparable; however, the contractual law differs. Ultimately, the firm can be described as a "nexus of contracts" where the hierarchy is its own court of law (Williamson 1991). Transaction cost economizing is not subject to discussion in this thesis report. The underlying principles in how agents relate to the transaction and the contracting situation are of importance to our thesis, however.

In both markets and hierarchies many of the underlying assumptions in the transaction, and especially the contracting difficulties, are the same. Agency theory illuminates this and has applicability in both individual, group and organizational context (Wright, Mukherji, and Kroll 2001). This will have implications on the further discussion towards a research question. One distinction is important to make: While transaction costs economics consider the fact that writing the contract is costly, agency theory ascribes most contracting cost to observing variables of interest (Hart 1995). Further, transaction cost economics contributes with determinants of firm boundaries as opposed to agency theory which incorporates incentive considerations into firm analysis. It is of interest that many of the behavioral, both human and organizational, assumptions harmonize between the two levels of analysis. Williamson (1981, 533) state the following assumption which transaction cost rely on: "…that at least some agents are given to opportunism." In terms of agency theory Eisenhardt (1989) also identifies self-interest as human assumptions. Wright et al. (2001) discuss how economic utilitarianism make it more evident that both principals and agents are concerned with utility maximization. Noreen (1988, 360) draw the link between utilitarianism and self-interest which he argue leads to opportunistic behavior; "Utilitarian ethical behavior,[…], has to do with voluntary compliance with rules that are, in some sense, in the individual's own self-interest." Consequently this implies that the level of congruency or conflict between the principal and agent depends on the goal orientation and reciprocity in the relationship.

The costs from contracting problems in agency theory has its foundations in information economics, and are due to information asymmetries (Eisenhardt 1989). Often, the literature discriminate between information problems as either hidden action or hidden information (Mas-Colell, Green, and Whinston 1995, 477):

> "The hidden action case, also known as moral hazard, is illustrated by the owner's inability to observe how hard his manager is working; the manager's coming to possess superior information about the firm's opportunities, on the other hand, is an example of hidden information."

Hart (1995, 27-28) raise the question what will happened to the agency related costs when governing structures change in the case of a firm merger. He states the following:

> "I argue that it is unsatisfactory to assume that informational structure changes directly as a result of a merger. In the same way, it is unsatisfactory to suppose that the agents automatically become less opportunistic."

This seem plausible when treating the firm as a continuation of the market (as above), and keeping the discussed assumptions intact. But is this always feasible? Due to the complexity of contractual problems Williamson (1981, 533) imply that "There is a tendency, however, to accept this fact [complexity] as given rather than inquire into the reason for it" and that "What is needed, I submit, is more self-conscious attention to "human nature as we know it."" Accordingly, Wright et al. (2001) argue that the agency theory has its limitation of being narrow due to its assumptions, which the authors claim, make it less reflective of realities in economic relationships. More precise (Wright, Mukherji, and Kroll 2001, 414):

> "…the restrictive assumptions of agency theory discount the possibility that diverse individuals in various situations may behave differently"

Economic transactions in embedded networks

Analyzing contractual difficulties in "thick" markets with the assumption of atomistic relationships might not always reflect real life and "human nature as we know it". However, it allows us to discover mechanisms which are of importance in economic transactions and contracting situations. Intuitively, one can expect the analysis to grow more complex as social structures in the transaction changes. This might be the case when agent`s become more dependent on mutual interests. Nevertheless, this is something Powell highlights in his seminal 1990 article. Powell discusses how networks function as a distinctive way of coordinating economic activity as a form of economic organization on the side of markets and hierarchies. The argument proposed by Powell (1990, 303) is that:

> "In network models of resource allocation, transactions occur neither through discrete exchanges nor by administrative fiat, but through networks of individuals engaged in reciprocal, preferential, mutually supportive action."

The key differences which is important to our discussion is what shape opportunities and expectations; namely the structure and quality of exchange ties. Economic relations are no longer cool and atomistic as in "thick" markets, but embedded in a more complex set of variables. In the comparison of networks and markets Powell (1990) argues that transactions in the former rely on complementary strengths and interdependence between the agents. In addition, they have relational means of communication, together with reputational concerns. Powel (1990, 305) states that:

> "Parties to network forms of exchange have lost some of their ability to dictate their own future and are increasingly dependent on the activities of others."

Consider as an illustration, Ducati motorcycles; which has a close collaboration with nearly 180 suppliers responsible for about 90 % of the total costs. Yet the product costs and quality is considered highly competitive (de Wit and Meyer 2010). We will not consider the strategic implications of this, however – we will link this to our previous discussion. Is the behavior of the agents likely to be unchanged when: cooperation is emphasized over competition; you have close inter-organizational relations; interaction is based on reciprocity; you have durable partnerships and relationships based collaborative agreements?

With more than 80 % of Ducati's network partners located in the Bologna area communication and cooperation get easier, and the synergies that emerge can be compared to those in industrial clusters as described by Porter (2008). The link between network form of economic organization and industrial cluster are also drawn by Powell (1990). Powell point to the economic development in Emilian in north-central Italy; here groups of firms are located in specific areas according to what they produce. Production is organized in collaborative agreements where only a fragment of the firms ends with a final product. Porter (2008) argues that agency costs are reduced within industrial clusters due to the reasons discussed above. Porter's main point is that monitoring systems and information sharing is facilitated. Based on the previous discussion, can it be a possibility that it is the actual behavior of the agents which is subject to change, not only the principal's possibility to reduce information asymmetries? Only speculating in this gives us no substantial answer. However, using agency theory in terms of a more formal economic approach will guide us. Presumably this will illuminate the mechanisms that make agency costs subject to change. At the same time it is desirable to be able to assess the criticisms of the agency model described above. Eventually, this will be a consequence to what extent we are able to discuss agency relations through more complex economic relationships.

Exchange ties and agency costs

From the above arguments it seems natural that exchange ties should be at the core of our discussion. We assume that these ties can converge from weak or absent, in an arm's length transaction, towards a strong set of social and professional exchange relationships, when transactions are performed in embedded networks. This implies that various forms of economic organization facilitate different exchange ties. In other words, when economic transactions are performed in network form of organization exchange ties affect the transaction compared to those performed in a market. The nature and the strength of such ties are likely to influence firm behavior (Gulati, Nohria, and Zaheer 2000).

Jensen and Meckling (1976, 308) provide good point of departure in terms of our theoretical approach:

> "We define an agency relationship as a contract under which one or more persons (the principal(s)) engage another person (the agent) to perform some service on their behalf which involves delegating some decision making authority to the agent. "

Agency costs will arise in any cooperative effort even if the principal-agent relationship seem concurrent (Jensen and Meckling 1976). In other words, it is unrealistic to imagine a transaction without any information asymmetries or conflicts in terms of what action to be carried out. Regardless if transactions take place in embedded networks it is likely that the variables which influences positively the agents level of production also generate a disutility for the agent; in that way it is likely to be a conflict between the agent and the principal despite their mutual interests. This is stressed to demonstrate that problems of moral hazard should not be extraneous in embedded networks. Considering that firms become less autonomous when transactions are organized in such way, agency theory should be highly relevant. Most of all due to the delegation of activities; the principal looses the ability to control actions when they are no longer observable.

Cowell (2006, 364) treat agency costs as: "the expected net payoff for the Principal under full information less what it is in the second best situation." If agency costs are subject to change in network form of economic organization one can speculate that this is partially due to new information structures, and partially because new incentives arise with exchange ties.

Model and analysis

Our analysis will be founded on a moral hazard model with effort and production where the agent's action is not directly observable to the principal. The basics of the model are described below. The model and notations in the following subsection will be similar to what is used by Laffont and Martimort 2002 (150-152).

Consider an agent with an effort which is costly. The agent has either none or positive effort normalized to zero or one: e in $\{0,1\}$. Effort is costly and generates a disutility for the agent equal to $\varphi(e)$ where $\varphi(0) = \varphi_0 = 0$ and $\varphi(1) = \varphi_1 = \varphi$.

The agent will receive a transfer t from the principal for exerting effort. This implies the following separable utility function: $U = u(t) - \varphi(e)$ with $u'(.) > 0$ and $u''(.) < 0$. The stochastic production level $\tilde{q}$ can either take a low or high value $\{\underline{q}, \overline{q}\}$ and production increases in effort level. The stochastic influence of effort on production is given by $\pi_0$and π_1 with $\pi_1 > \pi_0$.

Further, the principal has a utility function which is increasing in performance and prefers production with a positive effort level ($e = 1$). The principal can offer the agent a contract contingent the verifiable and observable random output $\tilde{q}$. Compensation is linked to output with the function $\{t(\tilde{q})\}$. Thus, the realized production level $\underline{q}$ or $\overline{q}$ yields accordingly $\underline{t}$ or $\overline{t}$.

The risk neutral principal expects the following utility:

$$V_1 = \pi_1(S(\overline{q}) - \overline{t}) + (1 - \pi_1)(S\left(\underline{q}\right) - \underline{t})$$

when $e = 1$, and

$$V_0 = \pi_0(S(\overline{q}) - \overline{t}) + (1 - \pi_0)(S\left(\underline{q}\right) - \underline{t})$$

if $e = 0$. S denotes the principals benefit.

Laffont and Martimort (2002) further derive the moral hazard incentive constraint and participation constraint, which ensure agent participation with a positive effort:

$$\pi_1 u(\overline{t}) + (1 - \pi_1)u(\underline{t}) - \varphi \geq \pi_0 u(\overline{t}) + (1 - \pi_0)u(\underline{t})$$

Normalizing the agent's reservation utility to zero the participation constraint writes:

$$\pi_1 u(\overline{t}) + (1 - \pi_1)u(\underline{t}) - \varphi \geq 0$$

It can be concluded that an incentive feasible contract need to satisfy the above constraints.

The above model will be the basis for analyzing the principal's problem to get the agent to put forth effort when there are complex exchange ties (already defined) present. This leads us towards a more precise research question:

Is the effort exerted by the agent likely to be influenced as complex exchange ties in the principal-agent relationship get stronger?

A careful analysis and discussion of possible modifications to the model will be necessary in order to reach the principal's maximization problem. Taking assumptions regarding risk, limited liability and other extensions of the model will be a part of this process. A sensible approach will borrow ideas from different models such that the reasoning will be of some substance. This calls for a thorough review of relevant literature.

It is worth mentioning that there is an existing literature on moral hazard in multiperiod relationships (for instance Lambert 1983). One of the arguments in this literature is that the principal will learn about the agent. Hence, the behavior of the agent can be assessed more appropriately due to a reduction in information asymmetry. To dismiss that the approach found in this paper is superfluous it is important to emphasize the following: Multiperiod relationships can be differentiated from our reasoning. Eisenhardt (1989) recommend to extend the agency theory to more complex and richer contexts. In particular researchers need to work towards an overall framework with self interest on the agenda to improve understanding of such behavior. The motivation for this paper is based on Eisnhardt's recommendation, and inspiration is found in Sobel (2005)'s attention to intrinsic reciprocity as a property of preference. Intrinsic reciprocity can be defined as follows (Sobel 2005, 382): “The theory permits individual preferences to depend on the consumption of others”. This alludes to an individual which is willing to sacrifice own consumptions to the benefit of others in response to kind behavior (Sobel 2005).

Considering this, we will reflect on a producer of some good, the principal, which operates in an embedded network. Thus, economic transactions regarding the production are coordinated in a network form of organization. The principal has delegated parts of the production to subcontractors. Accordingly, the principal and agent have mutual interests; they are engaged in interdependent cooperation with a reputational concern. The relationship is subject to reciprocity. In other words, their economic relationship is featured with complex exchange ties.

Acknowledging our academic limitations we still believe we can put forth an interesting and fruitful discussion based on the content of this report.

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