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Dedicated to my parents, wife and son.

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Table of Contents

Chapter 1: Introduction

Information economics has been one of the major developments in the modern theory of microeconomics. It studies how information and the efforts to obtain, transmit or block it, affects the working of various socioeconomic systems. While the value of information has been known for a long time ago, the rigorous analysis of the role of information in shaping the structure of economic systems and the behavior of individuals is a lively topic for research. What make this field so rich is, on the one hand, the characteristic of information and, on the other hand, the multitude of channels through which it is learned, consumed and transmitted. Regarding characteristics of information, we should note that information is different from other types of valuable commodities as it is easily obtained but hard to verify. It contrasts with the most of other types of valuable commodities as they have a high price, but once acquired, the uncertainty regarding their quality disappears. Regarding the second part, it should be noted that social scientists are still investigating why different people consume information in different ways and the complexity of information transmission channels.

Information economics was born in the 70s. Explicit treatments of information up to that time have been focused more on the informational role of prices of goods and services. For example, Hayek (1945) highlighted the importance of prices in a market economy for distributing information. These theories assumed that all participants have identical information about the quality and characteristics of goods and services. In the beginning of the 70s, however, economists started to research problems in which one party has superior information compared to the other party or parties. Rigorous analysis of problems with asymmetric information led to the birth of information economics as a major field. The classic article by Akerlof (1970) marks the formal introduction of information asymmetry in the literature. He analyzed the consequence of an information asymmetry in the market for second hand cars. Akerlof showed that the information asymmetry between the sellers and the buyers of second hand cars, results in deterioration of the average quality of available cars in the market. Subsequently, Mirrlees (1971) analyzed a problem in which agents have different intrinsic productivity in an optimal taxation problem. To deal with the information asymmetry, two general methods have been introduced: signaling and screening (Bolton & Dewatripont, 2005). The difference between these two

methods is that in signaling it is the informed party who takes an action to resolve information asymmetry, whereas in screening it is the uninformed party who takes action. Signaling is introduced by Spence (1973). He proposed that an informed party can credibly inform an uninformed party by taking a costly action that serves as a signal. For example, in the job market, employers do not know the ability of candidates. Therefore, high ability candidates might signal their ability by earning a college degree that is too costly for low ability candidates to earn. Stiglitz (1975) introduced a formal model of screening as a way for an uninformed party to extract information from the informed party. This happens by designing a menu of choices such that the optimal choice of the informed party reveals her private information. For example, an employer who does not know the productivity of job candidates might offer compensation packages that differ in the composition of contingent and non-contingent (fixed) bonuses. High productivity candidates favor contingent based packages, whereas low productivity ones favor non-contingent packages. The analysis of problems of asymmetric information with more than one agent is done in auction theory, which is developed by Myerson-Maskin-Milgrom (Mas-Colell, Whinston, & Green, 1995) in various publications.

A major development in information economic is the introduction of hidden actions where one party cannot observe the actions of the other party. For example, an employer does not observe how hard an employee works. This type of problems is analyzed first by Hölmstrom (1979). The key issue is designing a compensation package that compels the agent to behave in ways that the principal deems desirable. The theory of incomplete contracts by Grossman & Hart (1986) and Hart & Moore (1990) is another major development in information economics.

This thesis applies the insights of information economics to organizations. Chapter 2 studies the governance structure of heterogeneous collective entrepreneurships. Heterogeneity implies that members have different outside options and are also different in terms of knowledgeability. This sort of heterogeneity can be observed between Senior and Junior members of professional firms such as law firms. Members having different outside options implies that there are some business opportunities that are acceptable for some members but not for the other members. As a result, decision making is hampered and members conflict. This problem is known in the literature as the homogeneity hypothesis of Hansmann (1996). It implies that

the efficient ownership of enterprise requires that control is granted to a group of stakeholders having highly homogeneous interests. Despite this, heterogeneous collectives are observed in some industries such as law firms, agricultural cooperatives and so on. The paper studies why heterogeneous collectives (entrepreneurships) exist in some industries but not in other industries. In doing so, the governance structure of collectives is analyzed as it allocates decision rights to members. The paper shows that governance structure and the market are intertwined and also determines the efficient governance structure across different market types.

Chapter 3 studies the effect of managerial self-confidence and social status on organizational performance. It tackles the following puzzle in management science. On the one hand, various researchers have documented the observation that overconfident managers are favored by their followers, peers and investors. On the other hand, empirical evidence demonstrates that the link between confidence and competence is dubious. The inter-personal perspective researches the consequences of managerial confidence on the behavior of followers. The paper shows how managerial confidence influences followers' estimation of the manager's ability and how this, in turn, affects their effort level. This part provides an explanation for the observed positive link between managerial confidence and followers' perception of managerial ability and their effort provision. In addition, the paper studies how managerial concern for retaining and enhancing social status affects the organization.

Chapter 4 analyzes documentation. A document is defined as a record showing the history of actions and information in the past. While the information that a document provides might not be verifiable, the very existence of the information is verifiable by the document. The paper explores why organizations use documents extensively and what are the consequences of documentation. The paper studies documentation as a multi-purpose, multi-faceted activity and identifies three distinct functions for documentation: time saving, enforcing consistency and certification.

Finally, chapter 5 summarizes and concludes the thesis. What connects the chapters of the thesis is the role of information in decision making and communication in organizations. In Chapter 2, information is about business opportunities in collectives. In Chapter 3, the information is about the ability of the managers and it's motivational and behavioral consequences. Chapter 4 researches the inter-temporal transmission of information by

documentation and its effects on decision making and communication in organizations.

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Chapter 2: Governance of Collective Entrepreneurship

This paper studies optimal allocation of control rights in heterogeneous collective organizations. Four results are established. First, members' heterogeneity is costly as it makes communication coarse and hampers decision making. Second, efficient allocation of control rights entails granting the decision rights to the members whose preferences are more aligned with the market if and only if these members are highly knowledgeable. Third, efficient allocation of control rights might not be viable when members have outside options and some members are wealth constrained. One implication is that it is unlikely that junior members have decision authority in heterogeneous partnerships. Another implication is that the viability of collective entrepreneurship is problematic in many settings. Finally, repeated interactions improve viability, which is due to the equilibrium messages being less coarse and the richer strategies in a repeated game.

Keywords: Collective entrepreneurship, member heterogeneity, authority, cheap talk

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1. Introduction

Worldwide there are around 580 million entrepreneurs running their own business (Global Entrepreneurship Monitor). Many of them are not only incorporated as a sole proprietorship, but also as a member and an owner of a collective organization. Examples of these organizations are professional partnerships in the legal, financial and advisory professions, cooperatives in agriculture, and franchises in restaurants, lodging, retail food, and distribution. The literature on collectives has explored the role of income sharing for the existence and functioning of collectives (Levin and Tadelis 2005; Garicano and Santos 2004) but much less has been said about the allocation of control rights in collectives. As a result, there are still a number of open questions about collectives. For example, why do seemingly similar partnerships allocate control rights in different ways? why do we see heterogeneous partnerships in some industries but not in

other industries? This paper aims to address these questions. We specifically focus on heterogeneous collectives and investigate the efficient allocation of control rights. In addition, we explore the viability of efficient allocation of control rights when members have outside options and junior members are wealth constrained.

Collective entrepreneurship is defined as an association of entrepreneurs. The distinguishing feature of a collective entrepreneurship is that ownership or control rights is shared rather than individually allocated (Baker et al. 2008). Shared control implies that a collective decision-making procedure is needed in order to aggregate individual opinions into an organizational decision. This is where heterogeneity becomes a challenge. According to the homogeneity hypothesis of Hansmann (1996), efficient ownership of enterprises requires control be granted to a group of stakeholders having highly homogeneous interests. Shared control by various stakeholders would result in too many influencing activities for the organization to be viable. This problem is expected to be more pronounced in collectives due to shared control. For instance, if partners differ on their outside options, then a candidate business project might be attractive to one member but unattractive to another member of the partnership. Therefore, heterogeneity is expected to destabilize collective entrepreneurships. This is, however, at odds with the omnipresence of heterogeneous collectives in various industries, such as professional partnerships consisting of junior and senior members and agricultural cooperatives consisting of high and low quality farmers. As a result, we need to better understand the organization of collective entrepreneurships and more specifically the allocation of control rights in heterogeneous collectives. In order to address shared ownership, we distinguish two (classes of) members: junior (J) and senior (S). Members are heterogeneous along two dimensions: opportunity costs, which are higher for Senior than for Junior, and knowledgeability/expertise, which is modeled as the probability of learning the true value of projects. In addition, Juniors are wealth constrained, i.e., they are not able to raise money beyond the value of their outside option. Based on these two sources of heterogeneity, we formulate a unified account of the costs and benefits of member heterogeneity in collective entrepreneurships. We follow Hart and Moore (1990) by determining which subset of the membership is most suitable to take the organizational decisions.

In our model, both members investigate a project independently and then communicate with each other. The difference between the opportunity costs implies that member types might disagree on whether they should undertake the project. In this case of disagreement, the type with the decision (control) rights will make the final decision. In this setting, we derive three main results. First, we show that as heterogeneity increases, members' interests diverge and this in turn makes communication noisy as members transmit information strategically. In addition, conflicting interests breed disagreement and decisions cannot be made unanimously. This is the peril of heterogeneity that has been emphasized in the ownership literature (Hansmann 2013). Second, the governance structure that generates the highest total surplus is determined by the attractiveness of the market and the expertise (cognitive ability) of the member whose preference is congruent with the market. When the market is extremely favorable or unfavorable, the member type whose decision is in line with the market should be at the helm of the enterprise to create the highest value. When the market is not extremely favorable or unfavorable, the same result holds only if the member whose preference is congruent with the market has a high level of expertise. Otherwise, the efficient allocation of control rights entails granting the control rights to the member whose preference is not in line with the market. As a result, the efficient allocation of control rights is a function of market and expertise of members. Third, the efficient governance structure is not always viable. Viability requires that both members' participation constraints are satisfied. We show that junior being wealth constrained implies that members cannot compensate each other by side payments and, therefore, the participation constraints have to be satisfied solely from their payoff of implementing projects. In other words, Coasian bargaining does not restore efficiency. The participation constraint of the member holding the control right is always satisfied as that member never implements a project whose value (or expected value) is below the value of her outside option. The participation constraint of the member not holding the decision rights should also be satisfied in one way or the other. This is where communication plays a role. Heterogeneous members benefit from communicating with each other. The benefits of communication are not symmetric, i.e., only one type (or neither types) benefits depending on the market. Therefore, the market determines who benefits from communication. The member who does not benefit from communication should necessarily hold the control rights, otherwise her

participation constraint is not satisfied. As a result, different markets require different governance structures for a heterogeneous collective entrepreneurship to be viable. Market and governance structure are therefore intertwined.

The rest of the article is organized as follows. The next section reviews the relevant literature. In §3 we introduce the model and define its ingredients. §4 analyzes the communication between partners. Next, in §5 we determine the partnership type that generates a higher total surplus in each market type. §6 reviews the individual rationality constraints of partners to show which partnership is viable in each market type. In §7, we return to the communication problem between partners and show how repeated interactions allows them to have finer communication and this in turn affects the viability of heterogeneous partnerships. Finally, §8 summarizes and concludes the articles.

2. Literature Review

Partnership is an important institution for businesses in which the application and transfer of soft knowledge is critical. For example, Levin and Tadelis (2005) show that partnerships signal their human resource quality to the potential clients by sharing the payoffs with partners. Morrison and Wilhelm (2004, 2008) argue that a partnership can be the appropriate institution for transferring tacit knowledge because the reputational concern of the senior partner and the career concern of the junior partner counteract the bilateral moral hazard inherent in transferring tacit knowledge. This article is different since in the model partners do not take actions such as investment or transfer of knowledge. As a result, moral hazard is not an issue in our model. Instead, we analyze how the allocation of decision rights affects the surplus generated in the partnership and when the efficient allocation of decision rights is viable.

Our discussion on the allocation of decision rights rests on the assumption that contracts are incomplete (Grossman and Hart 1986, Hart and Moore 1990). Incompleteness of contract matters because if parties were able to write complete (contingent) contracts, then decision rights would be a trivial issue as parties would efficiently contract decision rights in any possible contingency. A notable difference between models based on incomplete contracts and our model is that in those models allocation of decision rights, ownership rights to be more precise, matters because it

affects ex post bargaining position of parties and therefore their ex ante investment incentives. As mentioned earlier, in our model parties do not invest and so allocation of decision rights does not create inefficiency per se. Inefficiency arises when the efficient allocation of decision rights results in one party's payoff fall below the value of her outside option. That is, the efficient allocation of decision rights might not be viable. In this sense our paper is close to Hart and Moore (1996) and following articles in which outside options feature prominently such as De Meza and Lockwood (1998) and Chiu (1998).

We identify three streams of literature that are relevant for our analysis of governance structure, communication and decision making. The First stream addresses the relationship between the architecture of the enterprise and decision making. Sah and Stiglitz (1986) compare how a hierarchical decision system differs from a polyarchical, or parallel decision system in terms of committing type I and type II errors. A number of articles extended their framework. For example, Christensen and Knudsen (2010) analyze decision making in hybrid organizational structures. Another notable article is Csaszar and Eggers (2013) that considers members that are different in terms of knowledge. In line with these articles, we address the efficiency of collective entrepreneurship. However, we differ in terms of decision makers having different outside options, partners having private information and the explicit communication between the decision makers.

Second, the literature regarding the effect of costless communication (Crawford and Sobel 1982), i.e. cheap talk, on centralization is also relevant for our model. An important result is that the truthfulness of information depends on the divergence of interests of the involved parties. The effect of cheap talk on organizational structure has been analyzed by Dessein (2002). He studied the setting where an uninformed principal has to choose between delegating decision making to an informed agent or retaining the decision rights and communicating with the agent.[1] The cheap talk literature is characterized by a principal-agent setting where it is only the agent who becomes informed and the decision is always made by the principal. We think this type of principal-agent modelling does not

[1] A series of follow up articles enriched the model of Dessein (2002) by incorporating the need for adapting to local knowledge and coordination between different divisions in an organization. Examples are Dessein and Santos (2006), Alonso et al. (2008), and Dessein et al. (2010).

reflect the decision-making process in collective entrepreneurship well as all members can be more or less informed about an upcoming issue.

Finally, we should highlight the difference between this article and the literature on decision making in committees and strategic voting (Li and Suen 2004, Gerling et al. 2005, Li et al. 2001, Feddersen and Pesendorfer 1999, Gerardi 2000, Oraiopoulos and Kavadias 2019). The canonical issue of these articles is the effect of decision (voting) rules, committee compositions and various concerns of members on the working of committees and the ensuing outcomes. The problem of our article is related due to the decision rule of majority voting. However, issues regarding strategic voting do not arise in our model because each governance structure assigns the right of implementation to a certain group of members.

3. The Model

A collective entrepreneurship consists of two types of members: Senior and Junior. We assume that all Senior members are identical, and all Junior members are also identical. Therefore, when analyzing the decision making, we assume there is a representative for each member type. In the rest of the article we use the term partnership to refer to a collective entrepreneurship.

The partnership considers implementing projects with the objective of producing new products or delivering new services. The revenue $\theta \in [0,1]$ of these projects is stochastic with CDF $F(\theta)$ that is common knowledge. If a project is implemented, then each member type receives θ. If the project is not implemented, each type receives its outside option.

The costs of implementing a project is fixed and normalized to zero. Availability of outside options, however, implies an opportunity cost for each type. The values of outside options are denoted by $k_i \in [0,1]$, $i \in \{J, S\}$, where $k_J < k_S$. The subscripts J and S refer to Junior and Senior, respectively. There are two categories of projects: a good project, G_i, for member type i is a project whose return matches or exceeds the value of the outside option of that type, that is, $\theta \geq k_i$. A bad project, B_i, for type i, instead, is a project whose return is lower than the value of the outside option of that type, $\theta < k_i$. The difference between k_S and k_J reflects the divergence of interests between Senior and Junior, i.e., the wider the gap,

the higher the likelihood of disagreement. Define $\Delta \equiv k_S - k_J$ and consider it as the measure of cost heterogeneity.

Finally, we need to define the notion of governance structure. A governance structure allocates decision rights to one of the two types. That is, the governance structure determines which member type makes the project implementation decision. We consider two governance structures: J-partnership in which Junior has the decision rights and S-partnership wherein Senior has the decision rights.

The sequence of events is represented in Figure 1. At time 1, members determine the governance structure. At time 2, nature chooses θ and member type *i* learns θ with probability q_i, i.e., each type *i* either learns θ, which happens with probability q_i, or does not learn θ, which happens with probability $1-q_i$. Neither type observes whether the other type has learned θ or not. At time 3, each type *i* sends a message, $m_i \in R^+$, to the other type. The messages are exchanged simultaneously. Finally, at time 4, the type having the decision rights makes the implementation decision which determines the payoffs from the project.

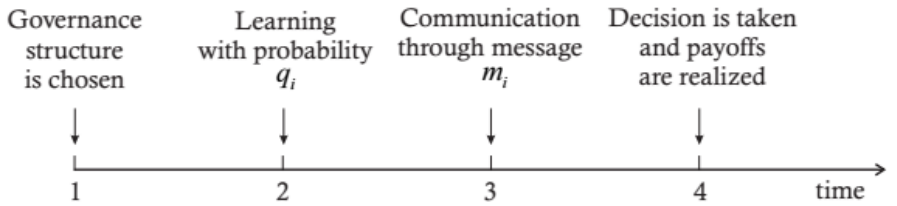

Figure 1Sequence of events

Our solution concept is perfect Bayesian equilibrium. It is adopted to capture the two ways in which beliefs about revenue θ can be updated: learning at time 2 and communication at time 3.

As beliefs, both prior and posterior, are pivotal for the analysis, it is insightful to categorize prior beliefs according to the ways that they affect the implementation decision. For this purpose, we define three market types based on E(θ).

DEFINITION 1. The market for the projects of the partnership is called

1. **Mature** if $E[\theta] < k_S$.

2. **Mixed** if $k_J < E[\theta] \leq k_S$ and

3. **Nascent** if $E[\theta] > k_S$.

The mature (nascent) market is replete with bad (good) projects for both types. In the mixed market, there are a lot of good projects from Junior's perspective but bad from Senior's perspective. Henceforth, we will use the subscripts *Ma*, *Mi*, and *Na* to refer to the mature, mixed, and nascent market, respectively.

4. Messages and Implementation

The communication between member types consists of an exchange of messages $m_i \in R^+$. We demonstrate that the equilibrium strategies of the communication game entail sending messages that are equivalent to sending Y or N to mean that the sender is either in favor of or against implementing the project, respectively. In addition, the receiver interprets Y (N) as an indication that the return or its expectation is more (less) than the sender's outside option

PROPOSITION 1. Truth telling cannot be supported as an equilibrium strategy in the communication game. The equilibrium message of both types takes the form of a simple Yes (Y) or No (N), indicating whether the sender is in favor of or against implementing the project, respectively. The receiver's belief upon receiving Y entails that θ or its expectation is at least as high as the sender's outside option. The receiver's belief upon receiving N entails that θ or its expectation is less than the sender's outside option.

The result of Proposition 1 should not be surprising given that the interests of Senior and Junior are not fully aligned. It is well known from the cheap talk literature (Crawford and Sobel 1982) that when parties' interests diverge, communication becomes noisy. Our setting is different as the receiver (decision maker) might learn the true θ and therefore ignore the message of the sender. This point, however, does not affect the incentives of the sender in communicating strategically.

A message m_i can be either default or non-default for type *i*. A default message is one that is consistent with a type's prior. For example, in the

mature market the default message of both types is N because $E(\theta) < k_J < k_S$. A non-default message is a message that is inconsistent with the sender's prior. In the mature market, Y is non-default as neither type sends Y based on priors. In the mixed market, Y is the default message for Junior but non-default for Senior. The importance of a non-default message is that it implies learning. This result is formalized in the following lemma.

LEMMA 1. *Sending a non-default message entails learning by the sender.*

The result in Lemma 1 is straightforward. Based on the priors each type would always send a default message, so the only rationale for a non-default message is that the sender has learned the true value of θ.

Next, we analyze the decision making in partnerships. Let the partnership members be heterogeneous regarding the opportunity costs, i.e. $k_J < k_S$. Recall that the message of a player takes the form of either Y or N. As a consequence, there are four possible compositions of the messages: YY, YN, NY and NN, where the first letter refers to the message of Junior and the second to the message of Senior.

We show that only one of these messages leads to a different decision in a J than an S-partnership. The cases NN and YY are straightforward to analyze. Regardless of the governance structure, a project gets implemented whenever the message composition is YY and is rejected whenever it is NN. The case NY also leads to the same decision in both governance structures. This is because $k_J < k_S$ implies that the message NY cannot be sent if neither type has learned or if both types have learned. In fact, if neither type has learned, then NY means $E(\theta) < k_J$ (given the N by Junior) and $E(\theta) > k_S$ (given the Y by Senior), which is impossible due to $k_J < k_S$. In the same vein, if both types have learned the revenue, then NY implies $k_S < \theta < k_J$, which is also impossible. Therefore, NY could only originate from a scenario of asymmetric learning, where one type learns whereas the other does not. Suppose it is Junior who learns; then, the N message implies that $\theta < k_J$ and therefore $\theta < k_S$. As a result, neither type would like to implement the project. If, on the other hand, it is Senior who has learned, then his Y message will imply $\theta > k_S$ and $\theta > k_J$. Therefore, Junior will also implement the project in a J-partnership. Therefore, the only case in which Junior and Senior would take a different

decision about project implementation is when the message exchange is YN. The following proposition states this result.

PROPOSITION 2. *When $k_j < k_S$, the implementation decision in an S-partnership might be different than in a J-partnership if and only if the message exchange is YN, where Y is sent by Junior and N by Senior.*

The result of Proposition 2 highlights the importance of the message composition YN for distinguishing the two governance structures in terms of their implementation decisions. However, it is silent about the level of heterogeneity that is needed to have a difference. The remainder of this section shows how this level of heterogeneity has to be above a certain threshold.

Consider the mature market. The default message for both types is N; thus, the Y by Junior reveals that she/he has learned that $\theta \geq k_J$. As a result, the project gets implemented in a J-partnership as it is profitable from Junior's perspective. In the S-partnership, instead, the implementation of the project depends on whether Senior has learned θ. If Senior has learned θ, then his message N entails that $k_J < \theta < k_S$, and thus the project is not implemented. However, if Senior has not learned θ, then he must update his belief about θ based on the message received from Junior. Specifically, under message YN Senior approves the project iff he did not learn and

$$E(\theta \mid \theta \geq k_J) - k_S \geq 0. \qquad (1)$$

Note that if the heterogeneity of member types is very low, i.e. $\Delta = k_S - k_J$ is close to zero, then (1) is always satisfied. On the other hand, for a given k_J, if k_S is close to 1 then (1) does not hold. As a result, there exists a threshold Δ^*_{Ma} for heterogeneity such that (1) holds if and only if $\Delta < \Delta^*_{Ma}$. In particular, the implementation decision is different for the two member types only for $\Delta > \Delta^*_{Ma}$. This result is crucial, as it determines a minimum threshold of cost heterogeneity between the members of the partnership such that the choice of the governance structure is relevant only for higher heterogeneity. In other words, the allocation of decision authority is irrelevant unless there is sufficiently high heterogeneity between the two member types.

Next, consider the nascent market. In a nascent market, YN implies that Senior has learned that $\theta < k_S$, otherwise he would not send this message. Therefore, Senior does not implement the project in an S-partnership. Junior, on the other hand, has or has not learned θ. If she/he has learned θ, then she/he implements the project in a J-partnership. If she/he has not learned, then she/he updates her belief about θ. Specifically, Junior implements the project in the J-partnership when she/he does not learn if

$$E(\theta \mid \theta < k_S) - k_J \geq 0. \quad (2)$$

Therefore, there is a threshold Δ^*_{Na} for heterogeneity such that if heterogeneity is higher than that threshold, then (2) always holds and the project is implemented in the J-partnership, but not in the S-partnership.

Finally, consider the mixed market. Contrary to the mature and nascent markets, the message YN can emerge from learning or not learning by either type. In fact, in a mixed market the default message of Junior is Y whereas the default message of Senior is N. Therefore, there are four cases regarding the learning possibilities. If the type that has the decision rights learns θ then that type ignores the message of the other type. However, if the decision maker does not learn θ, she/he forms a belief according to the Bayes formula. For example, if Senior does not learn in the S partnership, he does not implement a project following YN if

$$q_J E(\theta \mid \theta \geq k_J) + (1 - q_J) E(\theta) < k_S. \quad (3)$$

As heterogeneity increases, (3) becomes more likely to hold. That is, Senior is less likely to implement the project when heterogeneity increases.

Junior implements a project in the J-partnership when she/he does not learn θ and the message composition is YN if

$$q_S E(\theta \mid \theta < k_S) + (1 - q_S) E(\theta) \geq k_J. \quad (4)$$

From (3) and (4) it can be seen that if k_S and k_J are close enough, i.e. heterogeneity is low, then Senior implements the project in the S-partnership and Junior does not implement the project in the J-partnership. That is, the implementation decision does not depend on the governance structure. If, however, heterogeneity is sufficiently large then the

implementation decision is always different in the two governance structures.

PROPOSITION 3. *In each market j, j* ∈ {*Na,Ma,Mi*}, *when the message exchange between the two types is YN, there exists a threshold* $\Delta^*_j \geq 0$ *such that the implementation decision is different in the J- vs. S-partnership if and only if* $\Delta_j > \Delta^*_j$.

Proposition 3 entails that when heterogeneity is low, the interests of Senior and Junior are sufficiently congruent such that any project that is profitable for one type will also be profitable for the other type and vice-versa. Consequently, if the heterogeneity is low, the final decision regarding implementing projects will be identical in the S- and J-partnership. To ensure that the choice of governance structure implies different implementation decisions, we make the following assumption.

ASSUMPTION 1. $\Delta > max_{j\in\{Ma,Mi,Na\}} \Delta^*_j$.

5. Efficiency of Governance Structure

We have demonstrated that for sufficiently heterogeneous member types the project implementation decision can be different across governance structures only when the message exchange is YN. Such an exchange entails that the project is implemented only by the J-partnership. As a result, if the sum of the payoffs to Junior and Senior of implementing a project following YN is positive, then the J-partnership generates a higher total surplus than the S one and is therefore the efficient governance structure. Otherwise, the S-partnership structure is efficient. In this section, we first show how to determine the total surplus of implementing a project following YN. Then, we determine the conditions of efficiency for each governance structure.

Consider the mature market. YN can only occur if Junior has learned θ, as Y is the non-default message for Junior (see Lemma 1). As a result, it is certain that θ is at least as large as k_J. Senior might or might not learn

θ. The expected total surplus of implementing the project in a mature market, conditional on YN, is

$$E_S^{Ma} = 2(1-q_S)\left[E(\theta \mid \theta \geq k_J) - \frac{k_J + k_S}{2}\right] + 2q_S\frac{(F(k_S) - F(k_J))}{(1-F(k_J))}\left[E(\theta \mid k_J \leq \theta \leq k_S) - \frac{k_J + k_S}{2}\right]$$

.

Note that the first term reflects the event that Senior does not learn θ, whereas the second term refers to the case when Senior learns that θ is less than k_S This happens with probability

$$q_S\frac{F(k_S) - F(k_J)}{1 - F(k_J)}$$

The following notation simplifies the next results and related discussions.

$$E_L \equiv E(\theta \mid \theta \leq k_S), E_M \equiv E(\theta \mid k_J \leq \theta \leq k_S), E_H \equiv E(\theta \mid \theta \geq k_J),$$

$$\bar{k} \equiv \frac{k_J + k_S}{2}.$$

Notice that $E_H > E_M > E_L$. Using this notation, E_S^{Ma} can be restated as

$$E_S^{Ma} = 2(1-q_S)\left[E_H - \bar{k}\right] + 2q_S q_S\frac{F(k_S)-F(k_J)}{1-F(k_J)}\left[E_M - \bar{k}\right] \qquad (5)$$

The following assumption simplifies the analysis and proofs.

ASSUMPTION 2. *f*(θ) *is strictly quasi concave in all markets.*

Assumption 2 ensures that *f*(θ) is increasing before its mode and decreasing afterwards. The following proposition characterizes the efficient governance structure in a mature market.

PROPOSITION 4. *In a mature market, the uniquely efficient governance structure is the S-partnership when* $E_H < \bar{k}$. *If* $E_H \geq \bar{k}$, *then there exists a* q_S^* *such that the efficient governance structure is the S-partnership if and only if* $q_S > q_S^*$.

Figure 2 depicts Proposition 4. To understand this proposition, note that the difference between the J-partnership and S-partnership arises only

when the message composition is YN. In the mature market, the message Y of Junior implies learning, but the message N of Senior does not necessarily imply learning. As a result, the message composition YN means that the expected surplus of the project is either E_H, when Senior has not learned, or E_M when Senior has learned. The case $E_H < \bar{k}$ means the market is very unfavorable such that projects that are profitable for Junior are inefficient in expectation. That is, they do more harm to Senior than they benefit Junior. As a result, the S-partnership is the efficient governance structure as it does not implement such projects.

The case $E_H \geq \bar{k}$ implies a better market, where projects that are profitable for Junior are on average efficient (they might or might not be profitable for Senior). However, projects that are *only* profitable for Junior (unprofitable for Senior) are inefficient in expectation. As a result, when the message N of Senior is highly likely to be grounded on learning, i.e., q_S is high, projects are on average inefficient and the S-partnership is the efficient governance structure as it does not implement such projects.

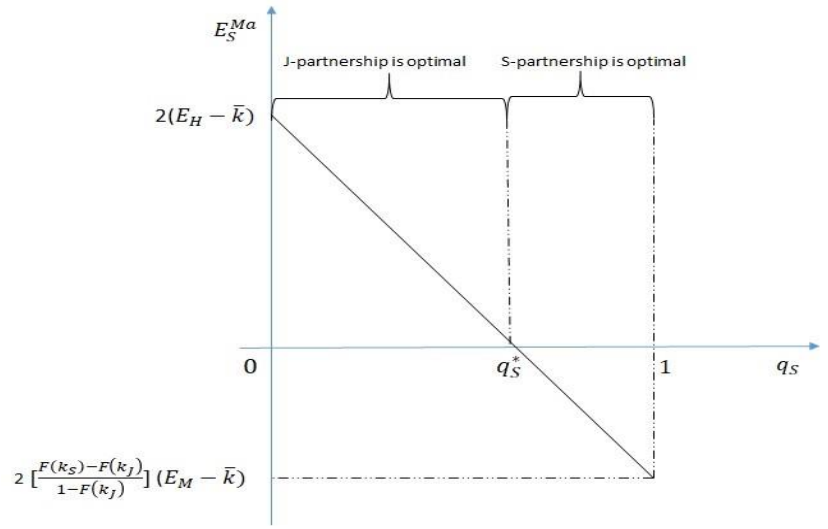

Figure 2: Efficient Governance Structure in the Mature Market

A similar analysis can be done for the nascent market, which results in the following proposition.

PROPOSITION 5. *In a nascent market, the uniquely efficient governance structure is the J-partnership when* $E_L \geq \bar{k}$. *If* $E_L < \bar{k}$ *then, there exists a* q_J^* *such that the efficient governance structure is the J-partnership if and only if* $q_J \geq q_J^*$.

Proposition 5 for the nascent market can be interpreted in a similar way as Proposition 4 for the mature market. The difference is that in the nascent market the message YN implies that Senior has learned, i.e., $\theta < k_S$. The expected return of the project is either E_L if Junior has not learned, or E_M otherwise. The case $E_L \geq \bar{k}$ implies an extremely favorable market where even projects that are unprofitable for Senior are efficient in expectation. That is, they benefit Junior more than they hurt Senior. Not surprisingly, the J-partnership is efficient as it implements the project. The case when $E_L < \bar{k}$ means the market is not as favorable as in the previous case. A project is efficient only when the message Y of Junior is grounded on learning, because $E_M \geq \bar{k}$. This happens with probability q_J. Therefore, in expectation implementing projects following YN is efficient when it is highly likely that the message Y of Junior implies learning.

Finally, the mixed market is a special case as the message YN does not necessarily imply learning by any type. This is because Junior sends Y even if she/he does not learn θ. The same also applies to Senior with the difference that he sends N when he does not learn. Therefore, we need to distinguish four cases regarding learning, where neither type learns, only one type learns, or both types learn θ and θ falls between $k_J$and k_S. We analyze this case in the appendix. The results are qualitatively like other markets.

We can summarize the main insight of this section in the following way. The partnership type that generates a higher total surplus is determined by two factors: market and the expertise (knowledgeability) of the partner whose message is congruent with the market. When the market is extreme, i.e., very favorable or very unfavorable, the partnership type whose implementation decision is congruent with the market generates a higher total surplus and, therefore, is efficient. When the market is not extremely favorable or unfavorable, the partnership whose implementation decision is congruent with the market is efficient only if the partner, whose message

is congruent with the market, is highly likely to learn the project's return, i.e., her message is less noisy. This is because the higher expertise of that partner translates into a higher resemblance of the portfolio of projects to the market. Intuitively, when a partner with high level of expertise sends a message implying that a project resembles the general characteristics of the market, then it is highly likely that the partner is right and so granting the decision rights to that partner results in implementing better projects in expectation.

We analyzed the efficient allocation of decision rights. A critical question to be answered is whether the efficient allocation of decision rights is viable or not. This is especially relevant because members have outside options and the efficient allocation of decision rights might result in the payoff of one type falling below the value of her outside option. A Coasian argument can be put forward in favor of viability of the efficient governance structure. Given that the efficient allocation of decision rights generates the highest total surplus, it should be possible to compensate a member whose payoff has fallen below the value of her outside option given that side payment is possible. It is indeed possible to design a simple mechanism that implements the socially optimum decision in Bayesian Nash equilibrium. The mechanism works as follows. Recall from Proposition 2 that the only message composition that results in conflict is YN. Any time the message composition is YN, Junior and Senior are asked if they agree that Junior pays k_S to Senior, the project is implemented, and all the proceeds go to Junior. The project is implemented only if they both agree. It is straightforward to check that this simple mechanism is incentive compatible[2], and results in implementing projects that yield at least $\bar{k}$ in the mature and nascent market and projects that yield at least $\bar{k}$ in expectation in the mixed market. Therefore, the mechanism implements the interim efficient decision in the mature and nascent market and ex ante efficient decision in the mixed market. Such a mechanism, however, requires Junior to be able to pledge k_S in advance, i.e., before implementing the project. If Junior is wealth constrained, then such a mechanism cannot be implemented. In our model, Junior is characterized by having a less valuable outside option compared to Senior. A low value outside option

[2] I am grateful to Jens Prüfer for commenting on the incentive compatibility of the mechanism in the earlier version of the paper.

implies worse economic opportunities and therefore, less saving and access to credit. Real world examples include new graduates of law in law partnerships and small farmers in cooperatives. As a result, assuming that Junior is wealth constrained is not unrealistic and matches the general framework of our model.

ASSUMPTION 3. *Junior is wealth constrained.*

A direct implication of Assumption 3 is that the efficient governance structure might not be viable. Therefore, we need to check the participation constraints of both types to ensure that both member types are willing to join the partnership.

6. The Choice of Governance Structure

Heterogeneity is usually considered to be a challenge in partnerships as it engenders conflict and hampers the decision-making process. Investor owned firms are often praised on the premise that all owners agree that profit maximization is the ultimate goal of the firm and all decisions are evaluated on the basis of their financial returns. This unanimity, however, does not always hold when owners have divergent interests as in heterogeneous partnerships, Hansmann (1996) and Holmstrom (1999). Despite this, heterogeneous partnerships are observed in sectors such as agriculture, professional services firms, consultants and so on. Therefore, heterogeneous partnerships have offered benefits to partners to lure them to join the partnerships. In other words, participation (individual rationality) constraints of partners have been satisfied in one or the other way. In the following section, we characterize the parameters space where the participation constraints of both types are satisfied. The parameter space, therefore, shows when a heterogeneous partnership is viable.

In §4 we demonstrated that the message composition YN results in conflict because Junior would like the project to be implemented whereas Senior prefers to avoid it. In addition, this is the only message composition with such an effect. The cost from this disagreement only accrues to the partner without decision rights as the other partner with the decision rights makes the final decision. As a result, it is sufficient to derive the expected loss to the partner without the decision rights in order to calculate the costs of heterogeneity. We also showed, in §4, that the message composition NY is the only occasion when the messages of Junior and Senior conflict,

but they agree after updating based on the message of the other partner. Therefore, the benefit of joining the partnership can be calculated by analyzing the benefits to partners resulting from NY.

A heterogeneous partnership is viable when the individual rationality constraints of both Junior and Senior are satisfied. It implies that a heterogeneous partnership is viable when the expected benefits to partners, resulting from NY, is at least as large as the expected costs accruing to them from YN. e and implement a project that he would have not chosen and that will be profitable. To illustrate, consider the mature market. The message NY necessarily implies that Senior has learned that θ is larger than k_S whereas Junior has not learned. As a result, only Junior benefits from the learning by Senior. The only way to meet the individual rationality constraint of Senior is to allocate control to Senior, i.e., the S-partnership. It safeguards Senior against the risk of implementing a project whose revenues are lower than k_S. Therefore, the equilibrium governance structure in the mature market is the S-partnership.

Consider the S-partnership in the mature market. The expected payoff to Junior, due to NY, is

$$(1 - q_J)q_S(1 - F(k_S))[E(\theta \mid \theta \geq k_S) - k_J], \qquad (6)$$

where the first three terms represent the probability that NY occurs. The expected loss to Junior of not implementing the project following YN in the mature market is

$$q_J\left(1 - F\left(k_J\right)\right)[q_S\frac{F(k_S)-F\left(k_J\right)}{1-F\left(k_J\right)}(E_H - k_J + (1 - q_S(E_H - k_J))]. \qquad (7)$$

To understand (7), note that Junior sends Y in the mature market only if she/he has learned that $\theta \geq k_J$. It happens with probability $q_J\left(1 - F\left(k_J\right)\right)$. The expected payoff of Junior can then be conditioned on whether Senior has learned or not. The first term in the square brackets reflects the expected payoff of Junior when Senior has learned. The second term reflects the expected payoff of Junior when Senior has not learned.

Individual rationality implies that the expected benefit to Junior should be at least as large as the expected cost. Therefore, by comparing (6) and (7), we can derive an upper bound for $q_J$as a function of q_S, such that Junior's

expected payoff exceeds her expected loss only if q_J is lower than that upper bound, i.e., $q_J \leq f(q_S)$. Otherwise, the heterogeneous partnership does not emerge in equilibrium. Therefore, we have the following proposition.

PROPOSITION 6. *The heterogeneous J-partnership does not emerge as the equilibrium governance structure in the mature market. The S-partnership is the equilibrium governance structure if and only if* $q_J \leq f(q_S)$.

Figure 3 summarizes the results regarding governance structure and efficiency in the mature market. From Proposition 6 we know that the S-governance emerges only if $q_J \leq f(q_S)$. This is the area below the curve $f(q_S)$ in Figure 3. In addition, from Proposition 4 we know that the S-partnership is the efficient governance structure only if $q_S \geq q_J^*$ Therefore, the area to the right of q_S^* shows the combination of q_S and q_J where S-partnerships are both efficient and viable. The area to the left of q_S^* depicts combination of q_S and q_J where an S-partnership is viable but inefficient.

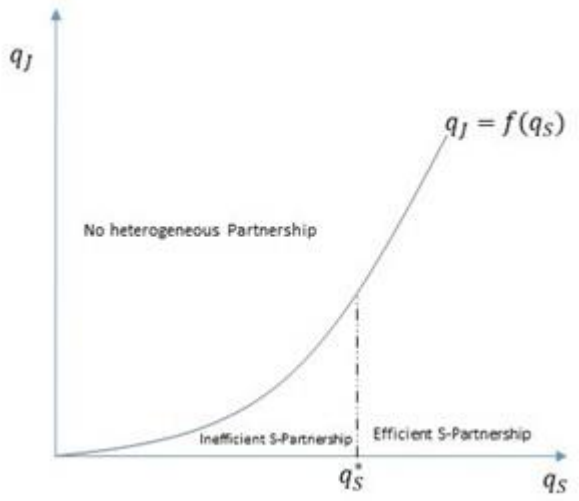

Figure 3: Emergence and Efficiency of the S-partnerships in the mature market

A similar analysis for the nascent market results in proposition 7.

PROPOSITION 7. *The S-heterogeneous partnership does not emerge as the equilibrium governance structure in the nascent market. The J-partnership is the equilibrium governance structure if and only if* $q_S \leq g(q_J)$.

Figure 4 summarizes our results regarding efficiency and governance structure in the nascent market. According to Proposition 7, we should not expect to observe the S-partnerships in the nascent market. In addition, the J-partnership is viable only if q_S is below the curve $g(q_J)$. Finally, Proposition 5 implies that J-governance is efficient only when q_J is sufficiently large, i.e., greater than q_J^*.

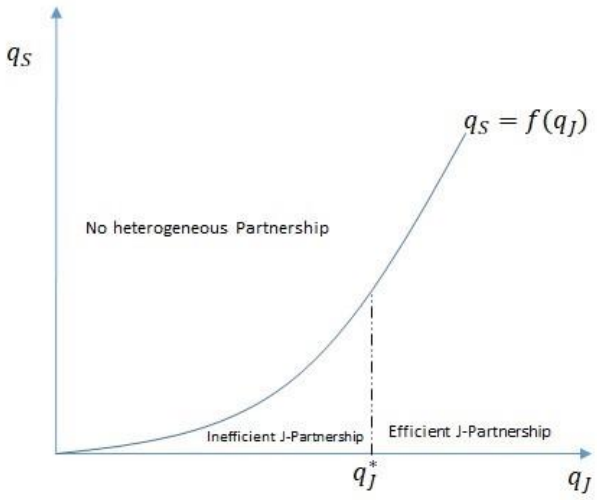

Figure 4: Emergence and Efficiency of J-partnerships in the nascent market

Finally, consider the mixed market. Contrary to the mature and nascent markets, the message NY cannot emerge in the mixed market as it requires both types to learn the return. But then NY implies that θ is larger than k_S and less than k_J, which is not possible. As a result, we don't expect to see heterogeneous partnerships in the mixed market as neither type benefits from learning.

PROPOSITION 8. *The heterogeneous partnership does not emerge in the mixed market.*

The core results of this section can be formulated as follows. Heterogeneity results in conflict in decision making as partners do sometimes disagree on the courses of actions the partnership should take. Governance structure resolves this conflict by giving one partner the authority to make the final decision following disagreement. The resolution of conflict, however, comes at the cost of the non-deciding partner who is always overruled, and aggrieved, following disagreement. The governance structure, therefore, determines who bears the cost of heterogeneity. The partner who bears the cost of heterogeneity will not join the partnership unless she/he is compensated in one or the other way. This is where learning kicks in. Learning is asymmetric in the partnership, i.e., only one type benefits from it. In the mature market, it is only Junior who benefits from learning whereas in the nascent market it is only Senior who benefits from learning. Consequently, in the mature market Junior can bear the cost of heterogeneity and being compensated by the benefits of learning. Senior, however, does not benefit from learning and so cannot bear the cost of heterogeneity. Therefore, only the S-partnership is viable in the mature market. A symmetric analysis implies that in the nascent market only the J-partnership is viable. In the mixed market, neither Junior nor Senior benefit from learning. Therefore, neither one is willing to shoulder the cost of heterogeneity and a heterogeneous partnership is not viable.

Next, for the participation constraints of partners to be satisfied, the expected magnitude of the benefits should be at least as large as the expected magnitude of costs of heterogeneity. The costs of heterogeneity, resulting from disagreement, increases with expertise (knowledgeability) of the partner without the decision rights whereas the benefits from learning decreases with the expertise. This is due to the fact that an expert is more likely to discover the true return of projects and, consequently, discover what is in her best's interests on her own. It implies that a partner is willing to join a partnership, without holding the decision rights, only if her expertise is below a certain level.

According to the homogeneity hypothesis of Hansmann (1996), efficient ownership of enterprise requires that control is granted to a group

of stakeholders having highly homogeneous interests. Shared control by various stakeholders would result in too many influencing activities for the organization to be viable. Our model, however, shows that a heterogeneous enterprise can be both efficient and viable given the market and of owners. Therefore, it is worthwhile to see how the predictions of the model match with the partnerships in practice.

First, consider professional partnerships. Our analysis implies that a J-partnership is not likely to emerge as it requires Senior to be less knowledgeable than Junior. That is, the partner who has more attractive outside options is less knowledgeable than the other partner. This is quite unlikely given the structure of most modern economies where the human capital is a key factor determining the demand for labor. This is consistent with the structure of most professional partnerships such as law partnerships, accountants and investment banking where it is the seniors who oversee decision making. For example, consider law partnerships. Big law firms can be reasonably assumed to operate in mature markets. Law partnerships have both senior and junior lawyers. The profile of senior lawyers with years of experience and junior lawyers who just graduated from law schools suggest a relatively high q_S and lowq_J. As a result, Figure 3 predicts that S-partnerships emerge, which seems consistent with the way law partnerships operate. In fact, most legal partnerships have two types of workers other than the partners. The first type consists of secretaries, accountants and other employees who support lawyers. The second type, associates, are junior lawyers with the prospect of moving up the ladder and becoming a partner. The associates have to work much like an employee for some years before becoming a partner, if they make it at all. That is, junior lawyers (to-be partners) must defer to the leadership of senior lawyers (partners). Management consulting firms also exhibit a similar pattern of giving control to senior members. As noted by Richter and Schroder (2006) ”assigning ownership to a narrowly confined group of senior employees as partners helps limit the governance costs that are associated with this assignment.”

Next, consider agricultural cooperatives. Member heterogeneity is a major concern in agricultural cooperatives. It is at the origin of many challenges facing cooperatives: horizon problem, portfolio problem, control problem, and influence costs problem (Cook 1995). Members of traditional cooperatives are farm producers who are its patrons. They

focused on organizing and marketing of raw farm commodities. The development of final product markets in terms of product differentiation resulted in increasing member heterogeneity because a substantial number of farmers responded by developing a stronger market orientation in order to capture a larger share of the food dollar. However, the changing orientation of a subset of the members may be at odds with the one-member-one-vote principle in agricultural cooperatives when the majority of farmers has only a focus on the farm. The viability of the cooperative may therefore be at stake.

The emergence of new generation cooperatives in the United States of America during the 1990s can be viewed as a response of these more market-oriented members. They exited traditional cooperatives and formed new generation cooperatives, which are characterized by closed membership and a number of other policies to reduce member heterogeneity. Grashuis and Cook (2018) characterize the emergence of these new generation cooperatives as the formation of a homogeneous group of relatively large producers. Another way to respond to the final product market developments is to change the internal payment policies. The fruit and vegetable cooperative The Greenery (Hendrikse 2011) faced the departure of a substantial number of innovative farmers. They formed their own cooperative (with a fairly homogeneous membership). They returned to The Greenery when the income rights structure was adjusted. Other cooperatives do not wait with adjustments in their internal structure till after the exit of members. Some cooperatives adopt payment policies such that the farmers having only a farm focus leave the cooperative voluntarily. The departure of these members entails that the heterogeneity of the remaining membership is reduced.

7. Improving Communication

In §4, we proved that the equilibrium messages are either a Yes (Y) or No (N). In this section we explore if communication can be improved when interactions are repeated over time.

Proposition 1 shows that the message exchanged by the two types in a one period game is a simple Yes or No and member types cannot ex ante commit to reveal their private information truthfully. This credibility problem is in part due to the fact that in a one period game there is no

consequence, or "punishment", for untruthful information revelation. However, when types have repeated interactions, they may find the right incentives to truthfully communicate the value of θ, as the long term benefits of more informative and trustworthy communication would in this case overcome the short term gains of strategic and untruthful information revelation (Fudenberg and Maskin 1986). The possibility of finer communication via relational contracts is analyzed when the message is YN Relational contracts are informal, self enforcing contracts that rely on the ongoing relationship between the parties involved. We define a specific type of relational contract, i.e., *partial revelation* (PR).

DEFINITION 2. In a repeated game, partial revelation (PR) entails that;

- Senior reveals the true value of θ in a J-partnership when he learns that $\theta < k_S$, Junior believes Senior and acts accordingly.
- Junior reveals θ truthfully in a S-partnership when she/he learns that $\theta \geq k_J$, Senior believes Junior and acts accordingly.

Consider the first case. If Senior truthfully reveals θ when he learns $\theta < k_S$, then Junior does not have any incentive to deviate from PR. Therefore, we only need to check whether PR is an equilibrium for Senior. Senior will stick to PR if there is a credible punishment available to Junior. Junior, however, cannot punish Senior upon deviating by any means other than reverting to the equilibrium of the one-shot game. In the second case, Junior truthfully informing Senior when $\theta \geq k_S$ behooves her to reveal truthfully whether she/he has learned and if so what the true value of θ is. Similar to the previous case, Senior does not have an incentive to deviate if Junior acts this way.

In order to analyze the emergence of PR we need to check if the sum of the discounted future gains exceeds the maximum temptation of deviation, i.e., the general logic of relational contracts. We do this for the mature market here and verify it for the nascent market in the appendix. Recall from §6 that in the mature market only the S-partnership can emerge. Therefore, projects that yield less than kJ are not implemented at all. It is, however, possible for Junior to learn $\theta \geq k_S$ and relay it to Senior. The present value of the expected benefit of sticking to PR for Junior is

$$\frac{\delta}{1-\delta} q_J (1 - q_S)(E(\theta|\theta \geq k_S) - k_J)(1 - F(k_S)), \qquad (8)$$

where δ is the discount rate. To understand (8), note that the benefit of PR to Junior occurs when the message is YN (more precisely θN), θ is equal or larger than k_S and it is only Junior who learns. This event occurs with probability $q_J\,(1 - q_S)(1 - F(k_S))$. The onetime gain to Junior of deviating from PR is at most $k_S - k_J$. That is, Junior can misinform Senior and claim that $\theta \geq k_S$ when θ is in fact between k_J and k_S. Junior honors PR if the benefit of honoring the relational contract exceeds the gains of deviating from it. It is given by

$$k_S - k_J < \frac{\delta}{1-\delta} q_J (1 - q_S)\big(E(\theta|\theta \geq k_S) - k_J\big)\big(1 - F(k_S)\big). \qquad (9)$$

Note that (9) holds if δ is sufficiently large. It is straightforward to verify that there exists a threshold for δ such that (9) holds if and only if δ is equal or larger than the threshold. Therefore, PR is sustainable in the S-partnership if Junior is sufficiently patient. In the appendix, we show that the same result applies also to the nascent market. Therefore, we have proved the following proposition.

PROPOSITION 9. *Partial revelation can be sustained if members are sufficiently patient.*

Proposition 9 implies that when members are sufficiently patient the prospect of higher benefits in the future enables them to resist the temptation for short term gains and, therefore, communicate in a more informative way. The improved communication, in fact, increases the expected payoffs of both types. As a result, one would expect that repeated interactions increase the overall efficiency of the partnership and the willingness of members to join the partnership. We show that this is indeed true by analyzing how the results of §5 and §6 change in a repeated game.

Consider an S-partnership in the mature market. Recall that, in an S-partnership, Junior incurs a loss when the message is YN as the project is not implemented. Some of these projects yield more than k_S That is, they are good for both types, but Senior cannot verify this due to strategic communication. PR enables the partnership to implement the projects that

are good for both types. Consequently, the expected loss to Junior of not implementing some profitable projects becomes

$$q_J \left(F(k_S) - F\left(k_J\right)\right)\left(E_M - k_J\right). \quad (10)$$

It is straightforward to check that (10) is smaller than the expected loss to Junior in the one period game given by (7). Therefore, PR decreases the expected costs of heterogeneity for Junior. The benefit of learning does not change with PR as NY results in a unanimous decision in the one period setting. As a result, PR increases the willingness of Junior to join the partnership. More formally, the upper bound for q_J in Proposition 6 changes from $f(q_S)$ to $f'(q_S) > f(q_S)$. That is, the possibility of formation of a heterogeneous S-partnership increases with PR. In addition, by implementing more good projects, the total surplus generated by the partnership increases when members interact repeatedly. We show, in the appendix, that the same result also applies to the J-partnership in the nascent market.

PROPOSITION 10. *Partial revelation increases the viability of the J-partnership in the nascent market, and the S-partnership in the mature market. In addition, the total surplus generated by partnerships increases when partial revelation emerges in equilibrium.*

Recall from §6 that a heterogeneous partnership is not viable in the mixed market if members interact only once. One might wonder whether repeated interactions can make a heterogeneous partnership viable in the mixed market by improving communication as in other types of markets. We show that this is possible. This requires defining partial revelation in the mixed market.

DEFINITION 3. *Partial revelation* in the mixed market requires that

- Both types truthfully reveal θ when they learn it;
- Projects are implemented only when θ is equal or larger than either k_J or k_S.

The definition entails that Senior and Junior have two options to agree: Implementing a project whenever it is good for both (k_S) or when it is good for Junior (k_J).

Suppose projects are implemented only if they are good for both types, that is, $\theta \geq k_S$. In this case, Senior has no incentive to deviate from PR as the partnership only implements projects that are good from Senior's perspective. PR enables Senior to benefit from good projects when θ is learned only by Junior and so would not have been implemented if Senior had operated as a standalone firm. As a result, Senior adheres to PR in both the S and J-partnership. Consider the J-partnership. The maximum punishment available to Senior, to inflict upon deviation by Junior, is reverting to the equilibrium messages Y and N. As a result, Junior honors PR and is willing to participate in the partnership only if her one time temptation plus her expected payoff upon deviation is less than or equal to her expected payoff with PR. Juniors' expected payoff upon deviation is just her expected payoff in a standalone firm. Her expected payoff in a standalone firm can be derived by partitioning θ in three ranges; from 0 to k_J, from $k_J$to k_S and from k_S to 1. It is then given by

$$(1-q_J)(E(\theta \mid \theta < k_J - k_J)F(k_J) + [E_M - k_J](F(k_S) - F(k_J)) + [E(\theta \mid \theta \geq k_S - k_J](1 - F(k_S)). \quad (11)$$

We denote (11) by E_{ST} where the subscript ST stands for standalone. The expected payoff of Junior with PR, denoted by E_{PR} equals

$$(1-(1-q_S))(1-q_J))E(\theta \mid \theta \geq k_S - k_J)(1 - F(k_S)).$$

Junior abides by PR if and only if

$$k_S - k_J + \frac{\delta}{1-\delta}E_{ST} \leq \frac{1}{1-\delta}E_{PR}. \quad (13)$$

Note that the last term in (11) is larger than the term in (12). As a result, in order for (13) to hold, the sum of the first and second terms in (11) should be negative. It implies that

$$q_J < \frac{[E_M - k_J]\left(F(k_S) - F(k_J)\right) - E(\theta \mid \theta < k_J - k_J)F(k_J)}{[E_M - k_J](F(k_S) - F(k_J))} \quad (14)$$

Denote the right hand side of (14) by q_J^*. Finally, for (13) to hold, we derive a lower bound for q_S as a function of q_J:

$$q_S \geq \frac{(1-\delta)(k_S-k_J)+\delta E_{ST}-q_J E(\theta|\theta\geq k_S-k_J)(1-F(k_S))}{(1-q_J)E(\theta|\theta\geq k_S-k_J)(1-F(k_S))} \quad (15)$$

Denote this lower bound by an increasing and convex function $f(q_J)$. We showed that the J-partnership becomes viable in the mixed market by repeated interactions if two conditions are met: $q_J < q_J^*$ and $q_S \geq f(q_J)$.

The S-partnership becomes also viable in the mixed market by repeated interactions with less stringent conditions. In fact, it can be proved that if $q_J < q_J^*$ and $q_S \geq g(q_J)$., where $g(q_J)$ is increasing and convex and $g(.) < f(.)$ for all q_J, then the S-partnership also becomes viable. Therefore, if $q_J < q_J^*$ and $q_S \geq f(q_J)$, then both governance structures are viable. This result is surprising because both governance structures implement the same type of projects with PR. That is, in both governance structures projects are implemented only when at least one type learns that θ is equal or larger than k_S. The stricter requirement for the J-partnership is due to the fact that the maximum punishment Senior can inflict upon deviation by Junior, is much weaker in the J-partnership compared to the S partnership as Junior has the decision rights in the former but not in the latter. As a consequence, the reward required to keep Junior honoring PR is also higher in the J-partnership.

PROPOSITION 11. *Suppose members interact repeatedly and PR involves implementing projects only if at least one type learns* $\theta > k_S$. *There is a* q_J^* *and functions* $f(q_J)$ *and* $g(q_J) < f(q_J)$ *such that*

- *J-partnership is viable in the mixed market if and only if* $q_J < q_J^*$ *and* $q_S \geq g(q_J)$*;*
- *J and S-partnerships are both viable in the mixed market if and only if* $q_J < q_J^*$ *and* $q_S \geq f(q_J)$

The intuition behind proposition 11 is better understood by considering the fact that neither Senior nor Junior is willing to join the partnership in the one-period game as they are better off running separate firms. Repeated interactions allow them to implement projects that are good for both types. Therefore, Senior is strictly better off as he benefits from implementing some good projects, he would not have implemented had he operated as a standalone firm. This is not the case for Junior as she/he would have implemented all the projects that the partnership implements had she/he operated independently. In addition, Junior incurs a loss as some projects that are good for her are not implemented in the partnership. But for Junior, the advantage of the partnership over a standalone firm is that the former does not implement projects that yield less than k_J, i.e., bad projects are not implemented in the partnership. As a result, for Junior to be willing to join the partnership, it should be the case that Junior would implement a lot of bad projects if operated in a standalone firm, q_J is low, the partnership does not miss a lot of good projects and q_S is high.

Finally, the required reward to Junior is lower in the S- than the J-partnership as the allocation of decision rights to Senior enables him to inflict a harsher punishment on Junior upon deviating from PR. In the S-partnership, Senior can stop implementing all projects upon YN if Junior deviates from PR once. In the J-partnership, all Senior can do is reverting to the equilibrium of the one period game. The stronger stick in the S-partnership, allows a weaker carrot to sustain PR compared to the J-partnership. Figure 5 depicts the result.

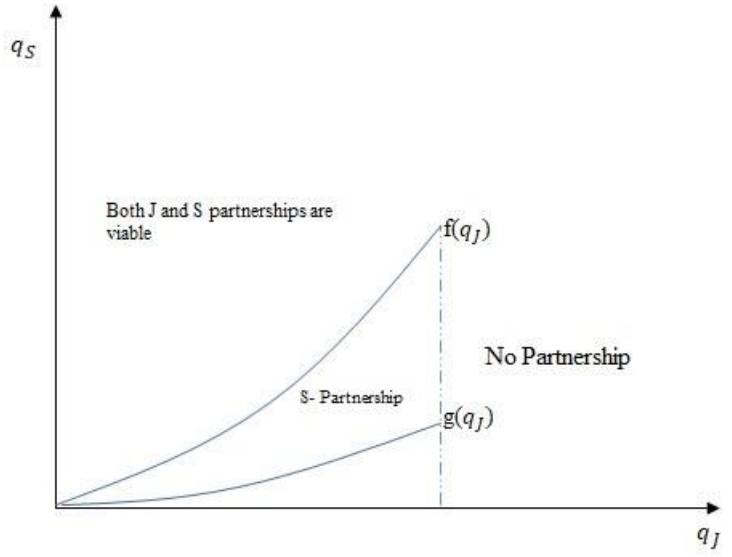

Figure 5: Viability of heterogeneous partnerships in the mixed market with repeated interactions and k_S

We can show that a heterogeneous partnership is also viable if PR entails implementing projects that only benefit Junior, $\theta \geq k_J$. The requirements, however, are more demanding than the previous case where PR entailed implementing projects that benefits both types. This is due to the fact that, contrary to the previous case, Senior is not always willing to join the partnership as PR implies some bad projects for him are implemented. Despite this fact, he is willing to join the partnership if the expected benefits from PR outweigh the costs associated with joining the partnership. The following proposition summarizes the result for this case.

PROPOSITION 12. *Suppose members interact repeatedly and PR involves implementing projects only if at least one type learns* $\theta > k_J$. *There is a* q_J' *such that the partnership is not viable if* $q_J \leq q_J'$. *Otherwise if* $E_H > k_S$ *and the below inequality holds, then both the J- and S-partnerships might be viable in the mixed market when members types are sufficiently patient.*

$$\frac{q_J[E_H - k_S](1 - F(k_J))}{q_J[E_H - k_S](1 - F(k_J)) - [E_M - k_S]F(k_S) - F(k_J)} > \frac{[E_H - k_J](1 - F(k_J)) + E(\theta \mid \theta < k_J - k_J)F(k_J)}{[E_H - k_J](1 - F(k_J))} \quad (16)$$

.

The logic behind this proposition can be explained in the following way. Note that implementing projects when either type learns $\theta > k_j$ implies that projects are implemented as long as they are good for Junior. Some of these projects might not be good for Senior. So, Senior incurs a loss. Senior, however, benefits from the possibility of identifying (and implementing) some good projects by Junior that he would not have been able to identify had he operated independently. Consequently, for Senior to be willing to join the partnership, the expected benefits should outweigh the expected loss. It entails that q_J should be sufficiently high and q_S should not be too high. In addition, his average payoff, resulting from implementing projects when $\theta > k_J$ should be positive. This explains the lower bound on q_J and $E_H > k_S$. Finally, note that Junior also makes a loss as some projects that are good for her are not implemented. In return, the partnership allows her to avoid some bad projects that she/he would have implemented had she/he operated independently. For Junior to be willing to join the partnership, the expected benefits should outweigh the expected loss. It requires q_S to be sufficiently high. Therefore, the incentive compatibility constraint of Senior determines an upper bound for q_S and the incentive compatibility constraint of Junior determines a lower bound on q_S. The inequality (16) ensures that the upper bound is higher than the lower bound.

8. Summary and Further Research

This article studies the viability and efficiency of heterogeneous collective entrepreneurships. For this purpose, we analyze communication and decision making in these organizations. To model the problem, we assume a stylized collective entrepreneurship consisting of a Junior and a Senior member. The governance structure determines which member is granted the decision rights. The difference between the opportunity costs of the two types reflects the divergence of interests, or heterogeneity of the collective entrepreneurship. The two types are also distinguished by having a different chance of learning or expertise.

We show that the divergence of interest makes communication noisy as members transmit information strategically. In addition, when the divergence of interests exceeds a threshold, i.e., heterogeneity becomes large, then the final implementation decision is not always consensual. Therefore, the member who does not have the decision rights is aggrieved

because some projects she/he likes are not implemented and some other projects that she/he does not like are implemented. This in turn implies that the member without the decision right will not join unless she/he is compensated in one way or the other. This compensation takes the form of learning as members can learn from each other. The learning, however, is not symmetric, i.e., only one-member type benefits from it and the identity of that member is determined by the market. If the aggrieved member is compensated by the benefits of learning, then a heterogeneous collective entrepreneurship becomes viable. The asymmetry of learning implies that market and governance structure are intertwined. We establish that the size of costs and benefits to the non-deciding member, depends on the level of expertise of the member. The higher the level of expertise the less the benefits and the higher the cost. Therefore, a member without the decision right is willing to join the collective entrepreneurship only if she/he does not have a high level of expertise.

Our analysis of efficiency shows that the governance structure that generates a higher total surplus is determined by two factors: the market type and the expertise of the member whose message is congruent with the market. When the market is extreme, i.e., very favorable or very unfavorable, the type of collective entrepreneurship whose implementation decision is congruent with the market generates a higher total surplus and, therefore, is efficient. When the market is not extreme, the collective entrepreneurship whose implementation decision is congruent with the market is efficient only if the partner whose message is congruent with the market is highly likely to learn the projects payoff, i.e., has a high level of expertise. Finally, we establish that if partners interact repeatedly, then they will be able to have more informative, finer communication when they are patient enough. Finer communication in turn allows them to increase their payoff and hence, increase the parameter space of viable collective entrepreneurship.

There are several limitations and possibilities for future research. First of all, we assumed an equal distribution of returns among members. In many cases, senior and junior members do not share the returns equally. This assumption allows us to analyze important cases where the return is mainly an increase in the human capital of members, such as in professional partnerships. But a promising line of research for future is analyzing the case where the returns are distributed endogenously.

Secondly, we abstracted from the nature of outside options heterogeneity and reduced it to the difference between opportunity costs of members. In some types of collective entrepreneurship, like cooperatives, the problem with heterogeneity is not merely about the financial returns of projects but more often, about how the business course of the entrepreneurship affects the future power and position of members. For example, milk processing cooperatives usually consist of farmers who deliver milk with different qualities. A cooperative might be able to produce a new lucrative product that makes use of only high quality milk. Farmers who are unable to produce high volumes of high quality milk might veto the launch of the new line despite benefiting from its revenue. We believe that these types of heterogeneity are more problematic than what we assumed and are worth further researching. Last, but not the least, is incorporating the political and institutional factors in analyses of collective entrepreneurship. This is especially relevant in developing countries lacking well-functioning institutions such as independent courts, professional police, economic and political freedom and so on (Bai et al. 2014).

Appendix

Proof of Proposition 1

First note that if the receiver has learned θ, then she/he will ignore the message and the sender is indifferent between sending any message. Of course, the sender does not know whether the receiver has learned or not. In addition, when the sender has the decision rights, she/he is indifferent between sending any message as the receiver's belief does not affect the implementation decision. Therefore, the relevant cases happen when the sender does not have the decision rights, i.e., Senior in J-partnerships and Junior in S-partnerships. Consider the case when Senior learns that $k_J \leq \theta < k_S$ in the J-partnership. If Senior truthfully reveal it to Junior and Junior believes it, then Junior would implement the project. But Senior can do better by claiming θ is less than k_J whenever $k_J < \theta < k_S$. As a result, Senior has incentive not to reveal θ truthfully when $\theta < k_S$. Knowing this, Junior does not believe Senior whenever the latter claims that $\theta < k_J$ and interprets this message as an indication that $\theta < k_S$. As a result, when Senior learns that $\theta < k_S$, any message claiming $\theta < k_J$ induces the same belief in Junior. Therefore, the equilibrium strategy of Senior entails claiming $\theta < k_J$

whenever she/he learns that $\theta < k_S$. It is evident that any message claiming $\theta < k_J$ is equivalent to sending no (N) to express a negative opinion on the project. If, on the other hand, Senior learns that $\theta \geq k_S$, then it is in the best interest of Senior to reveal the true θ as it leads to implementing the project by Junior in J-partnerships. Again, sending any message implying $\theta > k_J$ is equivalent to sending a simple yes (Y). Finally, when Senior does not learn θ, she/he relies on her prior and sends a message based on the expected value of θ. In case the expected value of θ is larger than k_S, she/he is indifferent between sending any message implying $\theta \geq k_J$ and sending a yes (Y) as both induce the same belief in Junior. In case the expected value of θ is less than k_S, Senior is indifferent between sending any message implying that $\theta < k_J$ and No (N) as both induce the same belief in Junior. As a result, the equilibrium communication strategy of Senior entails:

- Sending Y whenever she/he learns that $\theta \geq k_S$ or when she/he does not learn and the expected value of θ is equal or more than k_S.

-Sending N whenever she/he learns that $\theta < k_S$ or when she/he does not learn and the expected value of θ is less than k_S.

The equilibrium belief of Junior entails believing that θ or its expected value is equal or larger than k_S when the message is Y and believing that θ or its expected is less than k_S when the message is N.

A symmetric argument shows that Junior does not truthfully reveal θ when he learns that $\theta > k_J$ because if he does so and Senior believes it, then Senior does not implement the project when $k_J \leq \theta < k_S$ in the S-partnership. So, Junior is better off claiming $\theta > k_S$ when $k_J \leq \theta < k_S$. Given this fact, Senior does not believe Junior when the latter claims $\theta > k_S$. Following the same line of argument as for the case of Senior, the equilibrium communication strategy of Junior entails:

-Sending Y whenever he learns that $\theta \geq k_J$ or when he does not learn and the expected value of θ is equal or more than k_J.

-Sending N whenever he learns that $\theta < k_J$ or when he does not learn and the expected value of θ is less than k_J.

The equilibrium belief of Senior entails believing that θ or its expected value is equal or larger than k_J when the message is Y and believing that θ or its expected is less than k_J when the message is N.

Finally, the communication game has a babbling equilibrium in which the sender sends a random message and the receiver ignores it. Q.E.D.

Proof of Proposition 3

In a mature market assumption 2 implies that $E_M < \bar{k}$ since $f(.)$ is decreasing between k_S and k_J. Therefore, if $E_H < \bar{k}$ then $E_S^{Mature} < 0$. So, the S-partnership partnership is uniquely efficient. If $E_H > \bar{k}$ then the first term in

$$E_S^{Mature} = (1-q_S)[2E_H - k_S - k_J] + q_S \frac{F(k_S) - F(k_J)}{1 - F(k_J)}[2E_M - k_S - k_J]$$

is positive. The expression then shows that if q_S =1 the first positive term cancels whereas if $q_S = 0$ the first negative term cancels. As a result, there is a q_S^* such that E_S^{Mature} becomes positive if and only if $q_S < q_S^*$. Q.E.D.

Proof of Proposition 4

Following YN, the J-partnership implements the project, but the S-partnership does not (due to assumption 1). All other combinations of

$$E_S^{Na} = (1-q_J)[(E(\theta \mid \theta \le k_S) - k_i] + q_J \frac{(F(k_S) - F(k_J))}{F(k_S)}[E(\theta \mid k_J \le \theta \le k_S) - k_i] \quad (17)$$

messages result in the same implementation decision in either governance structure. Note that the message N from Senior in this market implies learning. The surplus that goes to type $i \in \{L,C\}$ after implementing such a project, given message YN, is

The first term in (17) reflects the event that the Y message from Junior relies on the prior belief, i.e., Junior did not learn θ. The N from Senior, however, implies learning. That's why the expectation is conditional on

$\theta \leq k_S$. If Senior learns but Junior does not, all that can be extracted from YN is $\theta \leq k_S$. The second term reflects the complementary event that Y from Junior stems from learning θ. When both Junior and Senior learn and send YN, it implies that θ is betweenk_S and k_J. That's why the expectation is conditional on $k_J < \theta < k_S$. The overall expected surplus, conditional on YN, can be stated as

$$(1-q_J)[2(E(\theta \mid \theta \leq k_S) - k_S - k_J] + q_J \frac{(F(k_S) - F(k_J))}{F(k_S)})[2E(\theta \mid k_J \leq \theta \leq k_S) - k_J - k_S]$$

We can now rewrite (17) as

$$E_S^{Na} = 2(1-q_J)[E_L - \bar{k}] + 2q_J \frac{(F(k_S) - F(k_J))}{(F(k_S)}[E_M - \bar{k}] \qquad (18)$$

If (18) is positive, then the J-partnership is more efficient than the S-partnership since the overall surplus generated by implementing projects following YN is larger than zero. The total expected surplus of implementing a project following YN is given by (18). Since the project is implemented only in a J-partnership, it is sufficient to examine the sign of (18) to determine the efficient governance structure. The following proposition states the result. Note that assumption 2 implies that $2E_M - k_S - k_J$ is positive. This follows since by this assumption $f(\theta)$ is increasing between k_J and k_S. Therefore, the second term in

$$(1-q_J)[2E_L - k_J - k_S] + q_J[F(k_S) - F(k_J)](2E_M - k_J - k_S)$$

is always positive by assumption 2. If the first term is also positive, then $E_S^{Nascent} > 0$ so J-partnership governance is uniquely efficient. This completes the proof of first part. For the second part note that if $E_L < \bar{k}$, then the first term in $E_S^{Nascent}$ is negative. Examining $E_S^{Nascent}$ we see that if $q_J = 0$ then the second term cancels so $E_S^{Nascent}$ becomes negative. If $q_J = 1$ then the first terms cancel so $E_S^{Nascent}$ becomes positive. Therefore, there must be a q_J^* such that $E_S^{Nascent} \geq 0$ if and only if $q_J > q_J^*$. Q.E.D.

Proof of proposition 5

The expression for the expected surplus in the mixed market given message YN is

$$E_S^{Mi} = 2q_S q_J\left(F(k_S) - F(k_J)\right)\left[E_M - \bar{k}\right] + 2(1-q_S)q_J\left(1 - F(k_J)\right)\left[E_H - \bar{k}\right] + 2q_S(1-q_J)\left[E_L - \bar{k}\right] + 2(1-q_S)(1-q_J)\left[E(\theta) - \bar{k}\right]. \quad (19)$$

The following proposition characterizes the efficient governance structure.

PROPOSITION 13. *In a mixed market the efficient governance structure is*

- *J if* $E_L \geq \bar{k}$.
- *S if* $E_H < \bar{k}$.

If $E_L < \bar{k} \leq E_H$, *the efficient governance structure is*

- *J if one of the following conditions is satisfied: 1a)* $E_M \geq \bar{k}$ *and* q_J *is sufficiently high; 2b) if* $E_M < \bar{k}$, q_S *is sufficiently low and* q_J *is sufficiently high;*
- *S if one of the following conditions is satisfied: 1b)* $E_M < \bar{k}$ *and* q_S *is sufficiently high; 2b) if* $E_M > \bar{k}$, q_S *is sufficiently high and* q_J *is sufficiently low.*

Proof: Assumption 2 does not readily imply $E_M < \bar{k}$. Therefore, we need to distinguish more cases compared to the nascent and mature markets. Note that E_S^{Mixed} in (12) shows that if $E_H \leq \bar{k}$ then $E_S^{Mixed} < 0$ since all other terms are less than E_L. Symmetrically, if $E_L \geq \bar{k}$ then $E_S^{Mixed} > 0$ since all other terms are larger than E_L. On the other hand, if $E_L < \bar{k} < E_H$ then we need to distinguish between cases based on whether $E_M < \bar{k}$ or not. Suppose $E_M < \bar{k}$ as q_S approaches 1 the expression of E_S^{Mixed} can be stated as

$$q_J\left(F(k_S) - F(k_J)\right)\left[2E_M - k_S - k_J\right] + (1-q_J)F(k_S)\left[2E_L - k_S - k_J\right]$$

since both terms are negative, we have $E_S^{Mixed} < 0$. Therefore, there exist a q_S^* such that if $q_S \geq q_S^*$. S-partnership partnership is efficient. Consider

the symmetric case when q_J approaches 1. This time the expression of E_S^{Mixed} can be stated as

$$q_S\left(F(k_S)-F(k_J)\right)\left[2E_M\ -k_S\ -k_J\right]+(1-q_S)\left(1-F(k_J)\right)\left[2E_H\ -k_S\ -k_J\right]$$

In the above expression, the first term is negative, but the second term is positive. As a result, there exist a q_S'' such that when $q_S < q_S''$ the expression is positive, otherwise it is negative. Therefore, we can summarize the result for the case $E_M < \bar{k}$ as: if q_S is sufficiently high then the S-partnership partnership is efficient. If q_S is sufficiently low and q_J is sufficiently high, then the J-partnership partnership is efficient. Finally, suppose $E_M \geq \bar{k}$. A similar reasoning leads to the following result:

if q_J is sufficiently high then the J-partnership partnership is uniquely efficient. Q.E.D.

Proof of Proposition 7

Consider now the nascent market. A similar analysis as for the mature market shows that NY messages only benefits Senior and not Junior since in the nascent market Junior sends N only if she/he has learned θ. Therefore, in order for Junior to be willing to participate in the partnership, she/he should not incur the cost of heterogeneity. It implies that Junior does not participate in a S-partnership. The J-partnership is the only viable form of heterogeneous partnership in the nascent market. For Senior to be willing to participate in a J-partnership, his expected benefit must outweigh his expected loss due to heterogeneity. The expected benefit to Senior is given by

$$(1-q_S)\ q_J F(k_J)[k_S\ -E(\theta\mid\theta\ \leq k_J)], \tag{20}$$

The first three terms reflect the probability of occurrence of NY. The expected loss of Senior in a J-partnership relates to implementing projects following the YN message, and is given by

$$q_S F(k_S)[q_J\frac{(F(k_S)-F(k_J))}{F(k_S)}(k_S-E_M)+(1-q_J)(k_C-E_L)] \tag{21}$$

Comparing (20) with (21) we can derive the necessary and sufficient condition for Senior to participate in the partnership, i.e., his expected benefit

has to be at least as large as his expected loss due to heterogeneity. This boils down to an upper bound for q_S as a function of $q_J$denoted by

$$g(q_J) = \frac{q_J F(k_J)[k_S - E(\theta|\theta \geq k_J)]}{q_J F(k_J)[k_S - E(\theta|\theta \geq k_J)] + F(k_J)q_J \frac{F(k_S) - F(k_J)}{F(k_S)}[k_S - E_M] + (1 - q_J)(k_S - E_L)}$$

and it is verified that $g(q_J)$ is increasing and convex in q_J.

Proof of Proposition 10

Consider the nascent market. Recall that only J-partnership partnerships emerge in the nascent market and the project is implemented following YN. Therefore, PR involves Senior truthfully informing Junior when $\theta < k_J$. The present value of the expected benefit to Senior of sticking to PR is given by

$$q_S(1 - q_J)E(k_S - \theta \mid \theta \leq k_J)F(k_J)$$

On the other hand, Senior can lie and misinform Junior when he learns that $k_J \leq \theta \leq k_S$ and avoid a loss of at most $k_S - k_J$ once. However, he loses the future benefits of partial revelation since Junior will not believe him any longer after the first lie. As a result, Senior honors partial revelation if

$$k_S - k_J < \frac{\delta}{(1-\delta)} q_S(1 - q_J)E(k_S - \theta \mid \theta \leq k_J)F(k_J)$$

The above inequality holds if δ is sufficiently large.

Proof of Proposition 11

With repeated interaction and PR, the implementation decision is identical to one period setting for all message composition but YN. PR enables the S-partnership partnership to implement projects if they yield more than k_S following YN. Therefore, the expected total surplus of implementing a project in the S-partnership partnership following YN is

$$2[E(\theta \mid \theta \geq k_S) - \bar{k}](1 - q_S) > 0 \qquad (22)$$

Therefore, the total surplus generated with PR is higher than the total surplus in the one period game.

Next, consider a J-partnership in the nascent market. Senior incurs a loss when the message exchange is YN, as Junior implements projects that are unprofitable for Senior. If PR is possible, projects that yield less than k_J will not be implemented following YN. Therefore, the expected loss to Senior is

$$q_S\left(F(k_S) - F\left(k_J\right)\right)(k_S - E_M) \tag{23}$$

Obviously, (23) is lower than the expected loss to Senior in the one period game. Since the expected benefit to Senior does not change from what it was in the one period setting, we can conclude, similar to the previous case, that the upper bound required to satisfy Senior's individual rationality constraint (Proposition 7) changes from $g\left(q_J\right)$ to $g'\left(q_J\right) > g\left(q_J\right)$. It implies that the possibility of formation of a heterogeneous J-partnership partnership increases with PR in an ongoing relationship. Avoiding projects that yield less than k_J increases the total surplus of the J-partnership partnership. Q.E.D.

Proof of Proposition 12

Consider the S-partnership partnership. Junior sticks to PR only if her one time temptation is less than the continuation value of PR,

$$k_S - k_J < \frac{\delta}{1-\delta}(1 - (1 - q_j)(1 - q_S)\left(E(\theta|\theta \geq k_S) - k_J\right)\left(1 - F(k_S)\right)). \tag{24}$$

If Junior is sufficiently patient, then (24) holds and, therefore, PR is sustainable in the S-partnership partnership. An important question still needs to be addressed; is Junior willing to join the partnership in the first place? note that Junior incurs a loss as none of the projects that are only good for her ($k_J \leq \theta < k_S$), are implemented with PR. To answer this question, we need to compare the expected payoff of Junior in the S-partnership partnership under PR with her expected payoff in a standalone firm. Her expected payoff in the S-partnership partnership with PR equals the right hand side of (24) without the discounting factor ratio, i.e.,

$$\left(1 - (1 - q_S)\left(1 - q_J\right)\right)E\left(\theta \,|\theta \geq k_S - k_J\right)\left(1 - F(k_S)\right) \tag{25}$$

Her expected payoff in a standalone firm can be derived by partitioning θ in three mutually exclusive ranges; from 0 to k_J, from k_J to k_S and from k_S to 1. It is then given by

$$(1 - q_J)(E(\theta \mid \theta < k_J - k_J)F(k_J) + [E_M - k_J](F(k_S) - F(k_J)) + [E(\theta \mid \theta \geq k_S - k_J](1 - F(k_S)) \quad (26)$$

Junior is willing to join the partnership if and only if (25) ≥ (26). Note that the last term in (26) is larger than the only term in (25). As a result, the necessary condition for (25) to be larger than (26) is that the sum of the first and second terms in the later is negative. It implies that

$$q_J < \frac{[E_M - k_J](F(k_S) - F(k_J)) - E(\theta \mid \theta < k_J - k_J)F(k_J)}{[E_M - k_J](F(k_S) - F(k_J))} \quad (27)$$

Given (27), the sufficient condition for (25)≥(26) can be derived as

$$q_S \geq \frac{(1-q_J)\{E(\theta \mid \theta < k_J - k_J)F(k_J) + E(\theta \mid \theta \geq k_S - k_J)(1 - F(k_S))\} + [E_M - k_J](F(k_S) - F(k_J))}{(1-q_J)[E\theta \mid \theta \geq k_S - k_J](1 - F(k_S))} \quad (28)$$

Note that (28) is a function of q_J. So, we can state (28) as $q_S \geq g(q_J)$, where g is increasing in q_J. If (27) and (28) are satisfied, then a S-partnership heterogeneous partnership becomes viable in the mixed market by repeated interactions. We established that Senior sticks to PR in either governance structures if Junior is abided by PR. In the S-partnership partnership, the maximum punishment Senior can inflict is refusing to implement projects following YN.

Proof of Proposition 13

Contrary to the previous case, Senior is not always willing to join the partnership as PR entails implementing some projects that are not good from his perspective (when $k_J < \theta < k_S$). The same is true also for Junior as projects whose θ is not learned are not implemented. Therefore, we need to check the participation constraints of both types. Senior is willing to join the partnership if his expected payoff with PR is at least as large as his expected payoff in a standalone firm. It requires

$$q_S[E(\theta \mid \theta \geq k_S - k_S)](1 - F(k_S)) \leq (1 - (1 - q_S)(1 - q_J))[E_H - k_S](1 - F(k_J)) \quad (29)$$

The left-hand side of (29) is positive. The right-hand side should also be positive for (29) to hold. It Implies $E_H > k_S$. If this the case, then we get, from (29), an upper bound for q_S as a function of q_J

$$q_S < \frac{q_J[E_H - k_S](1 - F(k_J))]}{q_J[E_H - k_S](1 - F(k_J)) - [E_M - k_S](F(k_S) - F(k_J))} \quad (30)$$

Senior sticks to PR if his deviation temptation is less than his expected payoff under PR. The deviation temptation depends on the governance structure. It is straightforward to check that in the J-partnership partnership, Senior does not deviate from PR since he would be worse off when Junior responds by reverting to the one-period equilibrium. In the S-partnership partnership, the deviation temptation is a onetime gain of $k_S - k_J$ plus the expected payoff of the standalone firm. That is, Senior honors PR if

$$(1 - \delta)(k_S - k_J) + \delta q_S[E(\theta \mid \theta \geq k_S - k_S)](1 - F(k_S)) < \left(1 - (1 - q_S)(1 - q_J)\right)[E_H - k_S]\left(1 - F(k_J)\right) \quad (31)$$

Comparing (31) with (29) shows that if δ is sufficiently large, then (31) holds whenever (29). That is, if Senior is sufficiently patient, then he sticks to PR whenever he joins the J-partnership partnership. Therefore, we established that if $E_H > k_S$ and (30) holds, then Senior is willing to join a S-partnership partnership and honor PR. In addition, if he is sufficiently patient, he is also willing to join a J-partnership partnership and honor PR. Consider Junior. Junior is willing to join the partnership and honor PR if her expected payoff under PR is at least as large as her expected payoff with PR. It implies

$$\left(1 - (1 - q_S)\left(1 - q_J\right)\right)[E_H - k_J]\left(1 - F(k_J)\right) \geq [E_H - k_J]\left(1 - F(k_J)\right) + \left(1 - q_J\right)E(\theta \mid \theta < k_J - k_J)F(k_J) \quad (32)$$

With a little bit of algebra (32) can be stated as

$$q_S \geq \frac{[E_H - k_J](1-F(k_J))]+E(\theta|\theta<k_J-k_J)F(k_J)}{[E_H-k_J](1-F(k_J))} \quad (33)$$

Finally, we need to check whether Junior honors PR or not. It is straightforward to check that Junior has no incentive to deviate from PR in a S-partnership partnership as the response from Senior (equilibrium of one-period game) makes her worse off. In a J-partnership partnership Junior honors PR if her one-time gain, $(k_S - k_J)$, plus the expected payoff in a standalone firm is less than her expected payoff with PR. It means

(34)

$$\begin{aligned}\Big(1-(1-q_S)(1-q_J)\Big)\,[E_H - k_J](1-F(k_S)) \\ \geq (1-\delta)(k_S - k_J) \\ + \delta\Big\{[E_H - k_J]\Big(1-F(k_J)\Big) + \Big(1-q_J\Big)E(\theta\,|\theta < k_J - k_J)F(k_J)\Big\}\end{aligned}$$

Comparing (34) with (32) shows that if δ is sufficiently large, i.e., Junior is patient, then (34) holds whenever (32) holds. That is, if Junior is willing to join either type of partnership, then she/he will always honor PR in a S-partnership partnership. Junior honors PR also in the J-partnership partnership if she/he is sufficiently patient. If the heterogeneous partnership is viable, then the participation constraints of both Junior and Senior should be satisfied. It entails that q_S should be such that both (30) and (33) are satisfied simultaneously. It can happen only if the right-hand side of (30) is larger than the right hand side

of (33) for a given q_J. If $q_J = 1$, then (30)>(33) implies

$$E(\theta) - k_J \geq \frac{F(k_J)E\Big(\theta|\theta<k_J-k_J)\Big)[E_H-k_S](1-F(k_J))}{[E_M-k_S](F(k_S)-F(k_J))} \quad (35)$$

In addition, since f is an increasing function of q_j, there exist a q_J'such that (30)>(33) does not hold whenever $q_J < q_J'$. That is, a heterogeneous partnership is not viable in the mixed market if $q_J < q_J'$.

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Chapter 3: Social Image, Self-Confidence and Organizational Behavior

This article analyzes the effects of self-confidence and social image on managerial performance in a model where the firm implements projects with stochastic returns and the manager cares about her social image. Three results are established. First, followers might exert a higher effort when the manager is confident compared to an unconfident manager despite knowing that there is a negative relationship between confidence and ability. This happens when the followers who are aware of the relationship between confidence and ability also know that a sufficient fraction of followers believe there is a direct association between confidence and ability. Second, image concern imposes a cost on organization because the manager is committed to implement inferior projects in order to save face. Our analysis therefore provides a behavioral explanation for commitment escalation. Third, managers with a high or low status are less vulnerable to image loss, compared to managers with an intermediate status, when it comes to correct a failed course of action. Image preservation is therefore the problem of middle status managers.

Keywords: Self-confidence, managerial social image, commitment escalation

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1. Introduction

The relentless quest of individuals to find the thinnest signs confirming their ability, while forgetting the strongest evidence implying lack of ability, has caught the attention of philosophers and social scientist and even biologists (Garrett and Sharot (2017)). In economics, it had been believed for a long time that having the most accurate information about any parameter, including the ability of the self, is pivotal for making optimal decisions and maximizing welfare. This view, however, has been challenged as an overwhelming number of studies, experiments and lab tests have

confirmed a positive association between possessing a positive self-assessment and a constellation of desirable, welfare enhancing outcomes (Lane et al. (2004)). Social scientists have documented not only the prevalence of inflated self-assessment among individuals with diverse backgrounds, but also the benevolent implications of having a positive self-assessment for psychological health and the general well-being of individuals. As a result, economists are trying to unveil the deep roots of the need for self-confidence, the strategies people follow to maintain their self-confidence and its various implications for economic decisions.

This article investigates confidence and social image from a social perspective. Empirical evidence poses an important puzzle. On the one hand, we know that most people think they are smarter and more capable than they actually are (Alicke and Sedikides (2009)). On the other hand, a number of studies show that overconfident managers are better received by their followers, peers and investors. For example, Anderson et al. (2012) and Kennedy et al. (2013) provide evidence that overconfidence, even when unjustified, results in a higher social status and a higher social evaluation of the manager's skills. In another example, Phua et al. (2018) show that overconfident managers induce more supplier commitment, stronger labor commitment and less turnover. Therefore, it seems that most people, including managers, are unduly confident and these overconfident managers are favored by their followers, peers and investors. This article aims to shed light on this puzzle.

We analyze the effect of the managerial self-confidence on motivating the followers. A positive association between competence and confidence results in confident managers eliciting higher effort and commitment from their followers than unconfident managers. The interesting case, however, happens if there is no relationship or even a negative relationship between confidence and competence. We show that even in the latter case, a confident manager might be more successful in motivating the followers compared to a more competent but unconfident manager. To show the underlying mechanism, we assume that there are two types of followers. Experts, who are aware of the negative relationship between confidence and competence, and non-experts who assume,

incorrectly, that confidence implies competence. We show that experts prefer a confident manager to an unconfident manager if two conditions are met. First, if a large fraction of followers is non-expert. Second, if managerial and followers' inputs are highly substitutable.

Next, we analyze the relationship between managerial status (social image) and reversing a failed business initiative. The analysis assumes an industry culture where managerial status is damaged in case the manager aborts the business initiative. One might think that a high managerial status, or social image, resembles a vulnerable asset that has to be taken care of and, subsequently, a high-status manager is less likely to reverse her decision following receiving new information. We show that this intuition is not correct. This is since image loss (status loss) is not monotonic with the initial value. That is, status loss initially increases with the status but decreases afterwards. In other words, a manager with a very high status is less vulnerable to image loss than a manager with a lower status. This non-monotonicity in turn implies that image concern is mostly the problem of managers with moderate status.

The rest of the paper is organized as follows. Section 2 introduces the relevant literature in psychology and economics and positions the paper in the literature. Section 3 presents the model. In Section 4 we solve the model and derive the equilibria of the game. Section 5 studies the welfare consequences of image concern. Section 6 presents comparative statics. In Section 7 an extension is presented and, finally, Section 8 summarizes the results and present possible avenues for future research.

2. Related literature

Overconfidence has been researched both from an intra-personal perspective and also from an inter-personal, social perspective. The intra-personal perspective researches the possible causes and potential effects of overconfidence for the psychological, biological and financial wellbeing of people. The inter-personal perspective on overconfidence studies how overconfidence affects the relationship of an individual with the society. In psychology, the seminal article of Dunning and Kruger (1999) proposes that individuals are biased

when it comes to assess their own ability. Subsequent studies provide some support for this hypothesis and show that there is a moderate relationship between how people evaluate themselves and objective measures of their performance (Dunning et al. (2004); Zell and Krizan (2014)). In economics, developments in behavioural economics have brought overconfidence to the forefront of the research agenda for theorists as well as empirical/experimental researchers.[3] The economic literature distinguishes the instrumental effect of overconfidence from the hedonic (affective) effect. The instrumental effect is beneficial when it counteracts the adverse effects of an incomplete self-control, time inconsistency or some forms of irrationality. For instance, the logic for the case of time inconsistency goes like this. When there is a delay between costly effort provision and the ensuing reward, time inconsistency results in procrastination and low effort provision because the cost of exerting effort is disproportionately felt high (O'Donoghue and Rabin (1999)). An inflated view of the self-mitigates this problem by pushing up the subjective perception of the chance of success and thereby counteracting against procrastination. That is, an inflated view of the self-counteracts the tendency to procrastinate (Benabou and Tirole (2002); Benabou and Tirole (2004)).[4] The hedonic perspective on overconfidence assumes that people derive utility merely from thinking positively or anticipating positive outcomes in the future (Koszegi¨ (2010); Benabou (2013)). Contrary to the instrumental case, this type of anticipatory utility is mostly detrimental since it results in distorted choices and making sub-optimal decisions. Benabou and Tirole (2016) provide a review of the topic of beliefs, including belief about self. This paper does not research overconfidence from an intra-personal perspective but takes

[3] Note that our interpretation of overconfidence is concentrated on the difference between the subjective evaluation and objective measures of performance and not on how people rank their themselves among others or their subjective placement. We do not, therefore, consider the effect of overconfidence on specific business decisions such as industry entry (Camerer and Lovallo 1999) or information acquisition in financial market (Garc´ıa et al. 2007).

[4] A related paper about the effect of incomplete self-control is Carrillo and Mariotti (2000). They show that individuals might strategically stop learning if they know that they are not able to commit to a future action. This article highlights information about ability and self.

overconfidence as an exogenous phenomenon and then analyzes its consequences in motivating others.

The inter-personal perspective on overconfidence builds on the premise that people care about their status or social image (Anderson et al. (2015)). This concern for preserving a positive social image is so strong that people take (or refrain from taking) obviously harmful (beneficial) actions to protect their social image (Bursztyn et al. (2018); Lacetera and Macis (2010)). Given the importance of social image, it is not a surprise that overconfidence functions as a tool for social signaling and strategic considerations (Burks et al. (2013)). This paper studies overconfidence from an inter-personal perspective and build on the premise that people care about their social image.

Finally, our paper analyzes the consequences of managerial overconfidence and image concerns on the firm. The organizational effects of CEO overconfidence have been analyzed in a number of papers. For example, Gervais et al. (2011) show that overconfident managers are more attractive to firms since firms are able to compensate them with flatter compensation packages. Goel and Thakor (2008) show that overconfident managers are more likely to be promoted and overconfidence is value enhancing up to a point when the manager is risk averse. On the other hand, overconfident managers are overly sensitive to the investment-cash flow ratio and engage more in value destroying activities according to Malmendier and Tate (2005 and 2009). Our paper is similar since we analyze the effect of managerial confidence on firm performance. However, our analysis includes both the direct channel and an indirect channel through which overconfidence affects organizations. Finally, our analysis of the effects of image preservation provides a new insight for the phenomenon of escalation of commitment outlined by (Staw (1981) and Bowen (1987)).

3. The Model

Players: A firm consists of a manager and a unit mass of followers. The firm intends to implement a project. Projects have a stochastic return $R \geq 0$ with a known CDF, F(R). A good project (G) returns at least as much as an outside option that yields $r > 0$. A bad

project (B) yields less than r. The manager is characterized by her ability and her confidence. The ability of the manager is either high H or low L. The proportion of high ability managers is σ in the society. A fraction α_H (α_L) of high (low) ability managers are confident (C). The other managers are unconfident (U). There are two types of followers: experts (E) who comprise a fraction $1-\gamma$ of the followers and non-experts (N) comprising a fraction γ of the followers.

Beliefs: Experts are rational, i.e., use Bayes' rule to form and update beliefs. Non-experts have distorted beliefs. They presume α_H =1, α_L =0 and γ =1. That is, non-experts believe that there is a direct and deterministic relationship between confidence and ability. In addition, non-experts believe that there is no difference between them and the experts.

Actions: There are six decisions. First, the choice of the project must be made. A high ability manager chooses a good project with probability $1-\beta$ and a bad project with probability β. A low ability manager always chooses a bad project. Second, the manager chooses a minimum acceptable return for the project denoted by R_{min}. Third, experts choose whether to investigate (I) the project or not (N). If they investigate, then they discern the true return of the project with certainty. Fourth, experts decide whether to communicate (C) or remain silent (S) following the investigation. If they do not investigate, then they remain silent. Fifth, the manager decides whether to proceed (P) with the project or abort (A) it. If the manager decides not to proceed with the project, then $R = r > 0$. Not proceeding with the project can be interpreted as implementing a safe project with a deterministic return equal to r. Finally, experts (non-experts) choose the effort level $e_E(e_N)$.

Information structure: Neither the manager nor the followers observe the return of the project and the manager's ability. The manager and the followers just observe whether the manager is confident or not. Experts know the true return of the project only if they investigate the project. In addition, they are aware that non-experts have distorted beliefs.[3]

Payoffs: The final return is a function of the project's return and followers' effort. It is denoted by $v(e_N, e_E, R)$ and specified by the following CES production function

$$v(e_N, e_E, R) = [(\gamma e_N + (1-\gamma)e_E)^{\nu} + R^{\nu}]^{\frac{1}{\nu}}$$

where v is the substitution parameter. The manager receives a portion y of the final return. The manager cares also about her ***social image*** or ***status*** among the experts. We reflect these considerations of the manager in a separable utility function given by

$$U = yv(e_N, e_E, R) - I_{(\Delta\rho_H)}.\Delta\rho_H \quad (1)$$

where ρ_H represent the social belief that the manager is high ability. The social belief is defined as the belief of outside stakeholders about the manager. These stakeholders include investors, business analysts, prospective employers, and so on. That is, the manager does not care about her status among the subordinates and cares only about how outsiders think about her. $\Delta\rho_H$ is the change in the belief after project implementation. The indicator function $I_{(\Delta\rho_H)}$ is defined as

$$\begin{cases} 1, & \text{if } \Delta\rho_H < 0 \\ 0, & \text{if } \Delta\rho_H \geq 0 \end{cases}$$

First, it represents the prominence of retaining status because zero is highlighted. Second, it reflects a key insight of Prospect Theory that losses loom larger than gains (Tversky and Kahneman (1992)).[5]

Non-experts exert a costly effort e_N and receive $1-y$ of the return of the project. Their utility is given by

[5] A similar specification has been applied by Gabaix and Laibson (2006) in another context.

$$U = (1 - y)v(e_N, e_E, R) - C(e_N) \qquad (2)$$

where $C(e)$ is continuous, increasing and convex.

Experts' stake is also $(1 - y)$. The cost of investigating the project is $S > 0$. In addition, they receive a positive utility, $T > 0$, if the manager changes her decision as a result of their feedback. The utility function of experts is given by

$$\begin{cases} (1-y)v(e_N,e_E,R) - C(e_E) & \text{If experts do not investigate} \\ (1-y)v(e_N,e_E,R) - C(e_E) - S + T & \text{If experts investigate \& communicate \& manager aborts the project} \\ (1-y)v(e_N,e_E,R) - C(e_E) - S & \text{All other cases} \end{cases} \qquad (3)$$

Timing of events: Nature determines the followers' type, manager's type (ability and confidence) and the profitability of the project. The manager chooses the minimum acceptable return for the project. Experts choose whether to investigate the project or not. If the experts investigate, they decide whether to communicate the return to the manager or remain silent. If the experts communicate, the manager decides whether to proceed with the project or not. Finally, both types of followers choose their effort level and payoffs are realized. Figure 1 depicts the timing of the game. The extensive form of the game is provided in Appendix 1.

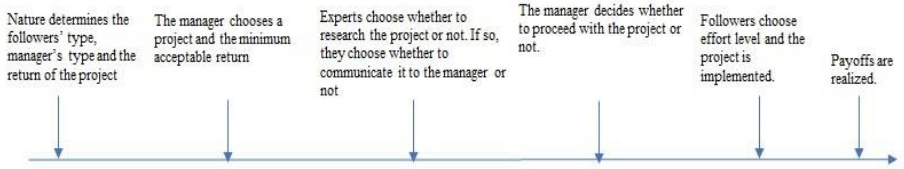

Figure 1:Timing of events

4. Equilibrium

The solution concept is Perfect Bayesian equilibrium. Therefore, we start with the last decision, i.e., the effort provision of the

followers in 4.1. In Subsection 4.2 the decision of the manager regarding project continuation is analyzed. The investigation and communication decisions of the experts are addressed in Subsection 4.3. Finally, the decision of the manager regarding the minimum acceptable return is addressed in Subsection 4.4.

4.1. Followers' effort

We analyze the effort provision of both types of followers when the manager is confident and compare it with the case when the manager is not confident. Followers choose their effort level so as to maximize their expected income. Given the payoff functions (2) and (3), the equilibrium effort level depends on the followers' effort and the project's profitability *R*. Both experts and non-experts have to estimate the project's return based on the manager's ability. Recall that the followers observe only whether the manager is confident or not. Define φ_K, $k \in \{C,U\}$ as the probability that the manager has high ability depending on whether she is confident (C) or unconfident (U). Rationality requires the followers to use the Bayes formula to assess the relationship between ability and confidence. As a result, followers' perception of a confident manager being of high ability is

$$\phi_C = \frac{\alpha_H \sigma}{\alpha_H \sigma + \alpha_L (1-\sigma)} \tag{4}$$

When the manager is unconfident, this perception is given by

$$\phi_U = \frac{\sigma(1-\alpha_H)}{\sigma(1-\alpha_H) + (1-\sigma)(1-\alpha_L)} \tag{5}$$

Critical for our analysis is whether $\varphi_C > \sigma$ or not. If the answer is yes, then a confident manager is assessed more favorably than a manager who is not confident. In other words, confidence is interpreted by the followers as a sign of competence. From (4) we can check that $\rho_C > \sigma$ if and only if $\alpha_H > \alpha_L$. This is intuitive, if high ability managers are more likely to be confident than low ability managers, then confidence increases the likelihood that a manager is high type. Therefore, the value of confidence is clear when $\alpha_L \leq \alpha_H$ since followers will exert more effort when the manager is confident compared to the case when the manager is not confident. If $\alpha_H <$

α_L, i.e., $\varphi_C < \sigma$, then confident managers are less likely to be high type than unconfident managers. Experts, being Bayesian and having correct information, are aware of the fact that $\alpha_L > \alpha_H$ entails $\varphi_C < \sigma$. Non-experts' distorted belief regarding $\alpha_i, i \in \{H,L\}$ implies that φ_C=1 and φ_U=0.

Consider first the non-experts. Non-experts think of the confident manager as a high ability one. Define R_k^j as the estimation of project's return by follower $j \in \{E,N\}$ facing a manager $k \in \{C,U\}$. Non-experts' estimation of the projects' return when the manager is confident is

$$R_C^N = (1-\beta)E(R \mid R \geq r) + \beta E(R \mid R < r)$$

and when the manager is unconfident $R_U^N = E(R \mid R < r)$. Obviously, $R_C^N > R_U^N$. In addition, recall that non-experts have a distorted belief. As a result, non-experts think that $e_N = e_C$. A consequence of this misconception is that non-experts assume the production function is $[e_N^{\upsilon} + R^{\upsilon}]^{\frac{1}{\upsilon}}$. Define $e_{NC}(e_{NU})$ as the effort provision of non-experts when the manager is (un)confident. Define e_{NC}^* as the solution to

$$Max_{e_N}\,(1-y)[e_N^{\nu} + (R_C^N)^{\nu}]^{\frac{1}{\nu}} - C(e_N) \qquad (6)$$

When the manager is unconfident, R_C^N is substituted with R_U^N in (6). Obviously, non-experts exert more effort when the manager is confident compared to the case when the manager is not confident since $R_C^N > R_U^N$. That is, $e_{NC}^* > e_{NU}^*$.

Next, consider the experts. The estimation of the projects return is easy in nine of the ten information sets because the experts know the true return, and therefore do not have to estimate the true return from the managers confidence. Eight of these information sets entail the choice investigation by the experts, i.e. the experts have learned the true value of the project by investigation. The ninth information set consists of the decision not to proceed by the manager when the experts have not investigated the project. This results in $R = r$. Experts will provide a higher level of effort with a confident manager than an unconfident manager in these nine cases because

non-experts exert a higher effort when the manager is confident. The tenth information set is characterized by experts not investigating the project and the manager chooses to proceed with the project. The experts' estimation of the project's return when the manager is confident is given by

$$R_C^E = \varphi_C\{(1-\beta)E(R \mid R \geq r) + \beta E(R \mid R < r)\} + (1-\varphi_C)E(R \mid R < r) \quad (7)$$

Obviously, $R_C{}^E < R_C{}^N$. Experts are aware that there are non-experts who exert a higher effort when the manager is confident. Therefore, they face a tradeoff. On the one hand, non-experts exert a higher effort when the manager is confident, but on the other hand, being confident implies lower ability. Expert solve the following problem when the manager is confident

$$Max_{e_E}\,(1-y)v(\gamma e_N^*, (1-\gamma)e_E, R_C^E) - C(e_E) \quad (8)$$

Denote the optimal solution to this problem by e_{EC}^*. When the manager is unconfident, then experts solve instead

$$Max_{e_E}\,(1-y)v(\gamma e_N^*, (1-\gamma)e_E, R_U^E) - C(e_E) \quad (9)$$

where R_U^E is the expected return when the manager is not confident. It is derived by substituting φ_C by φ_U in (7). Denote the optimal solution of (9) by e_{EU}^*. It is shown in the Appendix 2 that $e_{EC}^* > e_{EU}^*$ if and only if

$$\frac{(A)^{\nu-1} \mid R_U^E - R_C^E \mid}{(e_N^* R_U^E)^{\nu-1} v^{-2}(e^*, R_U^E)(R_U^E - R_C^E) - e_N^*} < \gamma \quad (10)$$

where A is a constant. Condition (10) relates the fraction of non-experts to the elasticity of substitution between the managerial ability and followers' effort and ($R_U{}^E - R_C{}^E$). It says that experts exert a higher effort with a confident manager than with an unconfident manager when two conditions are met. First, there is a sufficient number of non-experts. Second, managerial input and followers' input are highly substitutable.

The following proposition summarizes the analysis. Note that (10) is trivially satisfied for all v and $\gamma > 0$ when $\varphi_C \geq \sigma$.[6] So, we state the proposition only for the complementary case.

PROPOSITION 1. *If $\varphi_C < \sigma$, i.e., confidence and ability are negatively related, experts exert a higher effort with a confident manager than with an unconfident manager, when*

1- There are a sufficient number of non-experts;

2- Managerial ability and followers' effort are highly substitutable.

The main insight of Proposition 1 is that experts exert a higher effort when the manager is confident, compared to the case when the manager is unconfident, despite knowing that confidence is negatively associated with ability (competence). This happens because they know that a confident manager motivates a lot of non-experts. This in turn, compensates for the possible lack of competence of the manager. In other words, the production technology of the organization is such that having the followers exert high effort is more effective in boosting the production than putting a competent manager at the helm. This result can also shed light on the role and effect of charismatic leadership. We can reinterpret and substitute confidence with charisma. A charismatic leader is distinguished by a constellation of attributes that followers perceive about her. While the nature of these attributes and the ability of leaders to attain and maintain them is a subject of debate among management scholars, there is a consensus that charismatic leaders are able to motivate their followers by means other than extrinsic rewards (Conger (2015)). Our analysis implies that charismatic leaders might be able to motivate followers who seriously doubt their competence if sufficiently many believers are around.

4.2. Project Continuation Decision

It is worthwhile to review the belief system of the manager before analyzing the equilibrium strategy. Recall that the manager is either

[6] This is due to the fact that $\varphi_C \geq \sigma$ implies $R_C{}^E \geq R_U{}^E$ which makes the ratio of the left-hand side of (10) negative.

confident or unconfident. If the manager is confident, then her prior belief about the project is given by

$$P(R \geq R_{min}) = \varphi_C(1-\beta)$$

$$P(R < R_{min}) = 1-\varphi_C(1-\beta)$$

In case the manager is unconfident, then φ_C in the above equations should be replaced by φ_U. Next, note that before the manager makes the proceed decision, the experts either communicate or do not communicate. In case the experts do not communicate, the manager has no new information to update and therefore her beliefs do not change from what they were at the beginning of the game. In case the experts communicate, the manager updates her beliefs based on the message. Assume that the message of the experts is verifiable. If the message indicates that $R < R_{min}$, then the manager learns with certainty that the return is less than the minimum acceptable return, i.e., $P(R \geq R_{min}) = 0$. If the message indicates that $R \geq R_{min}$, then the manager learns with certainty that the project yields equal or more than the minimum acceptable return. That is, $P(R \geq R_{min}) = 1$. Given the belief system of the manager, it is obvious that the manager aborts the project whenever experts communicate that $R < R_{min}$ and proceeds otherwise.

4.3. Experts Investigating the Project and Communicating to the Manager

Before sending the feedback to the manager, experts need to investigate the project. Investigation entails a cost *S*. If the feedback contradicts the manager but does not change her decision, i.e., they are not heard, then investigating the project is wasteful and even detrimental as it results in a disagreement with the manager. If, on the other hand, their feedback results in the manager changing her implementation decision, then experts are pivotal and receive a reward of size *T*. Experts investigate only when $T > S$. Suppose that $T > S$. Experts are aware that the manager does not proceed only if $R < R_{min}$. That is, they know that they become pivotal only when the project yields less than the minimum acceptable return. In case

experts investigate and discover that the return is higher than R_{min}, they are indifferent between remaining silent and truthfully communicating $R > R_{min}$ as in both cases the manager implements the project.[7] To analyze the investigation decision of the experts, note that investigation entails a certain cost (S) and an uncertain reward (T). Experts investigate the project only if the expected value of investigation is equal or more than its cost. It implies

$$S \leq T(1-\phi_k(1-\beta))\frac{\int_0^{R_{min}} f(R)dR}{F(r)}, k \in \{C,U\} \tag{11}$$

The reward on the right-hand side of (11) is multiplied by $(1-\varphi_k(1-\beta))F(R_{min})/F(r)$. This is the probability that the manager chooses a project that yields less than R_{min}. If the manager did not lower the minimum acceptable return, then the reward would be multiplied by $(1-\varphi_k(1-\beta)) > (1-\varphi_k(1-\beta))F(R_{min})$. Therefore, lowering the minimum acceptable return dilutes the incentive of experts to investigate the project. We can restate (11) and consider the case when

$$\frac{F(R_{min})}{F(r)} < \frac{S}{(1-\phi_k(1-\beta))T} \leq 1$$

It refers to a situation when experts would have investigated the project, had the manager not lowered the minimum acceptable return. From (11) we can immediately conclude that for any triple $\{\varphi_k, F(.), \frac{S}{T}\}$, there exist a critical value for the minimum acceptable return R^*_{min} below which experts do not investigate the project.

LEMMA 1. *Experts investigate the project when (11) is satisfied. There exist a lower bound for the minimum acceptable return, $R^*_{min} > 0$, such that experts do not investigate the project if the minimum acceptable return is less than the lower bound $R_{min} < R^*_{min}$. Experts communicate the outcome of an investigation*

[7] They might even have slight preference to communicate $R \geq r$ when $R > R_{min}$ to please the manager, but the message being verifiable implies that the manager can not be lied to.

when the return is equal or lower than the minimum acceptable return.

4.4. Choosing the Minimum Acceptable Return

In determining the minimum acceptable return, the manager does not only consider her material payoff, but also takes the social consequences of reversing a decision into account. The manager enters the period with a given status ρ_H, which represents the social belief that the manager is high ability. If she does not change her mind following the feedback and implements the project, then her social image does not change from what it was. That is, if the manager implements the project, then her status remains intact. If, on the other hand, the manager changes her mind, i.e., aborts the project, then her image is tarnished as people see this as a sign of weakness. In other words, stakeholders expect decisiveness and confidence from a competent manager (Ashford (1986)). Stakeholders update their belief about the manager upon aborting the project according to

$$\rho_{H|D} \equiv \frac{C_H \rho_H}{C_H \rho_H + C_L(1-\rho_H)} \tag{12}$$

where C_i, $i \in \{L, H\}$ is the probability that a manager of type $i \in \{L, H\}$ changes her mind. An industry that expects a competent manager to be decisive assumes $C_L > C_H$. An industry that expects revision assumes $C_L \leq C_H$. The relationship between C_H and C_L is an indication of the *industry culture*. If $C_L > C_H$, then (12) implies

$$\rho_{H|C} < \rho_H$$

that is, changing the implementation decision tarnishes the social image of the manager because the stakeholders interpret it as a signal of hesitation and indecisiveness. However, it is not only the industry culture that determines the image loss. The initial image of the manager also affects the size of this loss. Denote the status (social image) loss function by $L(\rho_H, C_L)$. It is defined as

$$L(\rho_H, C_L) \equiv \rho_H - \rho_{H|C} \tag{13}$$

The manager determines the optimal minimum acceptable return by minimizing the total costs, which consists of the costs of implementing inferior projects and the costs of image (status) loss. Therefore, the manager determines the optimal R_{min} by minimizing the total costs with respect to R_{min}. The total cost function, depending on the manager's confidence $k \in \{C,U\}$, is given by

$$\frac{1-\phi_k(1-\beta)}{F(r)}\{F(R_{min})L(\rho_H,C_L)+y(F(r)-F(R_{min}))[v(e_N^*,e_E^*,r)-v(e_N^*,e_E^*,E(R\mid R_{min}<R<r))]\} \tag{14}$$

The first term in the curly bracket represents the expected costs of image loss. The second term in the curly bracket shows the expected cost of implementing projects that yield less than r. Denote the optimal solution of (14) by R_{min}^{**}. Recall from Lemma 1 that there exist a lower bound on the minimum acceptable return, denoted by R_{min}^{*}, such that experts never investigate the project when $R_{min} < R_{min}^{*}$. So, if $R_{min}^{**} < R_{min}^{*}$, experts do not investigate the project at all. Therefore, when $R_{min}^{**} < R_{min}^{*}$ the manager has to compare the total cost in (14) when $R_{min} = R_{min}^{**}$ with the total cost when the experts do not investigate. This latter cost, depending on the manager's confidence $k \in \{C, U\}$, equals

$$(1-\phi_k(1-\beta))y[v(e_N^*,e_E^*,r)-v(e_N^*,e_E^*,E(R\mid R<r))] \tag{15}$$

If the optimum total cost in (14) is less than (15), then the optimal value of the minimum acceptable return is R_{min}^{**}. Otherwise, the manager is indifferent between setting R_{min} equal to any value less than R_{min}^{*}. In any case, the optimal value of the minimum acceptable return is always less than r. In addition, the higher the social loss from aborting the project, the lower the minimum acceptable return.

PROPOSITION 2. *Managerial image concern results in implementing inferior projects, i.e., projects that yield less than r. The minimum acceptable return is inversely related to the social loss function.*

5. Welfare Analysis

We showed that when the manager is confident, both the experts and non-experts exert a higher effort compared to the case when the manager is unconfident. As a result, the total effort and production is higher when the manager is confident. Non-experts provide a higher effort when the manager is confident as they equate confidence with ability. Their effort level is inefficiently high unless $\alpha_L = 0$, i.e., low ability managers are never confident. Experts, however, provide an efficient effort level given their information about the manager's ability and the effort level of non-experts. The over-provision of effort by non-experts increases the payoffs of the experts and the manager. Confidence creates a rent for the manager and experts at the cost of non-experts. The welfare effect of confidence is not straightforward. It reduces the payoff of non-experts and increases the payoffs of the experts and the manager.

PROPOSITION 3. *Managerial confidence increases the payoffs of the manager and the experts and decreases the payoff of the non-experts.*

Next, recall that the manager's concern for preserving her image results in discouraging the experts to investigate the project on the one hand, and implementing inferior projects on the other hand. As a result, a managerial image concern imposes a cost on the organization. Unlike confidence, the welfare effect of image concern is clearly negative because it reduces the payoff of everyone but the manager.

PROPOSITION 4. *Managerial image concern is welfare decreasing.*

6. Comparative Statics

We defined the image (status) loss function in (13). It is insightful to see how it changes with the initial status of the manager. Interestingly, the status loss changes non-monotonically with the initial level of social image. The loss first increases with ρ_H and then decreases.

PROPOSITION 5. *There is a threshold* ρ_H^* *such that the status loss function* L *is increasing in* ρ_H *when the status is* $\rho_H < \rho_H^*$ *and decreasing afterwards. In addition, the cross derivative of the loss function with respect to* C_L *and* ρ_H *is negative.*

$$\frac{\partial L}{\partial \rho_H} > 0 \quad if\ \rho_H < \rho^*, \quad \frac{\partial L}{\partial \rho_H} < 0 \quad if\ \rho_H \geq \rho^*, \quad \frac{\partial L}{\partial C_L \partial \rho_H} < 0$$

Proposition 5 implies that the cost of revising the implementation decision first increases and then decreases with the status of the manager. This result can be interpreted intuitively in the following way. A low status manager does not have much to lose. Reversing the decision dilutes her image. However, the damage is not large because the initial stock was not large in the first place. A high-status manager does not lose much either, but for a different reason. This time, the initial prestige protects the manager's status. As a consequence, a manager with a very high social image finds it less costly to revise her decisions compared to a manager with a lower status. It seems that preserving status is most costly for managers with an intermediate status. This result provides an integrative explanation for the experimental results of Fast et al. (2014) that identify self-efficacy as the main driver of support for employee voice and Burks et al. (2013) that find social signaling the key function of overconfidence. Next, note that the manager sets the minimum acceptable return by striking a balance between the cost of implementing inferior projects and the cost of image loss. From Proposition 5 we know that the image loss function is non-monotonic in ρ_H and decreasing when ρ_H is high. Therefore, a high-status manager imposes less costs to the organization, by implementing inferior projects, as she is less vulnerable to image loss. In other words, a manager with a high social capital (status) rejects bad projects easier than a manages with less social capital. Figure 2 shows the relationship between the minimum acceptable return and the manager's status.

COROLLARY 1. *The portfolio of projects implemented by the manager changes non-monotonically with her status. A manager with a very high or very low status implements more profitable projects compared to a manager with an intermediate status.*

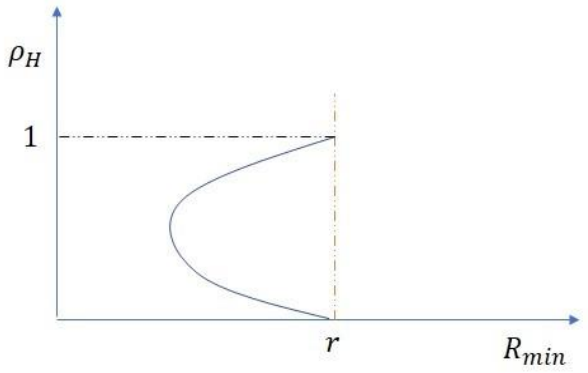

Figure 2: The Minimum Acceptable Return and Managerial Status.

Next, recall from 4.4 that the manager has to decide whether to induce the experts to investigate by setting the minimum acceptable return. We analyze how the managerial status and managerial stake in the project affect this decision. Consider managerial status. First, from (11) we see that a high managerial status discourages the experts from investigation as they expect a high status manager to select good projects in the first place and this in turn implies that a higher R_{min} is needed to induce them to investigate. So, the manager must pick a higher R_{min} to compel them to investigate. Doing so, however, decreases the expected benefits of receiving feedback for the manager. To see why, note from (14) that when R_{min} increases, the second component of the cost decreases. That is, the average return of projects that are filtered are not much below *r*. In addition, the first term in (14) changes non-monotonically (Proposition 5) with status. Therefore, the overall effect of status on R_{min} is not straightforward. The effect of managerial stake *y* is clear. From (14)

we see that increasing the managerial stake in the project increases the cost of implementing inferior projects and, as a result, puts an upward pressure on R_{min}.

PROPOSITION 6. *Increasing the managerial stake increases the likelihood that the manager induces the experts to investigate the project. There is a threshold for managerial status* ρ_H^* *such that if a manager with status* $\rho_H^{**} < \rho_H^*$ *does not induce the experts to investigate, then also all managers whose status are in the range* $\rho_H^{**} < \rho_H < \rho_H^*$ *will not induce the experts to investigate.*

Finally, recall from (12) that the social image of the manager is affected when she aborts the project as

$$\rho_{H|C} \equiv P(H\,type \mid reverse) = \frac{C_H \rho_H}{C_H \rho_H + C_L(1-\rho_H)}$$

We defined industry culture by $C_L - C_H$. If $C_L = C_H$, then $\rho_{H|C} = \rho_H$. Therefore, the industry culture determines how reversing the course affects the social image of the manager. The more open the culture, the less managerial status is damaged upon changing course. In an industry culture where people value feedback, the manager feels less pressed to appear assured of her decisions. As a result, the manager is more attentive to conflicting information in her decision making. In addition, note that the loss function $L(\rho_H, C_L)$ implies that two managers with the same level of social capital, identical ρ_H, might act differently in different organizations depending on the industry culture.

COROLLARY 2. *Industry culture affects the portfolio of projects implemented by the organization. Organizations operating in more open cultures are more conducive to implement profitable projects.*

7. Unverifiable messages

We showed in 4.3 that the manager reverses her decision following a contradicting feedback when she can verify the

messages. A more realistic case, however, might be that the manager cannot verify the message of the experts or that the manager does not agree with their evaluation. For instance, the manager and experts might evaluate the same project from different perspectives. Experts concentrate more on the operational and marketing aspects of launching a new product, while the manager thinks more strategically about the long-term effects of introducing the product on the position of the firm in the market and the reactions of competitors and investors. An immediate result is that communication becomes coarse, as is well known in the cheap talk literature (Crawford and Sobel (1982)). Experts will always announce that the return is lower than the minimum acceptable return whenever they find that the return is lower than *r*.

LEMMA 2. *Communication becomes noisy when the message is non-verifiable. There are two equilibrium messages: if the return is lower than the return of the outside option r, experts are indifferent between sending any value indicating that the return is lower than the minimum acceptable return to the manager. Otherwise, if the return is higher than r, then experts are indifferent between sending any value indicating that the return is higher than the minimum return to the manager. The manager considers any message implying that the return is less than the minimum acceptable return as an indication that the return is less than r.*

The noisy communication implies that the manager does not believe the value sent by the experts when it is lower than the minimum acceptable return. Following such a message, the manager updates her evaluation of the project's return and obtains a posterior belief on the return as

$$\hat{R} = E(R \mid R < r)$$

The manager has to determine the minimum acceptable return R_{min} and implement the project only if $\hat{R} \geq R^*_{min}$. If the posterior is higher

than the minimum acceptable return, i.e., $\hat{R} \geq R^*_{min}$, then the manager always implements the project following a negative feedback. In this case the experts will not bother investigating the project in the first place knowing that their feedback will never be pivotal. The expected payoff to the manager, of setting $R_{min} < \hat{R}$, equals

$$\phi_k(1-\beta)(1-F(r))yv(e^*_N,e^*_E,r)-(1-\phi_k(1-\beta))F(r)\{y(v(e^*_N,e^*_E,r)-v(e^*_N,e^*_E,E(R\mid R<r)))\},k\in\{C,U\} \quad (16)$$

If the minimum acceptable return is set below $\hat{R}$, then the manager aborts the project following a negative feedback. However, for the experts to investigate the project, R_{min} should still be sufficiently high to satisfy (11). Therefore, if the manager wants to induce the agent to investigate, she must set the minimum acceptable return somewhere in the range between R_{min} and $\hat{R}$ (assuming $R_{min} < \hat{R}$). Aborting the project following a negative feedback in combination with the Lemma 2 implies that experts send a negative feedback whenever their evaluation shows that the return is less than *r*. The expected payoff to the manager in this case is

$$\phi_k(1-\beta)(1-F(r))yv(e^*_N,e^*_E,r)-(1-\phi_k(1-\beta))F(r)L(\rho_H,C_L),k\in\{C,U\} \quad (17)$$

Comparing the payoffs of the manager when she aborts the project following a negative feedback (17) with the case when she always implements the project (16), shows that the manager aborts the project following a negative feedback when

$$L(\rho_H,C_L)<y[v(e^*_N,e^*_E,r)-v(e^*_N,e^*_E,E(R\mid R<r))] \quad (18)$$

This represents the incentive of the manager to induce the experts to investigate when communication is noisy. Note the similarity of this condition with (15). The difference is that (15) is multiplied by *F*(*r*) and is therefore less than the right hand side of (18). The difference implies that the manager has a stronger incentive to discourage the experts to investigate when the message is not verifiable.

8. Summary and Conclusion

This article investigates the consequences of self-confidence and image concerns in organizations. We analyze the effect of the manager's confidence on the followers' effort provision. The analysis shows that even if confidence is negatively associated with competence (ability), followers who are aware of this relationship might prefer a confident manager to a more competent but unconfident manager. The reason is that a confident manager is more effective in motivating a large fraction of followers who, incorrectly, associate confidence with ability. For the result to hold, two conditions have to be met. First, there should be a sufficient number of followers who associate confidence with ability. Second, managerial input should be highly substitutable with the followers' input.

Next, the article analyzes the effect of manager's concern for social image (status) on seeking feedback and reversing a failed business initiative when reversing results in loosing face. The analysis shows that the loss in social image (status), following reversing, is non-monotonic in initial image. The loss increases initially, reaches a maximum and then declines monotonically. As a result, a manager of very high or very low status incurs a lower image loss following reversing. Put it differently, image loss is mainly the problem of middle status managers. An immediate consequence is that managerial image concern creates inefficiency because managers are willing to implement inferior projects in order to save face. Increasing the managerial stake in the firm's performance reduces the inefficiency by making the manager internalize the externality she imposes on the organization.

There are various possibilities for future research. First, we analyze the effect of managerial confidence on followers by assuming two types of followers when one type is fully rational, and the other type is not rational. This represent an extreme situation that facilitates the exposition of the main mechanism. However, it will be more realistic to consider the cases when there are some followers in between these two types. That is, followers who are partially rational. In addition, it could be the case that some followers learn the ability of the manager from other types of followers whom they

consider to be more knowledgeable than themselves. Second, in our model the manager is either confident or unconfident and does not know her ability with certainty. A possible development is endogenizing the confidence of the manager by assuming that the manager knows her ability and chooses whether to appear confident or unconfident, similar to the approach of Benabou and Tirole (2002).

Appendix 1

Extensive Form of the Game

The extensive form is presented in two parts due to the size of the extensive form. Figure 3 shows the subgame regarding experts and non-experts. Recall that non-experts have distorted beliefs. It is reflected in Figure 3 by defining the possible worlds with (δ, ω). δ is the fraction of followers who are non-expert and ω is the fraction of managers who are high ability. Three possible worlds are highlighted. The world (1,1) entails that all followers are non-expert and all managers are high ability. The world (1,1) after the choice *C* by Nature reflects that non-experts believe that all followers are non-experts and a confident manager is always high ability. The objective function (6) reflects the sequential rationality requirement regarding this continuation game. The world (1,0) entails that all followers are non-expert and all managers are low ability. The world (1,0) after the choice *U* by Nature reflects that non-experts believe that all followers are non-experts and an unconfident manager is always low ability. The world (γ, σ) corresponds to the real world, i.e., a fraction γ of the followers is expert (and therefore a fraction $(1-\gamma)$ is non-expert) and a fraction σ of the managers is high quality (and therefore a fraction $(1-\sigma)$ is low quality).

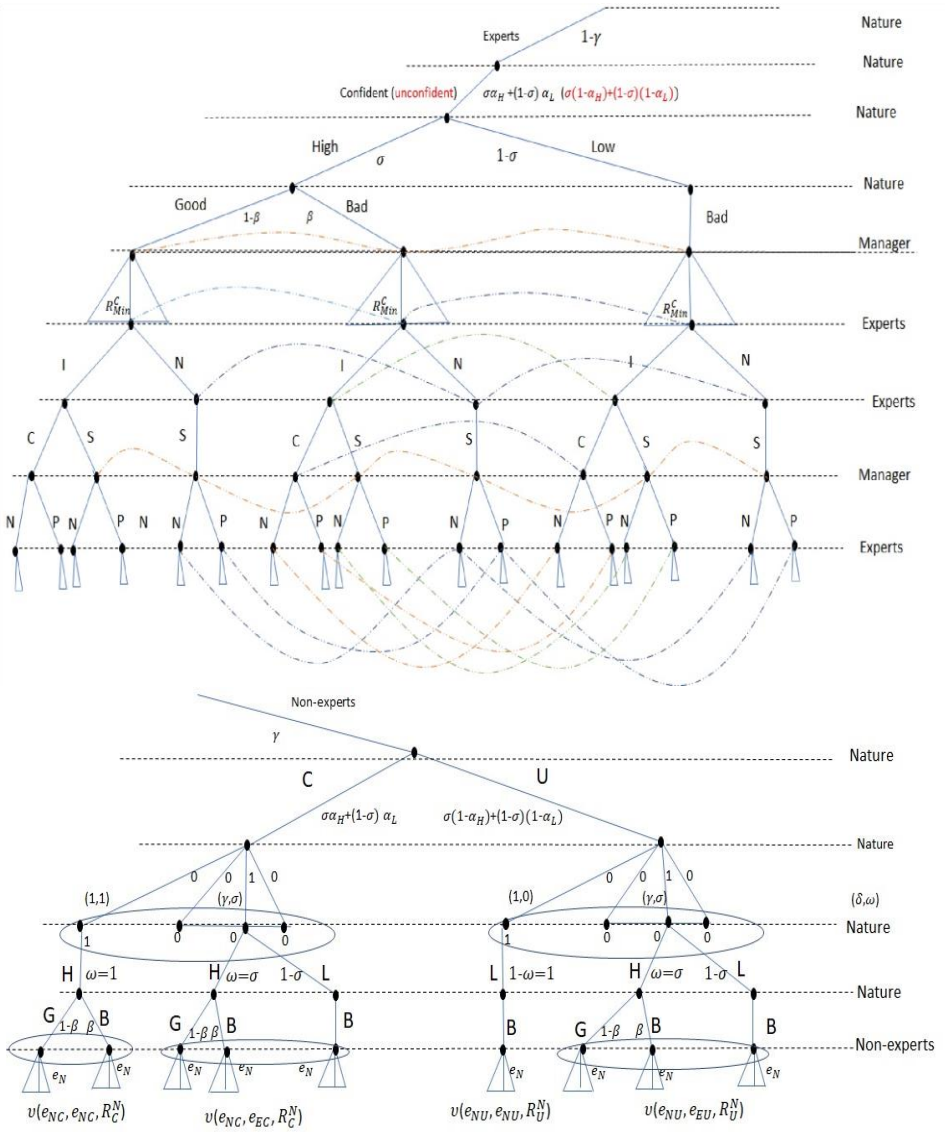

Figure 3: The subgame regarding the experts (above) and non-experts (below)

Experts do not have distorted beliefs and so, their worldview corresponds to the real world. In other words, their belief regarding (δ,ω) is (γ,σ) with probability 1. This belief can be reflected in the extensive form in a way similar to figure 3. However, it is not presented in order to keep the extensive form as simple as possible.

Specification of the perfect Bayesian equilibrium

Consider non-experts. Their strategy consists of choosing the effort level e_N given the manager's confidence. To choose the effort level, they need to form a belief about the expected value of the return. Their belief regarding the expected value of the return depends on the manager being confident or unconfident. In case the manager is confident, then they assume the manager is high ability. Therefore, the expected value of the project is given by

$$\beta E(R \mid R \geq r) + (1-\beta)E(R \mid R < r)$$

when the manager is confident. In case the manager is unconfident, non-experts assume the manager has low ability and therefore the expected return is $E(R \mid R < r)$.

Next, consider the experts. They make three decisions. The first decision is whether to investigate or not (a binary decision), given R_{min} and the manager's confidence. To make the decision, they form a belief about the possibility that the return is less than R_{min}. If the manager is confident, then this belief is given by

$$P(R < R_{min}) = \{\phi_C \beta + (1-\phi_C)\} \frac{\int_0^{R_{min}} f(R)dR}{F(r)}$$

where φ_C is the probability that a confident manager is high ability. It is defined in (4). The terms in the curly brackets represent the probability that a confident manager chooses a bad project. The last term is the probability that a bad project yields less than R_{min}. If the manager is unconfident, then this belief is given by

$$P(R < R_{min}) = \{\phi_U \beta + (1-\phi_U)\} \frac{\int_0^{R_{min}} f(R)dR}{F(r)}$$

where φ_U is the probability that an unconfident manager is high ability. It is defined in (5). The only difference between these two beliefs is that φ_C is replaced with φ_U when the manager is unconfident.

The second decision of the experts involves whether to communicate or not (a binary decision), given the manager's confidence, R_{min} and their investigation decision. Their belief regarding the project return depends on whether they have investigated or not. If they have investigated the project, then they know the true return with certainty. Otherwise, if they did not investigate, then their belief is identical to what it was in the previous decision node.

Finally, the experts' last decision involves choosing their effort level e_E given the manager's confidence, R_{min}, their investigation decision, their communication decision and the manager's decision regarding proceeding or not. To choose their effort level, the experts need to form a belief about the expected return of the project. If the manager has not proceeded, then the experts know that the return is r with certainty. That is, $P(R = r \mid \text{did not proceed})=1$. Otherwise, if the manager has proceeded and the experts have investigated, then they know the true return with certainty. Finally, if the manager has proceeded and the experts have not investigated, then their belief depends on the manager's confidence. The experts' belief is given

$$\varphi_k \beta E(R \mid R \geq r) + (1-\varphi_k)(1-\beta)E(R \mid R < r), k \in \{C, U\}$$

Consider the manager. The manager chooses the value of R_{min} given her confidence. To make the decision, she forms a belief regarding the possibility that the return is less than R_{min} ($R < R_{min}$) and the return is between r and R_{min} ($r < R < R_{min}$). The first belief $P(R < R_{min})$ is identical to the belief of experts when they decide to investigate or not. The second belief is given by

$$P(r < R < R_{min}) = \{\phi_k \beta + (1-\phi_k)\} \frac{F(r) - F(R_{min}}{F(r)}, k \in \{C, U\}$$

Appendix 2

Proof of Proposition 1

To simplify the notation, we drop the superscript when referring to the return from the experts' perspective. That is, we write R instead of R^E. Consider the value of production function when the

manager is unconfident $v(e_N, e_E, R_U) = [(\gamma e_N + (1-\gamma)e_E)^\nu + R_U^\nu]^{\frac{1}{\nu}}$.
Define $\Delta R = R_U - R_C$. We need to show that for any fixed e_E^*, we have

$$\frac{d(v(e_N^*, e_E^*, R)}{dR} \mid \Delta R \mid < \frac{dv(e_N^*, e_E^*, R)}{de_N^*} \Delta e_N^* \tag{19}$$

when $R = R_U$. Differentiating $v(e_N^*, e_E^*, R_U)$ according to R_U and e_N and plugging in the above inequality yields

$$R^{\nu-1}[(\gamma e_N + [(1-\gamma)e_E)^\nu + R_U^\nu]^{(\frac{1}{\nu}-1)} \mid \Delta R \mid < \gamma a^{\nu-1}[(\gamma e_N + [(1-\gamma)e_E)^\nu + R_U^\nu]^{(\frac{1}{\nu}-1)} \Delta e_N^*$$

Where $a = (\gamma e_N^* + (1-\gamma)e_E^*)$ is a constant. Next, note that

$$\Delta e_N^* = \frac{de_N^*}{dR} \mid \Delta R \mid - e_N^*, \text{evaluated at } R_U \tag{20}$$

We know that e_N^* is the solution to

$$e^{\nu-1}[e^\nu + (R_U^N)^\nu]^{\frac{1}{\nu}-1} - C'(e) = 0$$

Therefore, taking the derivative with respect to R and plugging into (20) we have

$$\Delta e_N^* = (e_N^* R_U)^{\nu-1}[e^\nu + (R_U^N)^\nu]^{\frac{1}{\nu}-2} \Delta R - e_N^*$$

Finally, we can return to (19) and plug in. It results in

$$\frac{(\frac{R_U}{a})^{\nu-1} \mid \Delta R \mid}{(e_N^* R_U)^{\nu-1} v^{-2}(e^*, R_U)\Delta R - e_N^*} < \gamma \tag{21}$$

Note that R_C and R_U are functions of φ_C and φ_U, respectively. In addition, φ_k, $k \in \{U,C\}$ is a function of α_H and α_L. Q.E.D.

Proof of Proposition 5

The loss function is given by

$$\rho_H - \frac{C_H \rho_H}{C_H \rho_H + (1-\rho_H) C_L}$$

which is equal to

$$\frac{(C_L - C_H)\rho_H(1-\rho_H)}{\rho_H(C_H - C_L) + C_L} \tag{22}$$

The loss function becomes 0 when $\rho_H = 0$ and when $\rho_H = 1$. Taking the derivative from (22) yields

$$(C_L - C_H) \times \frac{(C_L - C_H)\rho_H^2 + 2C_L\rho_H + C_L}{(\rho_H(C_H - C_L) + C_L)^2}$$

The numerator is a quadratic function that is positive when $\rho_H = 0$ and negative when $\rho_H = 1$, so it should pass zero only once. Therefore, the loss function (22) has one maximum between 0 and 1. The sign of the cross derivatives can be verified from taking the derivatives of (22). Q.E.D.

Proof of Lemma 1

The existence of a threshold for R^*_{min} follows from (11) because there exists a value for R_{min} such that the right hand side becomes smaller than any positive number on the left hand side. Q.E.D.

Proof of Lemma 2

Assume otherwise and consider the case when the return is between the minimum acceptable return and the risk free return. If followers send the true value, then the manager implements the project. If followers claim that the return is less than the minimum return, then the manager might not implement the project. Therefore, revealing the true return is a weakly dominated strategy. Q.E.D.

Proof of Proposition 6

The first part regarding the managerial stake follows directly from (14). The second part follows from the fact that the loss function $L(\rho_H, C_L)$ is non-monotonic in ρ_H and increasing before it's maximum according to Proposition 5. Therefore, denote the value of ρ_H that maximizes $L(\rho_H, C_L)$ by ρ^*_H and note that for all values of

$\rho_H < \rho_H^*$ the loss function is increasing and so is the second term of (14). Q.E.D.

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Chapter 4: Three Vignettes Regarding Documentation

This paper studies documentations as a medium of inter-temporal communication in organizations. A document is a piece of information, received from the past, whose content might not be verifiable, but its existence is verifiable. We establish three results. First, documentation improves noisy communication between a principal and an agent whose interest is not fully aligned with the principal by enforcing consistency. The improvement, however, is constrained by the magnitude of the conflict of interests. Documentation might even backfire when the interests of the principal and agent are too divergent. Second, documents serve as a certificate for parties to an agreement and this in turn decreases the likelihood of a breach by these parties. Third, documentation serves as a time saving tool that improves performance especially in stable environments with numerous short tasks.

Keywords: Decision making, cheap talk, information asymmetry

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1. Introduction

A considerable amount of organizational resources is dedicated to documentation. Creating, maintaining and retrieving documents require a remarkable time and resources. In the US health care, administrative costs account for more than 25 percent of hospitals' expenditures (Himmelstein et al. 2014). Despite the ubiquity of documents, there is not yet a systematic analysis of the role and effects of documentation on the performance of organizations. This paper analyzes documentation and provides a rationale for the widespread practice of creation and maintenance of various types of documents. We show how documentation affects communication and decision making in organizations.

A document is a record containing information that is received from the past. Regardless of whether the information is truthful or not, documentation makes the very existence of the information indisputable. For example, consider the dossier of a dispute that has been resolved by litigation. The dossier contains the information upon which judgment has been made but does not necessarily show if the information is truthful or not. This article

explores how documentation affects behavior when information is not verifiable. Documentation is a multi-purpose, multi-dimension activity with consequences that are beyond the initial intuition that comes to the mind. This richness implies that no single model can do justice to it. This article analyzes documentation by introducing three models in order to shed light on the most important functions of documentation. We analyze documentation in a principal-agent setting and also in a model of single agency. Each model is introduced with an example that highlights the main intuition of the model. Three results are established.

First and most important, documentation affects communication between a principal and an agent. This happens because documentation enforces consistency by providing the history of the past behavior of the agent. The history shows how the agent communicated upon receiving specific type of information in the past. Consistency requires that the agent communicate identical message upon receiving identical information. This enforced consistency is beneficial, i.e., improves communication if the interest of the agent does not diverge too much from the principal's interest and if the agent is patient enough. In case the misalignment of the interests is too high, then documentation deteriorates communication and the so the principal avoids it. The analysis also shows that there is a partition of parameter space where documentation leads to path dependency. That is, whether documentation is beneficial or not depends on the initial realization of information.

Second, the paper analyzes how a document serves as a certificate of an agreement between two parties. In this case, the parties compose a document to record their agreement. In case one of the parties breaches the agreement, the other party can take the document to a third party who can verify the breach and has some power to punish the party who breached. We endogenize the choice of the third party and, as a result, provide an explanation for the existence of various types of documents from internal memo to formal contracts.

Third, documentation improves performance by serving as a time saving device. The positive effect of documentation depends on the stability of the environment and the informational structure of pieces of data that are documented. We define the notion of informational density of pieces of data and demonstrate that the likelihood of documentation increases with the stability and informational density of pieces of data.

Finally, in a principal-agent setting with information asymmetry, documentation can cause, or exacerbate, moral hazards. This happens because the principal has to strike a balance between two conflicting objectives. On the one hand, the principal needs to compel the agent to consult documents. On the other hand, the principal does not like the agent to waste time on documents

when an alternative, but more promising, source of information becomes available. Consequently, the principal has to offer high-powered incentives to the agent when documentation is more extensive.

This paper contributes to the literature of information economics by analyzing inter-temporal flow of information via documentation. This is the first paper, to the best knowledge of the author, that formalizes the documentation and its effects in organizations. The rest of the paper is organized as follows. In the next section, we position the paper in the literature and identify relevant research areas. Section §3 analyzes documentation in a principal-agent setting with information asymmetry. Section, §4 analyzes how documentation helps parties to an agreement to protect themselves from a possible breach by the other party. In §5 the baseline model of documentation as a time saver is presented. In the section §6 we extend the analysis of the section §5 by incorporating the problem in a principal-agent setting. Finally, §7 concludes the paper and discusses future research possibilities.

2. Related literature

This paper studies the effect of documentation in communication. This connects this paper to the extensive literature on strategic information transmission. The seminal work of Crawford and Sobel (1982) started the cheap talk literature with the main insight being that the informational content of communication deteriorates as the conflict of interests increases. It was followed by a series of papers extending it to multiple agents and multi-dimensional communication (Battaglini (2002); Ambrus and Takahashi (2008); Krishna and Morgan (2001)) and designing mechanisms to elicit information from informants (Wolinsky (2002); Battaglini (2004); Gilligan and Krehbiel (1989). This paper also deals with imperfect communication resulting from agency bias. We differ, however, in that we do not analyze the effect of various types of decision rules and information aggregation techniques but rather on the medium of communication.

In organizational research, a number of papers analyze the organizational consequences of noisy communication. For example, Dessein (2002) concluded that delegation is superior to communication when the conflict is not too large. Alonso et al. (2008) studied the optimal degree of centralization in the presence of information asymmetry. Our paper is related to these papers as we are also concerned with strategic information transmission. However, this paper is different as it focuses on inter-temporal information transmission rather than the institutional setting through which information flows.

In the analysis of documentation as certificates, we refer to contracts as an extreme form of certificates. Our theoretical reasoning overlaps considerably with incomplete contracting literature a la Grossman and Hart (1986) and Hart and Moore (1990). However, we do not analyze the consequences of contract incompleteness for asset ownership and incentives for investment that are the focus of property rights models.

Our analysis of documentation as a time saving device rests on the assumption that people have limited memory, as emphasized by Simon (1950). Simon was also among the first to notice the importance of organizational memory. Simon (1991) highlights the role automated expert systems in operationalizing organizational memory by saying" One motive for such automation, but certainly not the only one, is that it makes organizational memory less vulnerable to personnel turnover." Later developments of the topic especially in organizational theory defined organizational memory in a broad sense consisting of not only information acquiring and retrieval but also the structure of information retention such as culture, individuals and information systems (Walsh and Ungson (1991); Stein and Zwass (1995)). This line of research laid the foundation of a flourishing line of research in organizational learning (Levitt and March (1988); Huber (1991)) and knowledge management studied, among others, by Nonaka (1994) and Grant (1996). Our paper is much narrower in scope and a focus on documentation rather than the entire business of information management.

Finally, the paper is also related to the classic problem of moral hazards resulting from imperfect information (Holmstrom¨ (1979); Shavell (1979); Harris and Raviv (1979))[1]. The focus of these papers is on designing optimal compensation package. We also deal with designing compensation package

but the main concern, in this paper, is the relationship between documentation and compensation package and not the latter in isolation.

3. Documentation as a Means of Enforcing Consistency

Managers are responsible for making decisions in organizations. In doing so, they rely on information provided by others including their subordinates and peers. The quality of the decisions depends, to a large extent, on the quality of information provided by the informants. If informants have private information, they might not be willing to truthfully inform the manager if they know that doing so results in the manager making decision(s) they do not like. It happens when the interests of the informant(s) and the manager (decision maker) are not fully aligned, i.e., informants are biased. When this is the case, informants tend to provide information strategically to affect the decision(s) of the manager. Strategic transmission of information is a well-known problem (Crawford and Sobel 1982) with remarkable consequences for organizational structure (Alonso et al. 2008). We show that documentation can improve decision making when the informants have private information and the interests of the informants and the decision maker are not fully aliened. The following example highlights the intuition behind our analysis.

An economic department is hiring new assistant professors. Assessment of candidates is done by the head of the department, but the ultimate hiring decision rests with the dean of the school. The head of the department is a microeconomist and thus tends to favor applicants that specialize in microeconomics to applicants with other specializations like macroeconomics, econometrics. The dean of the school is unable to assess the candidates herself and has to rely on the assessments made by the head of the department. In addition, the dean is aware of the tendency of the department's head and intends to design a hiring process to minimize the effect of this tendency. Can documentation serve as a countervailing tool against the tendency of the department's head? In other words, is it possible for the dean to improve the hiring process by asking the department's head to document the assessment process? Intuitively, documentation does not solve the core problem of the dean, the information asymmetry. Documentation does not enable the dean to verify the assessment since the knowledge of how to interpret the credentials of candidates remains soft. There is, however, a point in documentation. Documenting the evaluation

procedure enforces consistency and this in turn might affect the behavior of the department's head.

Suppose that in each period one candidate arrives and is evaluated. There are two types of candidates. Candidates who specialize in microeconomics and candidates who specialize in macroeconomics. Each candidate is either high or low in terms of the research merits. The dean asks the department's head to evaluate each candidate and then nominate the candidate only if the candidate is a high type. The department's head is in favor of micro candidates since he is a micro economist himself. This implies that the head tends to be lenient in evaluating micro candidates and impartial in evaluating macro candidates. The dean knows that there are micro and macro candidates and the department' head's tendency. However, the dean does not observe whether a candidate is high or low. Absent documentation, the head recommends a macro candidate only if the candidate has a high research merit. The head also recommends some micro candidates that do not have a high research merit. The dean hires all recommended candidates despite knowing that the head recommends some low candidates.

Next, what happens if the dean asks the head to document the evaluation process? To answer this question, suppose that candidates have a profile (W) that includes their publications' record. For example, (W) shows the journals where candidates published. Importantly, (W) is verifiable in the sense that the dean can verify whether a candidate has actually published in a journal or not. However, the dean does not know how to interpret or evaluate the value of publications. This is the private information of the head. The effect of documentation depends critically on the characteristics of type micro and macro candidates. To show this, assume that there are two categories of journals: top journals and field journals. In addition, there are two types of field journals: high quality field journals and low-quality field journals. Both the dean and the head know that high ability candidates publish in either the top or high-quality field journals, whereas low ability candidates publish only in low quality field journals. In addition, both the dean and the head know top journals, but only the head can distinguish high quality field journals from the low quality ones. The dean would like the head to nominate a candidate only if the candidate published either in the top or a high-quality field journal. The head, however, likes to hire some micro candidates even if they have published in a low-quality field journal. To see whether

documentation helps the dean to mitigate the effect of the head's tendency, we need to distinguish two possible cases.

First, the case when there are low quality field journals that publish exclusively micro or macro papers but not both. Documentation does not help in this situation because the head can select a group of low-quality field journals that exclusively publish micro papers and designate them as high quality field journals. There is no possibility for the dean to uncover the truth since the head does it in a *consistent* way. That is, the head nominates a candidate if the candidate has published either in a top journal or a high-quality field journal, regardless of specialty. The head also nominates a micro candidate if the candidate has published in low quality field journals that he designated as high quality. The dean observes that all candidates who published in some journals (including low quality micro field journals, unbeknownst to her) are nominated. Therefore, there is no way for the dean to constrain the head by documentation.

Next, consider the case when there is no low quality field journal that exclusively publishes micro or macro papers. If the head designates a low quality field journal as a high quality journal, then he has to also nominate macro candidates who published in that journal. The head cannot nominate some candidates who published in a journal but reject other candidates who published in the same journal since the dean observes the inconsistency. Documentation seems to play a role here. Note, however, that the head might decide to recommend all candidates who published in the mis-specified field journal if the proportion of micro candidates who publish in that journal is much higher than the proportion of macro candidates who publish there. Therefore, the force of consistency improves the process only if micro candidates share an important characteristic with macro candidates and the head's interests is aligned with the principal's interests at least for macro candidates. Otherwise documentation might actually do more harm than good.

Finally, note that for the documentation to have any effect, more than one period is needed. This is because the only punishment available to the dean, is refusing to hire a nominated candidate and for this to have an effect, the head should care sufficiently about the future.

This simple example highlights the main intuition: documentation enforces consistency. For this consistency to improve communication two conditions have to be satisfied. First, the agent's interest should not diverge

too much from the principal's interest (in the example, the head would like macro candidates to be assessed impartially). Second, the preferred and non-preferred groups should share one or more characteristics. Otherwise, the composer of the document (head) manipulates the evaluation of the preferred group and makes an impartial assessment of the non-preferred group in a consistent way.

3.1. The Model

Players: An agent (he) who is in charge of evaluating candidates. A principal (she) who makes the final approval decision. There are two types of candidates $\{t_1, t_2\}$ and each type can be either high H or low L in terms of ability. Henceforth, we call them high and low for brevity. The proportions of type t_1 and type t_2 in the society are p_1 and p_2, respectively. A fraction σ_i of type t_i, $i \in \{1,2\}$ candidates are low and the rest are high. Each candidate, regardless of its type, has a profile $\gamma \subseteq \{a_1, a_2\}$ representing its characteristics.

Actions: The principal decides whether to have documentation or not. If yes, then in each period, the agent sends the recommendation along with the candidate's profile to the principal. The recommendation of the agent takes the form of a *Y* or *N* denoting a positive and negative opinion, respectively. The principal makes the final approval decision, payoffs are realized and the period ends. In case the principal decides not to document, the agent evaluates a candidate and sends the recommendation to the principal. The principal approves or rejects the candidate. Payoffs are realized and the period ends.

Payoffs: The principal gets a utility of 1 from approving a high candidate regardless of its type. Approving a low candidate results in getting a (dis)utility of -1. The agent has an identical preference when the candidate is t_2 but is in favor of type t_1 candidates. That is, the agent receives a utility of 1 when a type t_1 candidate is approved, regardless of being high or low.

Information structure: The agent observes candidates' types and whether they are high or low. The principal is aware that there are two types of candidates and that each type might be high or low. However, the principal does not observe the types and whether candidates are high or low. These are the private information of the agent. The principal observes the profiles of

candidates and knows σ_i and p_i. The principal also knows that the agent is favor of one of the types.

The solution concept is subgame Perfect Equilibrium and we analyze only Pure strategy equilibria. Mixed strategies are less intuitive and less suitable for our analysis.

3.1.1. Decision Making without Documentation

Suppose the principal decides not to document. Consider the following strategies for the agent and the principal. The agent recommends only high candidates and the principal approves the recommended candidates. Obviously, this cannot an equilibrium strategy as the agent has an incentive to deviate and recommend low candidates of his favorite type. Next, consider the following pair of strategies. The agent recommends a candidate when the candidate is his favorite type. When the candidate is not his favorite type, he recommends the candidate only if the candidate is high. The principal approves all recommended candidates. We analyze if this be supported in equilibrium. Obviously, a negative recommendation results in rejecting the candidate as it indicates a low candidate that is not the agent favorite type. When the recommendation is positive the principal should approve the candidate only if

$$P(H\,|Y\,) - P(L\,|Y\,) > 0.$$

Otherwise she is better off not approving a recommended candidate. Since $P(L|Y\,) = 1 - P(H\mid Y\,) > 0$, the above condition boils down to $P(H\mid Y\,) > 1/2$. The probability $P(H|Y\,)$ can be derived in a straightforward way by conditioning on the nominee's type

$$P(H\,|Y\,) = P(H\mid Y, t_1)P(t_1) + P(H|Y, t_2)P(t_2) \qquad (1)$$

The agent never recommends a type t_2 candidate unless she is high, so $P(H \mid Y, t_2) = 1$. For t_1 candidates, the agent always recommends them regardless of being high or low, i.e., $P(H \mid Y,t_1) = P(H \mid t_1)$. Therefore, the probability that a candidate of type t_1 is high given that she is recommended by the agent equals the probability that a random t_1 candidate is high. We can then restate (1) as

$$P(H\mid Y\,) = (1 - \sigma_1)p_1 \; + p_2. \qquad (2)$$

If the majority of candidates are type t_2, i.e., $p_2 \geq 1/2$, then the principal should approve all candidates recommended by the agent knowing that some low candidates will also be approved. If the majority of candidates are t_1 type and most t_1 candidates are low, then it is likely that $P(H \mid Y) < 1/2$ and no candidate should be approved. Recall that the principal knows p_i and σ_i. Therefore, the equilibrium strategy of the principal entails approving all candidates that are recommended, when $P(H \mid Y) \geq 1/2$. If $P(H \mid Y) < 1/2$, then the principal should reject all recommended candidates. When this the case, the agent is indifferent between recommending and not recommending any candidate.

PROPOSITION 1. *Absent documentation, the equilibrium strategies depend on whether* $(1-\sigma_1)p_1 + p_2 \geq 1/2$ *or not. If it holds, then the agent recommends all favorite candidates. The agent recommends non-favorite candidates only if they have a high merit. The principal approves only recommended candidates. If* $(1-\sigma_1)p_1 + p_2 < 1/2$*, then the principal does not approve any candidate and the agent is indifferent between recommending and not recommending candidates.*

Note that in case the principal approves all recommended candidates, the probability that a hired candidate is high is given by (2). When this is the case, type t_1 candidates are systematically preferred to type t_2 candidates.

3.1.2. Decision Making with Documentation

Recall that each candidate has a profile γ showing characteristics such as publication, degrees, and so on. Critically, these characteristics are observable by the principal. However, the knowledge of interpreting these characteristics is the private information of the agent. That is, the principal can verify the profiles but cannot interpret them. It is the agent who knows how each element in the profile should be interpreted. To start, assume that the profile of candidates can have two elements, $\{a_1, a_2\}$. That is, a candidate's profile can include either a_1 or a_2 or both. For simplicity, assume that high candidates all have a_2 in their profile, regardless of being t_1 or t_2, i.e., their profile contains only a_2 or both a_1 and a_2. Low candidates, on the other hand, have only a_1 in their profile. Note, however, that this is the private information of the agent. The principal does not know that such a

relationship between profile and ability exist. Documentation enables the principal to constrain the behavior of the agent. This happens because once the agent recommends (rejects) a candidate with a specific profile, he can not reject (recommend) other candidates with identical profiles. Knowing this, the agent behaves in a way that is different from how he would have behaved, had there been no documentation. In this setting, the agent must decide whether to recommend a low candidate or not. Low candidates are marked by having only a_1 in their profiles. The agent prefers to recommend low candidates only when they are type t_1. With documentation, however, it is not possible because the principal can check that the agent recommended some candidates with only a_1 in their profiles but rejected some others with identical profiles. Therefore, the agent should decide whether to recommend low candidates regardless of their type or not. Consider the following definitions.

$E(Y|\gamma = \{a_1\})$: The expected payoff, of the agent, of leaving a period with recommending a low candidate.

$E(N|\gamma = \{a_1\})$: The expected payoff, of the agent, of leaving a period with rejecting a low candidate.

these two definitions help us in analyzing the decision of the agent.
Suppose the candidate is low,

we need to distinguish the case when the candidate is of type t_1 from the case when the candidate is t_2 type. Suppose the candidate is t_1 type. The expected payoff of the agent depending on his

decision is;

$1 + \delta E(Y|\gamma = \{a_1\})$ if the candidate is recommended
$0 + \delta E(N|\gamma = \{a_1\})$ if the candidate is not recommended
where δ is the discount rate. When the candidate is t_2 type, then the expected payoff is given by

$$-1 + \delta E(Y|\gamma = \{a_1\}) \text{ if the candidate is recommended}$$
$$0 + \delta E(N|\gamma = \{a_1\}) \text{ if the candidate is not recommended}$$

To derive $E(N|\gamma = \{a_1\})$, note that rejecting a low candidate in one period means that the agent cannot recommend low candidates in the future. As a result, the agent receives a unit of utility in each period if the candidate is competent and zero otherwise.

$$E(Y|\gamma = \{a_1\}) = \sum_{t=1}^{\infty} \delta^t (1-q) \quad (3)$$

where q is the probability of receiving a low candidate given by $E(Y|\gamma = \{a_1\}) = \sum_{t=1}^{\infty} \delta^t (1-q)$

$$q = \sigma_1 p_1 + \sigma_2 p_2$$

To derive $E(Y|\gamma = \{a_1\})$, note that if the agent recommends a low candidate in one period, he cannot reject low candidates in the future periods. As a result, leaving a period with recommending a low candidate implies that the agent has to recommend all low candidates in the future. We have

$$E(Y|\gamma = \{a_1\}) = \delta\{\sigma_1 p_1(1+E(Y)) + \sigma_2 p_2(-1+E(Y)) + (1-q)(1+E(Y))\}$$

To simplify the notation, we write $E(Y|\gamma = \{a_1\})$ and $E(N|\gamma = \{a_1\})$ as $E(Y)$ and $E(N)$, respectively. The above equation gives the expression for $E(Y)$ as

$$E(Y) = \frac{\delta(1-2p_2\sigma_2)}{1-\delta} \quad (4)$$

Given $E(Y)$ and $E(N)$, we are ready to analyze the decision of the agent. Note that there are three possibilities. First, the agent rejects the first low candidate even when the candidate is his favorite t_1 type. It happens when $1 + \delta E(Y) < \delta E(N)$. Given (3) and (4), it implies that

$$p_2\sigma_2 - p_1\sigma_1 > \frac{1-\delta}{\delta} \quad (5)$$

Second, in contrast to the first case, the agent recommends the first low candidate even when the candidate is not his favorite type. It happens when $-1 + \delta E(Y) > \delta E(N)$. This case implies

$$p_2\sigma_2 - p_1\sigma_1 < \frac{\delta-1}{\delta} \quad (6)$$

Finally, it can also happen that

$$-1 + \delta E(Y) < \delta E(N) < 1 + \delta E(Y)$$

This case refers to the situation when the agent rejects the first low candidate only if the candidate is not his favorite type and recommends it if the candidate is his favorite type. In other words, this case leads to *path dependence*. It happens when

$$\frac{\delta-1}{\delta} < p_2\sigma_2 - p_1\sigma_1 < \frac{1-\delta}{\delta} \tag{7}$$

When this happens, the outcome of documentation depends on whether the first low candidate is a favorite type or not. In case the agent cares sufficiently about the future, $\delta \approx 1$, then (7) happens when the fraction of favorite low candidates is close to the fraction of low candidates that are not favorite type. This indicates that we can identify areas or zones for $p_2\sigma_2 - p_1\sigma_1$ that determine whether documentation is beneficial, backfires or leads to path dependence.

Assume, without loss of generality, that the fraction of low candidates q is fixed. We can rewrite (5), the area where documentation is beneficial, as

$$p_1\sigma_1 \leq \frac{1}{2}(q - \frac{1-\delta}{\delta}) \tag{8}$$

This reflects our intuition in the example of the beginning of this section. For documentation to be beneficial, it should not heavily target the agent's favorite type. Doing the same transformation for (6) and (7), we can show that when

$$\frac{1}{2}(q - \frac{1-\delta}{\delta}) < p_1\sigma_1 < \frac{1}{2}(q + \frac{1-\delta}{\delta}) \tag{9}$$

path dependence emerges. Finally, when the agent's favorite candidates are heavily targeted by documentation,

$$p_1\sigma_1 \geq \frac{1}{2}(q + \frac{1-\delta}{\delta})$$

then documentation backfires as the agent recommends all low candidates. Figure 1 depicts the areas (zones) where documentation is beneficial, detrimental and leads to path dependence.

PROPOSITION 2. *With documentation, the equilibrium strategy of the agent entails either*

- *Recommending all low candidates (detrimental zone).*
- *Not recommending any low candidate (beneficial zone).*
- *Recommending all low candidates if the first low candidate is a favorite type and not recommending any low candidate otherwise.*

As Figure (1) shows, an increase in δ results in the shrinkage of the path dependence zone and expansion of beneficial and detrimental zones. Intuitively, as the agent becomes more patient, the weight of the consumption in the first period, when an incompetent candidate is received for the first time, diminishes. Conversely, when the agent is not patient enough, the consumption in the first period becomes pivotal in his decision. In other words, short termism induces path dependence. The parameter δ can also be interpreted as the probability that the agent continuous working in the next period. Therefore, an agent who is uncertain whether she will be doing the same job in the future or not, is more likely to exhibit myopic behavior.

Next, from Figure 1 we see that an increase in $p_1\sigma_1$ makes documentation less beneficial for the principal. This reflects our intuition that documentation cannot be beneficial for the principal if it works heavily against the agent. A high value of $p_1\sigma_1$ together with a fixed q implies that most low candidates are the agent's favorite type and, therefore, the agent is willing to recommend all low types knowing that most of them will be his favorite type.

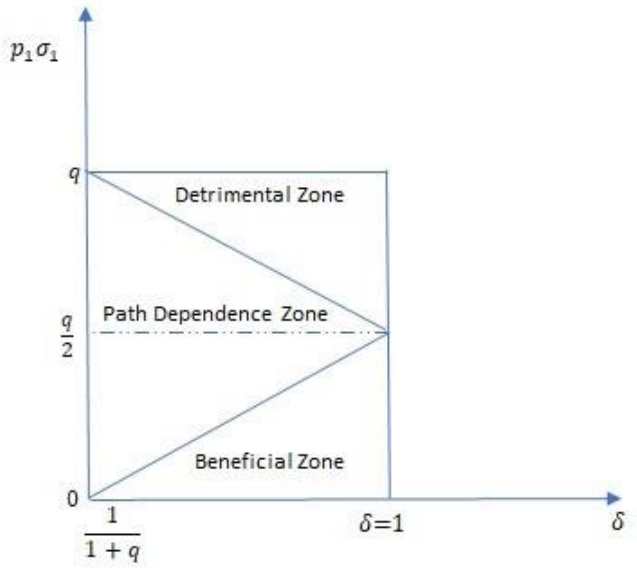

Figure 1: Documentation strategy of the agent

Recall that the principal receives a utility of -1 from hiring a low candidate whereas the agent receives a utility of -1 only if the low candidate is not his favorite type. Otherwise, if the candidate is his favorite type, the agent receives a utility of 1 of approving the low candidate. We can generalize the analysis by assuming that the agent receives a utility of $-1\times\alpha$ of hiring a low candidate of his favorite type. The parameter $\alpha \leq 1$ represents the conflict of interests. In our analysis so far α was assumed to be -1, but it can be any number less than one. It is straightforward to show that having α instead of -1 changes the upper bound of $p_1\sigma_1$ from $\frac{1}{2}(q+\frac{1-\delta}{\delta})$ to $\frac{1}{1-\alpha}(q+\frac{1-\delta}{\delta})$ and the lower bound from $\frac{1}{2}(q-\frac{1-\delta}{\delta})$ to $\frac{1}{1-\alpha}(q-\frac{1-\delta}{\delta})$. Therefore, we can draw the corresponding zones for different values of α and δ as in 2. As we can see, when the interests diverge too much, α <<0, then the beneficial zone shrinks substantially while the detrimental zones grows.

COROLLARY 1. *The beneficial (detrimental) zone shrinks (expands) with the magnitude of the conflict of interests.*

Given the behavior of the agent with documentation, the principal should decide whether to ask for documentation or not. When documentation is beneficial the optimal decision of the principal is clear, she should ask for documentation. When documentation is detrimental, the principal is better off without documentation as it results in approving all low candidates whereas in the absence of documentation only one type of low candidates is approved. The case when documentation results in path dependency is more subtle. If the first low candidate is a favorite type, then the agent recommends it and so documentation will do more harm than good. But if

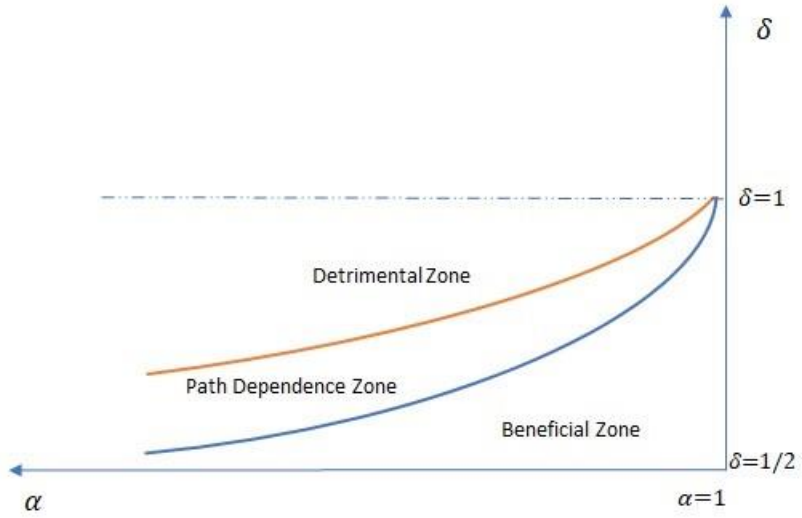

Figure 2: Documentation zones.

the first low candidate is not a favorite type, then the agent rejects it and documentation becomes beneficial. The expected benefit of documentation, when it leads to path dependency is

$$\frac{p_1\sigma_1}{q}(-1+(1-2q)\frac{\delta}{1-\delta})+\frac{p_2\sigma_2}{q}(1-q)\frac{\delta}{1-\delta}$$

The first term in the above equation refers to the case when the first low candidate is a favorite type. In this case, the principal receives -1 for that period plus the expected payoff when all candidates are approved $(1-q-q)$

in the future. The second term refers to the case when the first low candidate is not a favorite type. Absent documentation, the principal receives an expected payoff of $\frac{1}{1-\delta}(1-p_1-p_2\sigma_2)$ if she approves all recommended candidates and 0 otherwise. As a result, the principal is better off with documentation if

$$\frac{p_1\sigma_1}{q}(-1+(1-2q)\frac{\delta}{1-\delta})+\frac{p_2\sigma_2}{q}(1-q)\frac{1}{1-\delta}\geq max\{0,\frac{\delta}{1-\delta}(1-q-p_1\sigma_1)\} \quad (10)$$

The following Lemma states the result.

LEMMA 1. *There exist an upper bound on $p_1\sigma_1$ such that (10) is satisfied if $p_1\sigma_1$ is equal or lower than the upper bound.*

Lemma 1 is intuitive. If $p_1\sigma_1$ is low, then path dependency is more likely to make documentation beneficial as the first low candidate is more likely to be a non-favorite type. Denote the upper bound in Lemma 1 by $p_1^*p_2^*$. We can state the equilibrium documentation decision.

PROPOSITION 3. *The equilibrium documentation decision of the principal entails:*

- *When $p_1p_2 \leq p_1^*p_2^*$, then documentation is optimal.*
- *When $p_1p_2 > p_1^*p_2^*$, then documentation is optimal only if the equilibrium strategy of the agent is not recommending any low candidate (beneficial zone).*

Note that our interpretation of the case when documentation plays a detrimental role is based solely on the outcome of decisions, hiring high ability candidates in our case. However, if we incorporate other criteria, then the interpretation might change. For example, suppose that the principal cares also about procedural fairness. That is, the principal would like all candidates to be treated equally. In this case, documentation might be valuable even when it deteriorates the quality of approved candidates.

4. Document as a Certificate

When a citizen makes a promise to another citizen, she can make it either verbal or record (document) it. If the promise is merely verbal, only the individuals involved observe the promise. Therefore, in case a person does not fulfill the promise, the consequence is that the other party is aggrieved. The most severe punishment available to the aggrieved party, in a civilized society, is refusing to interact with the person who did not fulfill the promise. This serves as a punishment only if they are supposed to interact in the future. If the promise is documented, however, there are more people who observe, or can potentially observe, the promise. As a result, in case the promise is not delivered, the consequences are worse for the person who made the promise. Therefore, documentation serves as a tool that provides incentive to people to honor their promises. In other words, documentation brings additional parties into a dyadic relationship and this in turn might increase the pressure on parties to honor their promises. For documentation to have such an effect, it has to satisfy two requirements. First of all, the document should enable a third party to *verify* a breach. If a third party cannot verify whether a party has breached her promise or not, as stated in the document, then documentation does not achieve its purpose. Secondly, the third party should have some sort of leverage to punish a party once the breach is verified. In other words, the third party should be able to *enforce* the promise. These two properties are, however, in tension. The tension can be explained as follows. Consider two interacting parties and assume that they stand at one end of a line segment. The distance along the line segment from the position of parties indicates the hierarchical or formal distance from the transacting parties. The transacting parties are at the same hierarchy. These parties are able to fully verify a breach in case it happens. However, being at the same hierarchy, each party is unable to hold the other party accountable in case the former breaches a promise. The other end point of the line segment represents the courts. Parties can write a formal document, a contract, that is fully enforceable by the court. This increased enforceability, however, comes at the cost of a lower verifiability. A judge is much less likely to be able to verify a breach. Courts are able to verify broad terms and not relationship-specific details. In between the two extremes, other institutions lie that are able to verify and enforce the promise with various degrees of compromise between enforceability and verifiability.

To show the idea more formally, define an agreement between two parties A and B as a set consisting of promises. That is, an agreement is represented

by a $set\ S \equiv \{s_1, s_2, .. s_N\}$ where each member $s_i, i \in \{1,2,..,N\}$ represents a promise from party A to party B. As an example, suppose John and Ann make an agreement for painting Ann's house at a certain price. Their agreement entails four elements. First, John should paint the house completely (s_1). Second, the painting should be completed before a certain date (s_2). Third, John should use high quality materials (s_3) and finally, John should deliver a specific drawing for one of the bedrooms which Ann explained to him in detail (s_4).

Next, denote the distance of a third party from the transacting parties by $d \in [0,1]$. By distance we mean the hierarchical distance such that the degree of authority increases as the third party becomes more distant. The transacting parties are at distance zero d=0 whereas distance one d=1 represents the court. Next, define the subset $I(d) \subseteq S$ as the set of verifiable elements at distance $d \in [0,1]$. The set $I(d)$ is such $I(d_1) \subseteq I(d_1) \Leftarrow\Rightarrow d_1 > d_2$ for all $d \in [0,1]$. Intuitively, the set $I(d)$ shows which elements of S are verifiable for a third party at distance d from the transacting parties. The property $I(d_1) \subseteq I(d_2) \Leftarrow\Rightarrow d_1 > d_2$ implies that the number of verifiable elements decreases with the distance. In our example of John and Ann, the third party can be either a neighbor d_1 or another professional painter d_2 or the court d_3. The neighbor knows Ann and her house well enough to verify all four elements of the agreement. That is, $I(d_1) = S$. The professional painter is able to verify all elements but the special drawing s_4 which requires knowing Ann personally and her taste, i.e., $I(d_2) = S/s_4$. Finally, a judge is able to verify only if the painting is done completely and on time, but cannot verify the quality of the material and the special drawing. It implies $I(d_3) = S/\{s_3, s_4\}$. Therefore, we have $d_1 < d_2 < d_3$ and $I(d_3) \subset I(d_2) \subset I(d_1)$.

The agreement set S can now be ordered by defining a relation on it. For any pair $i, j, s_i \leq s_j$ if $s_j \in I(d)$, then $s_i \in I(d)$ for all $d \in [0,1]$. In other words, the ordered set S is such that if element s_j is verifiable at distance d, then all elements $s_i, i \leq j$ are also verifiable at that distance.

Next, define another set W whose elements $w_i, i \in \{1,2..N\}$ show the value of corresponding promises in the ordered set S. That is, there is a bijection $f : S \to W$. Given the sets S and W, we can calculate the value of an agreement at a distance d by

$$g(d) \equiv \sum_{i=1}^{n} w_i \, , n = max_i, s_i \in I(d).$$

The function $g(d)$ indicates the value of an agreement at a distance d. Obviously, $g(0)$ equals the total value of an agreement while $g(1)$ is the value of the agreement in the court. In our example, the agreement of John and Ann consists of four promises and the value of each promise s_i is $w_i, i \in \{1,2,3,4\}$ for her. The neighbor at d_1 is able to verify all promises and so the value of the agreement in case the neighbor is the third party is $w_1 + w_2 + w_3 + w_4$. If the third party is a judge, then the value of the agreement is $w_1 + w_2$. Obviously, as the third party becomes more distant, the value of the agreement decreases. That is, $g(d_i) \leq g(d_j) \Longleftrightarrow d_j \leq d_i$.

Next, consider enforceability. It represents the probability that the third party enforces the value of an agreement at distance d. Denote this probability with $f(d)$ to emphasize that it is also a function of the distance. We assume that $f(d_1) \leq f(d_2) \Longleftrightarrow d_1 \leq d_2$. That is, a third party who sits higher in the hierarchy ladder, is more likely to be able to enforce an agreement. We think it is a reasonable assumption and reflects the working of modern economies.

We are now ready to analyze documentation by defining a document. A document is an indisputable description of an agreement where the elements of the agreement, the promises, are verifiable at a distance d. Indisputable means that the parties to the agreement cannot deny that they have consented to the content of the document, i.e., the existence of the agreement is not deniable. Being verifiable at a distance d implies that a third party, at a hierarchical distance d from the parties, is able to verify the fulfilment of all promises mentioned in the document. Documentation can be regarded as the decision to optimally choose the position of the third party. The position of the third party in turn determines the type of the document. The transacting parties solve the following problem

$$Max_d \; g(d)f(d)$$

$$0 \leq d \leq 1$$

Assume, without loss of generality, that $g(d)$ and $f(d)$ are differentiable. The optimal solution, denoted by d^* is given by

$$\frac{g'(d^*)}{g(d^*)} = \frac{f'(d^*)}{f(d^*)} \tag{11}$$

The condition (11) therefore, implies that parties to an agreement should choose a third party by striking a balance between value and enforceability. The position of the third party then dictates the kind of document that is needed. An agreement whose value depends, to a considerable extent, on the nuances and subtleties necessitates a third party that is close to the transacting parties even though such a third party has limited authority to enforce the agreement. An agreement whose value depends mostly on coarse measures calls for a more distant and powerful third party such as a judge. The document in this case, takes the form of a formal contract. In our example, Ann might become worried that John does not stick to their agreement completely and so asks John to sign a document showing their agreement. In doing so, the critical decision is determining a third party that will serve as a referee in case Ann and John disagree on how well the agreement has been implemented. Of the three possible candidates, the judge has full power to enforce the contract. The other professional painter does not have full authority like a judge but can exert a pressure on John by, for example, threatening to damage his reputation. Finally, the neighbor is even less powerful than the professional painter. However, John might care about the neighbor if she is also considering having John painting her house. As we see, these third parties offer various degrees of verifiability and enforceability. We review three possible scenarios and show how each scenario requires a different type of documentation.

The first scenario entails that Ann cares mostly about her house being painted completely and on time and less about the quality and the drawing of the bedroom. That is, for Ann, $w_1 + w_2 >> w_3 + w_4$ or equivalently $\frac{g'(d)}{g(d)}$ drops very slowly. In this case, a formal contract is the best type of document because a judge can fully enforce the contract and make John compensate her in case he does not paint the house completely or on time. The second scenario entails that Ann cares about the quality of the material very much. That is, she prefers to have her house painted a little bit later but with the promised quality. In this case, the ratio $\frac{g'(d)}{g(d)}$ drops slowly with d when d is such that s_3 is verifiable and fast afterwards. The best choice involves having another painter as the third party. The corresponding document in this case describes s_1, s_2, and s_3,. Finally, the third scenario entails Ann caring a lot about the special drawing. Ann might be able to paint her house herself and buy high quality material from the market but cannot make the drawing as it

requires professional skills. This scenario implies that $\frac{g'(d)}{g(d)}$ drops very fast with *d* early on and then slows down. Therefore, having the neighbor as the third party is more beneficial for Ann as the neighbor is the only potential third party who is able to verify the drawing. Here the document describes the full agreement. Note that the optimality condition (11) can also be represented in term of elasticity as

$$\frac{dlog(g'(d^*))}{dlog(q(d^*))} = 1 \qquad (12)$$

It entails that at the optimal distance d^*, the elasticity of *g*(*d*) according to *q*(*d*) is equal to one in absolute terms. This is another way of representing the optimality condition. The following Proposition summarizes this section.

PROPOSITION 4. *Optimal documentation involves selecting an optimal third party by the transacting parties. Selecting an optimal third party implies striking a balance between verifiability and enforceability.*

5. Documentation and Time Saving

Consider electronic medical records (EMR). In most developed countries citizens have medical records that are accessible by health care provides. These medical records are updated whenever a patient visits a doctor or gets a new treatment at a medical center. Most EMR systems have an assessment component where doctors are required to write their diagnosis and the courses of treatments. This assessment component is discretionary, so doctors decide what to write and how detailed it is. How does a doctor decide about it? Assume a patient with a specific symptom visits her doctor. In order to diagnose the cause of the symptom, the doctor asks the patient to take an X-ray scan, a blood test and also performs physical examination. Next, the doctor sends the results of the scan and the blood test to specialists for interpretation. Finally, the physician receives all available information and then forms an opinion about the disease that caused the symptoms. The physician starts the treatment process and monitors the patient periodically. The physician can update the EMR of the patient during each visit by writing her assessment of the progress of the treatment process. She can also refuse to write assessment and update only the parts that are required. In deciding to write her assessment, the physician weighs the costs and benefits of

writing the assessment in the EMR. Adding the assessment to the EMR requires spending some time but saves time in the next visits. Writing periodical assessments in the EMR helps the physician to remember the history of the diagnosis and the process of treatment such that she does not have to go through the whole EMR to remember a patient's history. This is due to the fact that the physician has a limited, imperfect, memory. If the physician had a perfect memory, then there was no need to add periodic assessment to the EMR. Limited memory, however, implies that the physician forgets the details about her patients unless she writes it in the EMR. Limited memory is a key contributing factor for documentation. However, limited memory matters only when time is valuable. If the physician has plenty of time, then she can read all the details of the EMR of a patient before each visit. Limited memory, therefore, matters in combination with time constraint. Next, note that despite being aware of her limited memory, the physician might not write all the details. For example, the physician might write the full details of the X-ray scan but briefly mention the results of the physical examinations, if at all, because she feels that the patient's state is not stable and the same examinations might provide different results if repeated shortly afterwards. Documenting unstable details is a waste of time unless one is interested in the trend or the dynamism of a variable/phenomenon. Stability, therefore, is another key factor in documentation. This example highlights our intuition about documentation. It involves saving a resource, time, for the future by refusing to consume it in the presents. The value of the saving, however, depreciates if the environment is not stable.

5.1. The Model

An individual must make a decision *a* in two consecutive periods. To make the decision, the individual needs to gather information about the relevant parameters that affect the decision. For simplicity, assume that the decision should match the state of the world *w*, in each period, to yield the desired outcome that gives the individual a reward $W > 0$. If the decision does not match the state of the world, the payoff is zero. The utility function of the manager is therefore given by

$$U^i = W.I_{(a^i)}, i \in \{1,2\}$$

where $I_{(a}i_{)}$ is an indicator function defined as

$$\begin{cases} I = 1, & \text{if } a^i = w^i \\ I = 0, & \text{if } a^i \neq w^i \end{cases}$$

In the beginning of period *i*, before making the decision, the individual receives a set $S^i = \{s_1^i, s_2^i, . s_N^i\}$. One and exactly one member of S^i reveals the true state of the world w^i. In the beginning of each period the decision maker learns the probability that each element reveals the true state of the world. That is, the decision maker learns $f(s_j), j \in \{1,2,..,N\}$. Importantly, w^1 and w^2 are independent of each other, i.e., the state of the world in the second period is independent of the first period. Therefore, knowing the true *w* in the first period does not affect decision making in the second period. We can think of *S* as a general set containing N pieces of information of which exactly one reveals *w* in each period.

In each period, the individual can research each s_j by spending time t_j and verify whether s_j reveals *w* or not. However, it is impossible to research all members of *S* since $\sum_{j=1}^{N} t_j > T$ where T is the total time available per period and fixed in each period. When any element s_j is researched in the first period, the individual can prepare a document (like keeping records) that facilitates researching the same element s_j in the second period. That is, if an element s_j is documented in the first period, the required research time reduces to αt_j in the second period. The parameter $\alpha < 1$ determines how effective documentation is in terms of saving time in the future. Documentation reduces research time only if the environment is more or less stable or if the element under research belongs to the subset of elements that are stable. We define stability as the probability that documentation in the first period reduces research time in the second period and denote it, for the element s_j, by β_j. Therefore, documenting an element in the first period saves $t_j(1-\alpha)$ in the second period with probability β_j.

We are interested in the documentation decision by the individual. In order to do so, we need to analyze how the individual researches the elements in each period.

5.1.1. Decision making in the second period

The individual does not document anything in the second period since there is no future to use this documentation. The only decision to make is

deciding which s_j to research. The program that the individual solves is given by;

$$max_{e_i}\ U^2$$

$$s.t$$

$$\sum_{j=1}^{N} e_j t_j^2 \leq T$$

$$e_j \in \{0,1\}$$

The decision variable e_j indicates whether s_j is researched or not. This problem cannot be solved analytically. It can be shown that this problem is a variant of the famous knapsack problem and so is NP-hard[8] (Martello and Toth (1990)). However, if we assume, without loss of generality, that partial research is possible, then we can solve the problem. To do so, we need to replace $e_j \in \{0,1\}$ with $0 \leq e_j \leq 1$. If partial research is possible, an element s_j can be researched for a time period t that is shorter than it's required research time $t < t_j$. The ex-ante probability of discovery then reduces to $f(s_j)\frac{t}{t_j}$. When partial research is possible, the optimal solution for the problem can be derived in two steps. First, we need to sort s_j according to their *informational density* defined as

$$I_j \equiv \frac{f(s_j)}{t_j}, j \in \{1,2,..,N\}$$

Second, start researching the elements s_j from the one with the highest density followed by the second highest and so on.

LEMMA 2. *The optimal search decision involves sorting elements according to their informational density and then researching the element*

[8] NP-hardness means there is no algorithm that can solve this problem in a reasonable time when the problem becomes large.

from the one with the highest density and then the second highest and so on until time allows.

Intuitively, an element that is more likely to be informative and can be researched in shorter time should have a higher priority over another element that is less informative or requires a longer time to research. Informational density plays a fundamental role in our analysis and so it is worthwhile to explore it further. Recall that $f(s_j)$ is the probability that element s_j reveals the true state of the world. In other words, it a measure of *informativeness* of each element. Analyzing the relationship between informativeness and informational density is illuminating. We briefly review three cases to highlight this point. First, the case when all elements are equally likely to reveal the state of the world, $f(s_j) = 1/N$. It follows immediately that informational density is higher for shorter elements and so these elements are more likely to be researched. Second, when informativeness is proportional to the research time,

$$f(s_j) = \frac{t_j}{T}$$

It follows that informational density is independent of the research time and all elements have identical information densities. The reason is that the higher informational content of longer elements is offset by a higher research time. Finally, in case the informativeness of the elements increase disproportionately with their research times, longer elements will have a higher informational density.

5.1.2. First Period

In the first period, the individual has to make a joint decision about researching and documenting. The optimization problem in the first period is

$$max_{e_j, e_j^d}\ U^1 + \delta U^2(\sigma^*)$$

$$s.t$$

$$\sum_{j=1}^{N} e_j t_j^1 + e_j^d t_j^d \leq T \quad (1)$$

$$e_j^d(1 - e_j) = 0 \quad (2)$$

$$e_j^d \in \{0,1\} \quad (3)$$

$$0 \leq e_j \leq 1 \quad (4)$$

This problem is similar to the optimization problem in the second period but has an additional decision variable and an additional constraint. The additional decision variable $e_i^d = \{0,1,\}$ denotes the documentation decision and the additional constraint, (2), ensures that an element can be documented only if it has been researched. σ^* is the optimal strategy in the second period which entails adopting the solution approach of Lemma 2. Note that this problem is at least as hard as the original knapsack problem and therefore is NP-hard. It is, however, possible to introduce a solution that incorporates the documentation decision and optimizes the problem. The solution involves calculating the value of documentation for all elements, even those who are not initially supposed to be researched, and then deciding on documentation. Note that an element s_j can be researched faster in the second period if it has been documented in the previous period, given that it is stable. That is, the research time decreases to αt_j with probability β_j. The added value of this shorter research time can be stated in terms of informational density by introducing an updated informational density as

$$\hat{I}_j = \frac{\beta_j f(s_j)}{\alpha t_j} \quad (13)$$

As expected, the value of documentation increases with the informational density and stability of the element. Next, note that if

$$\hat{I}_j \leq I_j$$

then there is no point in documenting element s_j as it does not add value. When

$\hat{I}_j > I_j$ we still need to check whether the added value of documenting s_j outweighs the associated costs. In order to do so we need to know the cost of documenting an element. The cost of documenting an element is actually the opportunity cost of the time that has to be allocated for documentation. This time could otherwise be allocated to researching, and possibly documenting, other elements. As a result, the cost of documenting an element increases with the research time. Once we determined the cost of documentation, we can compare the cost and benefit of documentation for the elements that satisfy $\hat{I}_j > I_j$. Intuitively, the benefits of documentation increase with the stability and decrease with research time. The following proposition summarizes the analysis of this section.

PROPOSITION 5. *The optimal solution to the documentation problem involves trading off the future benefits of enhanced informational density with the opportunity costs of time in the present. Documentation is more likely to be value enhancing for elements that have a higher informational density, are more stable and have a shorter documentation time.*

One implication of the solution to documentation is that an element that might not have been researched absent documentation, gets to be researched when documentation is possible. This happens when documentation reduces the research time considerably in the second period such that it becomes worthwhile to forgo some valuable research time in the first period. If the benefits of a reduction in the research time, in the second period, is at least as large as the value of the time that has to be allocated for research and documentation, then that element is worth documenting. This point can be demonstrated using our example of EMR with a twist. Assume that the treatment takes two periods. Recall that the doctor could ask for three medical tests: X-ray scan, blood test and physical examinations. Denote them by {*A*,*B*,*C*}, respectively. The probability that the test {*A*,*B*,*C*} reveals the disease is {1/4,1/4,1/2}, respectively. The time required for doing the test and receiving the interpretation is {1,1,3}, respectively. Finally, the total available time is 3 units in each period. In the absence of documentation, tests A and B a have higher informational density compared to C. According to Lemma (2) tests A and B should be performed completely. Test C can be performed partially due to the lack of time. That is, only 1/3 of it can be done. As a result, the probability of discovering the disease in each period is

(1/4+1/4+1/3×1/2=2/3). The overall probability of discovering the disease in the absence of documentation is

$$\frac{2}{3}+\frac{1}{3}\times\frac{2}{3}=\frac{8}{9}$$

Consider the same problem with documentation. Assume for simplicity that documentation time is negligible, $t^d=0$. In addition, documentation reduces the time required for doing test C by 1/3 but does not reduce the required times of the other two tests. Proposition 5 implies that test C should be completely performed and documented in the first period. Therefore, it becomes possible to do all the three tests in the second period. When it happens, the probability of discovery becomes 1/2 (only test C can be done) in the first period and 1 in the second period. Therefore, documentation allows the health care to discover the disease with certainty. This example highlights two points about documentation. First, documentation changes the set of activities that an organization undertake. Second, documentation can be a value enhancing activity.

6. Extension

6.1. Documentation and Incentives

In the section §5, we assumed that the document is retrieved, in the second period, by the same person who created it in the first period. As a result, the interests of the composer and the retriever were fully aligned. In most real cases, however, people who document are not necessarily the same as those who use that document in the future. For example, secretaries oversee documenting the minutes of meetings and some other types of data in organizations. However, it is mostly other employees and managers who use these documents later. When this is the case, two types of problems might arise. First, managers might then become concerned whether the secretaries document with due diligence or not. This type of problem falls more or less into the category of moral hazard problems that has been extensively researched. Second, the manager decides about the content of the document knowing that the document will be used by her subordinates whose interests

might not be fully aligned with her. In this case, the manager's concern is the effect of documentation on the behavior of the users of the document.

For example, consider an investment firm who is researching multiple investment opportunities. For simplicity, suppose that investment choices are similar in terms of risk and return but can be made in different countries. So, the firm should decide where to invest. Each time the firm researches a specific country, the manager can instruct her subordinates to create a document that facilitates researching that country in the future. However, the manager is also aware that making a country easier to research might distort the incentives of her employees such that they research countries that have been documented, and hence are easier to research, than other countries which might be more promising. As a result, the manager may decide not to document or not fully document the process despite the potential benefits of documentation. Importantly, the adverse effects of documentation depend on how the manager compensates the employees who are involved in researching possible investment options. The weaker the link between the employees' payments and the investment outcome, the stronger the effect of documentation on employees' behavior. This section analyzes this problem.

Consider the documentation problem we analyzed in §5 with two differences. First, all elements are identical in terms of informativeness, i.e., $f(s_j) = 1/N, s_j \in S$. Second, there is a principal and an agent. The principal conducts the research and documentation in the first period. The agent retrieves the document, conducts the research and communicates the results to the principal in the second period. The principal can verify the message of the agent. That is, the principal can verify whether the agent has discovered the true state of the world and whether the agent has actually researched an element or not. The principal, however, cannot instruct the agent about the research strategy in the second period. It is the agent who decides how to conduct the research. The timing of the events is as follows. The principal determines the compensation package of the agent, the contract. The agent observes the contract and conducts the research. Payoffs are realized. Both parties are risk neutral. We are interested to investigate how documentation affects the behavior of the agent in the second period. In short, we would like to know how documentation induces the agent to research the elements of S.

Doing so requires us to know how the agent is compensated. A general linear contract takes the form of

$$y + vx$$

where *y* is the bonus contingent on finding the true state of the world and *v* is a fixed, piece wise reward to be paid for researching each element s_j. The equilibrium strategy of the agent σ^* is straightforward. The agent will research as many elements as possible if *v* 6=0. Otherwise, if *v* =0, the agent researches as many elements as possible but stops immediately when he discovers the true state of the world. Next, note that the assumption regarding identical informational densities of elements implies that the optimal research strategy yields an expected surplus (probability discovery) of *W*(*n*/*N*), where *n* is the maximum number of elements that can be researched during a period out of a total *N* elements. It is known to both the principal and the agent. The principal determines the contract by solving the following problem

$$max_{y,v}\, E(U_P|\sigma^*) = Wb - (y + vx)$$

s.t

$$E(U_A|\sigma^*) \geq \eta W(\frac{n}{N})$$

$$E(U_P|\sigma^*) \geq (1-\eta) W(\frac{n}{N})$$

where η denotes the bargaining power of the agent. Assume for simplicity that the employment market is competitive, i.e., η =1. All the surplus goes to the agent. There are many solutions for this problem given the strategy of the agent. The principal can offer only a piece wise contract (*y* = 0, *v* = *W*/*N*) or only a contingent bonus contract (*y* = *W*(*n*/*N*), *v* = 0). Any combination yielding the same value in expectation is also possible. Different modes of payment, contingent versus piece wise, result in the same value in expectation but induce a different behavior. Paying the agent per element

(piece wise) results in researching all possible elements even when the agent discovers the true state of the world after the first element. So, the risk is fully allocated to the principal. Fully contingent payment, on the other hand, results in stopping research after discovering the true state of the world but allocates all the risk to the agent.

LEMMA 3. *The optimal contract can include any combination of contingent and non-contingent clauses. Different types of contracts differ only in allocating the risk.*

The principal would like the agent to research as many elements as possible but stop immediately after discovery. To achieve this, the principal can offer a contingent based contract to the agent who would accept it. Therefore, the overall documentation strategy of the principal, in the first period, does not change from what it was under single agency.

LEMMA 4. *Documentation strategy is identical in a principal-agent setting as in a single agency, given that there is no information asymmetry.*

6.2. Information Asymmetry

So far, we assumed that the agent did not have private information. We would like to know whether information asymmetry has consequences for documentation or not. To do the analysis, assume that the agent receives a private signal in the beginning of the second period implying that one of the elements, say s_j, is more informative than the rest of the elements. We call that element the *indicated* element. In terms of our model, the indicated element's contribution to the discovery is $p > 1/N$. That is, the indicated element has a higher informational density than the rest of the elements and an optimal research plan requires the indicated element to be always researched. Does the agent always research the indicated element? the answer depends on the contact. If the contract consists only of a contingent bonus, ($y = W(n/N)$, $v = 0$), then the agent researches the indicated the element as it increases the chance of discovery more than other elements. If the contract has both a piece wise and a contingent bonus component ($y \neq 0$, $v \neq 0$), then the agent researches the indicated element only if the expected benefits of researching the indicated element outweighs its opportunity costs.

The opportunity cost refers to the minimum number of elements that the agent must give up in order to have time to research the indicated element. Denote this number by γ. The agent researches the indicated element if

$$y(p - \frac{\gamma}{N}) \geq (\gamma - 1)v \tag{14}$$

The first best decision, however, requires the agent to research the indicated element when

$$y(p - \frac{\gamma}{N}) \geq 0 \tag{15}$$

comparing (14) and (15) we see that the first best does not emerge unless γ =1 or v =0. Therefore, the optimal contract, in the presence of private information, contains only of a contingent bonus. If for any reason the contract has a piece wise component, due to the agent being risk averse for instance, then the first best decision does not emerge.

LEMMA 5. *In the presence of private information, the optimal contract consists only of a contingent bonus.*

Given the behavior of the agent, the decision for documentation in the first period is not as simple as it was before. On the one hand, documentation reduces the required research time of elements and therefore, increases the opportunity costs of researching the indicated element whenever the indicated element is not in the research list. On the other hand, documentation increases the number of elements that can be researched in a period and so increases the chance that the indicated element becomes part of the research list.

7. Conclusion and Further Research

This paper analyzes the effects of documentation in organizations. Documentation is defined as a history that shows the actions done and/or information known in the past. We show that documentation is a multi-purpose activity that cannot be understood by any single model. Therefore,

we present three models, each analyzing documentation from a specific point of view. We identify three main roles for documentation.

First, documentation is analyzed in a principal-agent setting when there is information asymmetry. The model shows that documentation is not always beneficial for the principal but can also be detrimental or lead to path dependency. Second, we analyze documentation as a tool for saving time in the future when people have limited memory and limited time. Finally, we study documentation as a way of providing a certificate to the parties to an agreement that protects them against a possible breach from the other party.

This paper is the first, to the best of our knowledge, that studies documentation explicitly. As a result, we can think of various paths to advance the theory and develop models that enhance our understanding of documentation. One specific area is to study the medium of documentation. This paper does not distinguish between different mediums and their relative costs and effectiveness. With the new developments in information technology, however, the costs and benefits of documentation has changes from what it was in the age paper and pen.

Next, there are lots of unexplored questions about the effect of documentation in shaping incentives and affecting the behavior of those who compose documents and those who use these documents later. This paper studied one important aspect in the section §3 and another one in §6. Section §3 analyzes what we believe to be a key function of documentation, enforcing consistency. Our analysis assumed a specific information structure for the sake of clarity and feasibility. It is very important to extend the analysis to other types of information structures to see how results change. The analysis in §6 is brief and uses restrictive assumptions in order to stay focused on one topic. A promising way for future research on documentation is studying the subject when the assumptions are relaxed.

Finally, and probably the most important agenda for future research, is the role of documents in showing the information available to the decision makers in various points of time. In order to evaluate the performance of a decision maker, it is crucial to know what she knew at the time of decision making. Documents can show the information available to the decision maker but if the decision makers know this in advance, then she might decide to stop documentation in the first place.

Appendix

Proof of Lemma 2

The problem is the binary knapsack problem with probabilities being the value of elements and their corresponding research time as their weights. Relaxing the integrality of e_i the optimal solution, according to Dantzig (1957) involves sorting elements decreasingly according to $\frac{f(.)}{t}$ and start researching the first element, then the second and so on until time allows. All elements are completely researched except the last one that might be researched partially. To show that this solution is optimal, suppose that elements are sorted according to $\frac{f(.)}{t}$ and the last element that can be researched is g. Assume, contrary to the proposed solution, that an element $i < g$ is not researched fully. It then implies that another element $j > g$ can be partially researched instead. This is because the optimal solution should use all the available time. Therefore, we can increase the research time of the element i by $\varepsilon > 0$ and decrease the research time of j by $\epsilon \frac{t_i}{t_j}$. This results in an increase in the probability of discovery by $\varepsilon(f(s_i) - f(s_j)\frac{t_i}{t_j})$ that is positive since $\frac{f(s_i)}{t_i} > \frac{f(s_j)}{t_j}$, a contradiction. In the same vein, researching elements after g results in a contradiction. Q.E.D.

Proof of Proposition 5

The value of documenting an element W_i can be calculated as follows. First define $\hat{I}_i$ as

$$\hat{I}_i = \frac{\beta f(s_i)}{\alpha t_i} \tag{16}$$

if $\hat{I}_i < I_i$ then$\hat{I}_i = I_i$ otherwise if $\hat{I}_i > I_i$then $\hat{I}_i$ is defined as in (16). Next, denote the ordered research set by R. This is the set whose elements are chosen to be researched using Dantzig method and elements are ordered from the first element to the last. Consider the last element s_s and its informational density I_s. If $\hat{I}_i < I_s$, then W_i =0. Otherwise, use Dantzig method for the knapsack problem and calculate the total probability of discovery with the updated informational density for the element s_i in period $t \in \{1,2\}$ and denote it by $V^t(\hat{I}_i, I_{j\neq i})$ Then compare it with the same discovery probability using the initial informational density I_i and denote it by $V^t(\hat{I}_i, I_{j\neq i})$. Finally,

the sum of the differences between the probabilities of discovery in period 1 and 2 gives the total value of documenting the element. That is

$$W_i = [V^2(\hat{I}_i, I_{j\neq i}) - V^2(I_i, I_{j\neq i})] + [V^1(\hat{I}_i, I_{j\neq i}) - V^1(I_i, I_{j\neq i})] \quad (17)$$

We can calculate the value of documentation for all elements in the grand set S and store them in a set W.

Next, the cost of documentation of an element s_i equals the sum of the values of elements that have to be given up in order to have sufficient time for documenting elements_i. This forgone value depends on the elements that are given up. As a result, we need to know which elements have to be given up. We should proceed as follows. First, the value of documentation W_i for all elements is calculated from (17). Next, elements of W are sorted in an increasing order. That is, from the lowest to the second lowest and so on.

$$W_1 \leq W_2 \leq \ldots \leq W_N$$

Next, define the set of elements that are currently chosen to be researched by R and denote the last element in R by s_s. The number of elements that have to be given up is

$$TN = Argmin_j \sum_{j=0, j\neq i}^{s} t_{s-j} \geq t_i^d \quad (18)$$

if element s_s is in the list of research a priori or

$$TN = Argmin_j \sum_{j=0, j\neq i}^{s} t_{s-j} \geq t_i^d + t_i \quad (19)$$

otherwise. The value that has to be given up is

$$TC = \sum_{i=1}^{TN-1} f(s_{s-i}) + \alpha f(s_{TN}) \quad (20)$$

where α is defined as

$$\begin{cases} 1 & \text{if } \Sigma_i^T t_{s-i} = t_i^d \\ \frac{\Sigma_{i=1}^T t_{s-i} - t_i^d}{T} & \text{Otherwise} \end{cases}$$

Next, we begin with the first element of the set W. If $W_1 > TC$ and the element W_1 is in the research list, then we update the research list R and decide to document the element. If the element is not in the research list, then

we put it in the research list and update S. If $W_1 \leq TC$, then we do nothing and move on to the next element W_2. This process is repeated until the last element W_N.

Proof of Lemma 1

Consider the condition

$$\frac{p_1\sigma_1}{q}(-1+(1-2q)\frac{\delta}{1-\delta})+\frac{p_2\sigma_2}{q}(1-q)\frac{1}{1-\delta} \geq max\{0, \frac{\delta}{1-\delta}(1-q-p_1\sigma_1)\}$$

Note that the term $(-1+(1-2q)\frac{\delta}{1-\delta})$ in the left hand side is less than $\frac{\delta}{1-\delta}(1-q-p_1\sigma_1)$ on the right hand side whereas the other term $(1-q)\frac{1}{1-\delta}$ is larger than it for any $q \leq 1$. In addition, $\frac{p_2\sigma_2}{q} = 1-\frac{p_1\sigma_1}{q}$. The left hand side is a convex combination of two terms, one larger and one smaller than the right hand side. As a result, there must be a lower bound for value for $p_2\sigma_2 = 1-p_1\sigma_1$such that the inequality holds when $p_2\sigma_2$ is at least as large the lower bound. Q.E.D.

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Chapter 5: Summary and Conclusion

Chapter one introduces the thesis by reviewing the trajectory of development of information economics from a historic perspective. Then each chapter is introduced by explaining the research questions, relevance and the solution approach.

Chapter two researches the governance structure of partnerships when members are heterogeneous in terms of the value of their outside options and knowledgeability (expertise). To account for the heterogeneity, the paper assumes two types of members: juniors and Seniors. Seniors have more valuable outside option than Juniors. The paper analyzes decision making and communication in three types of markets that differ in the availability of attractive business opportunities. Three results are established. First, we show that market and governance structure are intertwined. In markets with few attractive opportunities, mature markets, decision rights is more likely to be granted to Seniors as these members are more vulnerable. That is, they are more likely to incur loss from implementing projects that yield less than their outside option. In markets with abundant attractive projects, nascent markets, decision rights is more likely to be granted to Juniors. Intuitively, Juniors are more vulnerable in this type of market. Their vulnerability, however, results from missing promising projects rather than implementing inferior projects. Finally, in markets that are somewhere in between the other two markets, mixed market, both member types are vulnerable and therefore, heterogeneous partnerships are not viable. In either the mature or nascent market, the member type who is not granted the decision rights joins the partnership only if s/he is not highly knowledgeable. Otherwise that type is better off operating in an independent, homogeneous partnership. This explains why partnerships where Juniors are granted the decision rights are rare. This requires the Seniors not to be highly knowledgeable. Second, our analysis identifies the efficient governance structure in each market type. We show that the efficiency of governance structures depends on the knowledgeability of the member type whose preference is more in line with the market, i.e., Seniors in the mature market and Juniors in the nascent market. In the mature market if Seniors are highly knowledgeable, then it is more efficient to grant decision rights to them. Otherwise, Juniors should be granted the decision rights. The same applies in the nascent market. If Juniors are highly knowledgeable, then they should hold the decision rights.

Otherwise Seniors should hold the decision rights. Finally, the paper studies the effect of repeated interactions on the viability of heterogeneous partnerships. It is known that if people expect to interact frequently with each other in the future, then cooperative behaviors can be sustained given that individuals are patient. Our analysis shows that if heterogeneous members are patient enough, then the efficient governance structure is viable in all markets. It happens because with frequent interactions, the prospect of gains from cooperative behavior in the future, outweighs the short-term gain from strategic behavior. Therefore, when people are patient, i.e., care sufficiently about the future, they can forgo the short-term benefits of strategic behavior.

Chapter three studies social image (status) in organizations and overconfidence both in organizations and also from an individual perspective. In the organizational context, the paper aims to provide an explanation for two observations that seem to be in conflict. On the one hand, most people overrate themselves in terms of skills and ability, i.e., are overconfident. On the other hand, overconfident managers are shown to be more successful in eliciting effort and commitment from their followers and peers, compared to mangers who are not overconfident. The paper assumes an organization consisting of a manager and two types of followers. One type of followers, called experts, are rational, i.e., use Bayes rule in forming and updating beliefs. The other type, called non-experts, are less rational, i.e., do not use the Bayes rule in forming and updating beliefs. The manager is either high ability or low ability. In addition, the manager can be either confident or unconfident. The paper establishes three results. First, it shows that experts might prefer confident managers to unconfident managers, even when low ability managers are more likely to be confident than high ability manager and experts are aware of it. This happens because non-experts associate confidence with ability and therefore, think that a confident manager is a high ability one. Experts are aware that non-expert associate confidence with ability and know that non-experts exert a higher effort when the manager is confident, compared to the case when the manager is unconfident. If the higher effort of the non-experts compensates the manager's ability slack, because confident managers are less likely to be high ability, then the experts would also prefer a confident manager to an unconfident manager despite knowing the relationship between confidence and ability is dubious. In short, the paper shows that managerial confidence can increase the output if two conditions are met. First, a large portion of followers believe that confidence is associated with competence. Second, managerial input is highly

substitutable with followers' input. Next, the paper shows how the manager's concern for her social image (status) affects her decision making. Social image concern results in implementing inferior projects when reversing damages, the social image of the manager. This happens when followers expect decisiveness from managers. It might seem that managers with a very high status are more vulnerable to image loss and therefore are more likely to implement inferior projects. The analysis shows that this intuition is wrong since the high-status managers are less vulnerable to image loss than managers with lower status. Status loss, resulting from reversing, is non-monotonic in the initial status. The status loss initially increases, reaches a maximum and then decreases afterwards. As a result, status loss is mostly the problem of managers with middle stats.

Chapter 4 researches documentation. It analyzes how documentation affect communication and decision making in organizations. The paper defines a document as a piece of information whose content is not verifiable but the very existence of it is indisputable. Documentation is a multi-purpose, multi- faceted activity that is widely practiced but less explored. The paper identifies three functions for documents. First, documents improve communication in a principal-agent setting with asymmetric information. The model assumes that the raw information that the agent receives is observable by the principal, but she cannot interpret the information. It is the private information of the agent. With documentation, the principal can observe the interpretation of agent in the past and therefore, the agent has to be consistent when interpreting information. In other words, documentation shows how the agent communicated in the past upon receiving certain type of information. This history, then ties the hand of the agent because the agent cannot communicate differently with the same type of information at later times. In short, documentation enforces consistency and this consistency in turn forces the agent to communicate more informatively. The analysis shows that the enforced consistency is not always beneficial, but it might backfire. Whether documentation improves communication or backfires, depends on two factors. First, it depends on the magnitude of divergence of interests. If the interests are too divergent, then documentation backfires. The agent would prefer to systematically mislead the principal. Second, the agent should be sufficiently patient if documentation is going to be beneficial. Intuitively, if the agent is not patient, i.e., does not care sufficiently about the future, then documentation loses its grip as consistency becomes less important for the agent. Next, the paper shows that documentation serves as

a certification for an agreement. In this case, an agreement consists of a set of promises. The parties to an agreement can observe these promises. Documentation makes the promises observable by a third party. The distance of the possible third parties, from the parties to the agreement, can vary. The farthest distance from the parties are courts. The distance of the third-party matters because the set of observable promises shrinks as the distance increases. That is, a third party that is closer to the parties of an agreement can observe more element of the agreement (promises) than another third party who sits at a farther distance. For example, in a multi-division company, the CEO can observe more elements of an agreement between two division managers compared to a judge. So, the distance of the third party determines the observability of the agreement for that party. Another difference between the possible third parties are their ability to enforce the promises. This time, the more distant the third party, the more powerful s/he becomes in terms of enforcing the promises. In the previous example of a multi-division company, a judge is more powerful than the CEO when it comes to enforce an agreement. As a result, the parties to an agreement, choose the third party by making a tradeoff between observability and enforceability. Once the place of the third party is determined, the corresponding type of document is composed. In the multi-division company, if the two-division manager choose the CEO as the third party, then the document takes the form of a memorandum of understanding (MoU). If the third party is a judge, then the document takes the form of a contract. Finally, the paper analyzes the role of documentation as a saving tool. Organizations save time by documenting repetitive tasks. The analysis shows that documentation becomes more effective when tasks are stable. In addition, documentation might change the courses of action that an organization takes.

Samenvatting

Deze thesis onderzoekt communicatie en besluitvorming in organisaties. Er zijn in totaal vijf hoofdstukken, inclusief het huidige hoofdstuk. Hoofdstuk 1 introduceert de thesis door een bespreking van de geschiedenis van de ontwikkeling van de informatie-economie. Vervolgens wordt elk hoofdstuk vooraf gegaan door een uitleg over de onderzoeksvragen, hun relevantie en de oplossingsbenadering.

Hoofdstuk 2 onderzoekt de bestuursstructuur van partnerschappen wanneer haar leden heterogeen (verschillend) zijn wat betreft de waarde van hun externe mogelijkheden en deskundigheid (expertise). Om de heterogeniteit te verklaren, gaat het artikel uit van twee soorten leden: junioren en senioren. Senioren hebben meer waardevolle externe mogelijkheden dan junioren. Het artikel analyseert de besluitvorming en communicatie in drie soorten markten die verschillen op het gebied van de beschikbaarheid van interessante zakelijke kansen. Er worden drie resultaten vastgesteld. Als eerste laten we zien dat markt- en bestuursstructuren met elkaar zijn verbonden. In markten met weinig aantrekkelijke kansen (ontwikkelde markten) is de kans groter dat besluitvormingsrechten worden toegekend aan senioren omdat deze leden kwetsbaarder zijn. Dat wil zeggen dat de kans groter is dat ze verlies lijden door het implementeren van projecten die minder opleveren dan hun externe mogelijkheid. In markten met legio aantrekkelijke projecten (opkomende markten) is de kans groter dat besluitvormingsrechten worden toegekend aan junioren. Junioren zijn gevoelsmatig kwetsbaarder in dit type markt. Hun kwetsbaarheid komt echter eerder door het over het hoofd zien van veelbelovende projecten dan door het implementeren van slechte projecten. Ten slotte zijn beide typen leden kwetsbaar in markten die ergens tussen de andere twee markten in zitten (gemengde markten) en daarom zijn heterogene partnerschappen niet geschikt. In zowel ontwikkelde als opkomende markten treedt alleen het type leden zonder besluitvormingsrechten toe tot het partnerschap toe als hij/zij niet heel deskundig is. In andere gevallen functioneert dat type beter in een onafhankelijk, homogeen partnerschap. Dit verklaart de zeldzaamheid van partnerschappen waarin de besluitvormingsrechten aan junioren worden toegekend. Een vereiste hiervoor is dat senioren niet heel deskundig zijn. Ten tweede stelt onze analyse voor elk markttype vast welke bestuursstructuur het meest efficiënt is. We tonen aan dat de efficiëntie van bestuursstructuren

afhangt van de kennis van het type leden van wie de voorkeur meer in overeenstemming is met de markt: d.w.z. senioren in ontwikkelde markten en junioren in opkomende markten. Als senioren in ontwikkelde markten zeer deskundig zijn, is het efficiënter om de besluitvormingsrechten aan hen toe te kennen. Anders moeten de besluitvormingsrechten aan junioren worden toegekend. Hetzelfde geldt voor opkomende markten. Als junioren zeer deskundig zijn, dan moeten zij de besluitvormingsrechten hebben. Anders moeten senioren de besluitvormingsrechten hebben. Tot slot wordt in dit artikel het effect van herhaalde interacties op de levensvatbaarheid van heterogene partnerschappen onderzocht. Het is bekend dat mensen die verwachten dat ze in de toekomst vaak met elkaar zullen omgaan, coöperatief gedrag blijven vertonen, op voorwaarde dat zij geduldig zijn. Uit onze analyse blijkt dat als heterogene leden geduldig genoeg zijn, de efficiënte bestuursstructuur in dat geval in alle markten levensvatbaar is. Dit is het geval omdat het vooruitzicht op toekomstige door samenwerking behaalde winst opweegt tegen korte termijn gewin door strategisch gedrag in situaties met veelvuldige communicatie. Wanneer mensen geduldig zijn en bijvoorbeeld het belang van de toekomst inzien, kunnen ze daarom de korte termijn voordelen van strategisch gedrag terzijde schuiven.

Hoofdstuk 3 onderzoekt het sociale beeld (status) in organisaties en daarnaast overmoed in zowel organisaties als vanuit een individueel perspectief. Binnen de organisatorische context probeert het artikel een verklaring te geven voor twee ogenschijnlijk tegenstrijdige observaties. Enerzijds overschatten de meeste mensen zichzelf op het gebied van vaardigheden en competenties: ze zijn bijvoorbeeld overmoedig. Aan de andere kant zien we dat overmoedige managers succesvoller zijn in het genereren van betrokkenheid en inspanningsbereidheid bij hun volgers en collega's, in vergelijking met managers die niet overmoedig zijn. Het artikel gaat uit van een organisatie die bestaat uit een manager en twee soorten volgers. Eén soort volger, de deskundige genoemd, is rationeel en gebruikt bijvoorbeeld de stelling van Bayes bij het vormen en bijstellen van overtuigingen. De andere soort, de niet-deskundige genoemd, is minder rationeel. Deze maakt bijvoorbeeld geen gebruik van de Bayes-stelling bij het vormen en bijstellen van overtuigingen. De manager is óf zeer deskundig óf weinig deskundig. Daarnaast kan de manager zelfverzekerd zijn of onzeker. Het artikel stelt drie resultaten vast. Allereerst wordt aangetoond dat deskundigen de voorkeur kunnen hebben voor zelfverzekerde managers boven onzekere managers. Zelfs wanneer een manager met een geringe

deskundigheid meer zelfvertrouwen heeft dan een manager die zeer deskundig is en de deskundigen zich daarvan bewust zijn. Dit gebeurt omdat niet-deskundigen zelfvertrouwen associëren met deskundigheid en daarom denken dat een zelfverzekerde manager deskundig is. Deskundigen zijn zich ervan bewust dat niet-deskundigen zelfvertrouwen associëren met deskundigheid. Ze weten ook dat niet-deskundigen zich meer inspannen als de manager zelfverzekerd is, vergeleken met een situatie waarin de manager onzeker is. Als de grotere inspanningen van de niet-deskundigen de deskundigheid van de manager compenseren omdat zelfverzekerde managers meestal minder deskundig zijn, dan zouden de deskundigen ook de voorkeur aan een zelfverzekerde manager moeten geven boven een onzekere manager, ondanks het feit dat zij weten dat de relatie tussen zelfvertrouwen en deskundigheid twijfelachtig is. Samenvattend toont het artikel aan dat het zelfvertrouwen van een leidinggevende tot betere resultaten kan leiden wanneer er aan twee voorwaarden wordt voldaan. Ten eerste gelooft een groot deel van de volgers dat zelfvertrouwen samenhangt met competentie. Ten tweede zijn kan de bijdrage van de leidinggevende uitstekend worden vervangen door de bijdragen van de volgers. Vervolgens laat het artikel zien hoe de aandacht van de manager voor zijn/haar sociale beeld (status) invloed heeft op zijn/haar besluitvorming. Het belang van het sociale beeld leidt tot het implementeren van inferieure projecten indien het niet-implementeren ervoor zorgt dat het sociale imago van de manager schade oploopt. Dit gebeurt wanneer volgers besluitvaardigheid van managers verwachten. Het lijkt misschien dat managers met een zeer hoge status kwetsbaarder zijn voor statusverlies, en daarom eerder geneigd zijn inferieure projecten te implementeren. De analyse toont echter aan dat deze aanname verkeerd is omdat managers met een hoge status minder gevoelig zijn voor statusverlies dan managers met een lagere status. Statusverlies als gevolg van het terugdraaien van beslissingen is in eerste instantie niet-monotonisch. Het statusverlies neemt aanvankelijk toe, bereikt vervolgens een maximum en neemt daarna af. Hierdoor is statusverlies voornamelijk problematisch voor managers met middelmatige kwaliteiten. Tot slot wordt in dit artikel overmoed bestudeerd vanuit een interpersoonlijk perspectief. De analyse toont aan dat overmoed ontstaat door een combinatie van optimisme en een beperkt geheugen. Iemand die optimistisch is, verwacht dat hij/zij in de toekomst beter zal presteren dan in het heden. Dit optimisme kan voortkomen uit een op groei gerichte mindset waarbij de persoon verwacht te leren van zijn/haar ervaringen. Ook kan het komen door alvast te genieten van datgene wat in de toekomst gaat komen. In ieder geval houdt optimisme in dat iemand

verwacht dat hij/zij in de toekomst in staat zal zijn om moeilijkere taken uit te voeren die een hogere beloning hebben. Een beperkt geheugen impliceert daarentegen dat iemand vergeet dat zijn/haar vaardigheid is verbeterd als het gaat om het uitvoeren van toekomstige taken. Daarom heeft de persoon een drijfveer om zijn/haar zelfbeoordeling positief te vertekenen. Met andere woorden, de persoon vormt een inschatting over zijn/haar vaardigheid in het heden binnen een specifieke context. De persoon verwacht dat zijn/haar vaardigheid toeneemt of groter is binnen andere contexten. Daarnaast is de persoon zich ervan bewust dat hij/zij dit punt zal vergeten. Dit heeft als gevolg dat de persoon een drijfveer heeft om zijn/haar vaardigheid te overschatten.

In hoofdstuk 4 wordt onderzoek gedaan naar documentatie. Er wordt geanalyseerd op welke manier documentatie invloed heeft op de communicatie en besluitvorming in organisaties. Het artikel definieert een document als informatie waarvan de inhoud niet te controleren is, maar waarvan het bestaan een feit is. Documentatie is een multifunctionele, veelzijdige handeling die veel wordt toegepast maar niet vaak wordt onderzocht. In het artikel worden drie functies van documenten vastgesteld. Ten eerste verbeteren documenten de communicatie in een principaal-agent situatie waarin sprake is van asymmetrische informatie. Het model veronderstelt dat de ruwe informatie die de agent ontvangt waarneembaar is door de principaal. Deze kan de informatie echter niet interpreteren. Het is namelijk de privé-informatie van de agent. Met behulp van documentatie kan de principaal de interpretatie van de agent in het verleden observeren. Om deze reden moet de agent consistent zijn bij het interpreteren van informatie. Met andere woorden: documentatie laat zien hoe de agent in het verleden communiceerde na het ontvangen van bepaalde soorten informatie. Deze geschiedenis beperkt de agent vervolgens in zijn handelen, omdat de agent op een later moment niet anders kan communiceren op basis van hetzelfde type informatie. Kort gezegd dwingt documentatie consistentie af. Door deze consistentie is de agent op zijn beurt gedwongen om op een meer informatieve manier te communiceren. De analyse toont aan dat deze afgedwongen consistentie niet altijd gunstig is, maar ook een averechts effect kan hebben. De vraag of documentatie voor betere communicatie zorgt of juist een averechts effect heeft, is afhankelijk van twee factoren. Ten eerste hangt het af van het vooroordeel van de agent. Als de agent te bevooroordeeld is, dan heeft documentatie een averechts effect. Wanneer hij te bevooroordeeld is en documentatie aanwezig is, kan de agent de voorkeur

geven aan het systematisch misleiden van de principaal. Ten tweede moet de agent voldoende geduldig zijn voordat documentatie nuttig wordt. Als de agent niet geduldig is en zich bijvoorbeeld niet voldoende bekommert over de toekomst, dan wordt het belang van documentatie minder omdat de agent consistentie minder belangrijk vindt. Vervolgens laat het artikel zien dat documentatie dient als bewijs voor een overeenkomst. In dit geval bestaat een overeenkomst uit een reeks beloften. De partijen die bij een overeenkomst zijn betrokken, kunnen deze beloften nakomen. Documentatie zorgt ervoor dat deze beloften waarneembaar zijn voor een derde partij. De afstand van de mogelijke derden tot de bij de overeenkomst betrokken partijen kan variëren. De rechtbank is het verst verwijderd van de partijen. De afstand van de derde partij is belangrijk omdat de reeks van waarneembare beloften afneemt naarmate de afstand toeneemt. Dat wil zeggen dat een derde partij die dichter bij de bij de overeenkomst betrokken partijen staat, meer elementen van de overeenkomst (beloften) kan waarnemen dan een andere derde partij die zich op een grotere afstand bevindt. Zo kan de CEO van een bedrijf met meerdere divisies bijvoorbeeld meer elementen zien van een overeenkomst tussen twee divisiemanagers dan een rechter. De afstand van de derde partij bepaalt dus de waarneembaarheid van de overeenkomst voor die partij. Een ander verschil tussen de mogelijke derden is hun vermogen om het nakomen van de beloften af te dwingen. Hiervoor geldt dat hoe groter de afstand van de derde partij is, des te machtiger hij/zij wordt wat betreft het afdwingen van de beloften. In het vorige voorbeeld van een bedrijf met meerdere divisies is een rechter machtiger dan de CEO als het gaat om het afdwingen van een overeenkomst. Als gevolg daarvan kiezen de partijen bij een overeenkomst voor een bepaalde derde partij door een afweging te maken tussen waarneembaarheid en afdwingbaarheid. Zodra de positie van de derde partij is bepaald, wordt het overeenkomstige type document samengesteld. Als de twee divisiemanagers in het bedrijf met veel divisies kiezen voor de CEO als derde partij, krijgt het document de vorm van een memorandum van overeenstemming (MoU). Als de derde partij een rechter is, wordt het document een contract. Tot slot analyseert het artikel de rol van documentatie als een opslaghulpmiddel. Organisaties besparen tijd door het documenteren van repetitieve taken. De analyse toont aan dat documentatie effectiever wordt wanneer taken niet veranderen. Bovendien kan documentatie zorgen voor een verandering van de gang van zaken van een organisatie.

About the Author

Behrang Manouchehrabadi was born in 1982 in Tehran, Iran. He received his BSc and MSc degrees in Industrial Engineering from Iran. For five years, he worked as an operations and supply chain management consultant, before resuming his studies at ERIM, Erasmus University in 2013. He obtained a research master in Logistics in 2015. During his studies at Erasmus University, he became interested in Microeconomics and therefore, pursued a PhD in Business Economics at ERIM, Erasmus University. His research interests include organizational economics, game theory and information economics. His research findings have been presented in many international conferences including SIOE Annual Meeting (2018), and EMNET (2017, 2019). He has been involved in coordinating and teaching several courses, and supervising students at master and bachelor levels. Behrang is currently a Postdoctoral fellow at the Department of Operations, Rotterdam School of Management.

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Presentations in conferences

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A new look on heterogeneous partnerships (Presented by George Hendrikse)

June 2018, SIOE, Montreal, Canada
Communication and decision making in heterogeneous partnerships.

May 2018, OB, Rotterdam, the Netherlands
Manager's self-confidence, employee commitment and performance.

May 2017, Tinbergen, Rotterdam, the Netherlands
A new perspective on the boundaries of the firm.

Dec 2015, EMNET, Cape town, South Africa
Chinese skewed cooperatives.

Teaching

Bachelor Thesis	2015-2019
Master Thesis	2017-2019

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