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**Extended Abstract**

**Communication and Decision Making in Heterogeneous Partnerships**

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**Abstract**: We investigate the effects of member heterogeneity on communication and decision making in partnerships. We show that member heterogeneity makes communication noisy in a partnership and this in turn alters the optimal allocation of decision rights in the partnership. In addition, the effect of heterogeneity also depends on the market in which the partnership operates. Finally, it is shown that repeated interactions alleviates the communication problem resulting from heterogeneity.

Keywords: Partnership, strategic communication, member heterogeneity, decision rights.

# Objective and Research Question

Economic and business analysis of modern enterprises have been mostly centered on investor owned firms, IOFs, where investors have only a financial relationship with the firm. Important as it is, a substantial share of business activities occur inside enterprises other than investor owned firms such as partnerships, cooperatives, nonprofit organization and so on. A noteworthy example is food production where, according to Pattison (2000), one third of global food production happens inside various farmer partnerships. This focus on investor owned firms, however, has come at the costs of overlooking the very factors that affects the performance of non-IOF enterprises. One critical factor is heterogeneity among the owners of the enterprise as emphasized by Hansmann (2009). Heterogeneity is not much of a concern in IOFs since the owners, despite having different preferences over a range of issues, all share the same ultimate goal of maximizing the profit. In partnerships, however, members do not merely care about the profitability of the partnership itself, but also on how the activities of the enterprise affect their own business. We investigate how heterogeneity affects the performance of partnerships and how this effect interacts with the broader institutions in which the partnership is embedded.

This paper aims to shed light on the effect of membership heterogeneity on decision making and communication of partnerships. As heterogeneity increases, communication among members becomes noisy in the sense that informed members do not reveal their information truthfully to the decision maker. In other words, the members try to influence the decision maker by sending information strategically. This strategic information transmission then determines the optimal allocation of authority, or decision rights, in the partnership. We show that the effect of heterogeneity on the efficiency of partnerships depends, among other things, on the market in which the enterprise operates. Our paper, therefore, enables us to derive a number of propositions regarding the membership composition and governance structure of partnerships in different institutional environments. For example, our paper can shed light on the existence of heterogeneous cooperatives in developing countries whereas cooperatives in most western countries seem to be more homogenous.

# Motivating Case-Cooperatives in China

To motivate the modelling and also show the relevance of our analysis, we review a real business case. This case highlights the role of cooperatives in China and shows how heterogeneity is pronounced in an important type of non-IOF enterprise.

According to Liang & Hendrikse (2013) agricultural cooperatives in China are managed by a small group of key members called core members. These members, counting for a small percentage of the total members, hold relatively large shares of cooperative capital and are in charge of key functional areas like purchasing, production, marketing and so on. In order to be a core member, an individual must possess important skills in management, or one functional area, or have good network relationships with local authorities and other downstream and upstream supply chain members. In general as Liang and Hendrikse (2013, P 249) state “Farmers with greater asset capital, human capital, and social capital have a higher probability to obtain authority, economic benefits, or political benefits”. These core members obtain disproportionate power in decision making and income distribution. The majority of cooperative members who are not part of the core, called common members, are simple farmers, good at farming but lacking the knowledge and skill in marketing or management and lacking financial and social capital to qualify as a core member. Common members, although indispensable for production and satisfying customer demands, are marginalized to a large extent when it comes to decision making.

What is interesting from our point of view is that these commons and cores are quite heterogeneous if for anything but the possibility of doing business outside the cooperative. Especially, the core members are expected to have a range of outside options whereas the commons are barely able to do any business outside the cooperative. This difference between common and core logically implies that core members have a much higher opportunity costs than the common members. As a result, common members might be willing to implements some projects that core members are not willing to implement. This difference in opportunity costs can then result in conflict and tension when one type would like to implement a project but not the other type. Specifically, given that the cooperative law stipulates democratic decision making, commons are expected to control the cooperative and be highly involved in decision making. In reality, however, the opposite happens in Chinese cooperative. That is, despite heterogeneity, the minority is in charge of decision making. This paper tries to explain this phenomenon by contrasting it with cooperatives in developed countries where members are more or less homogenous.

## Relation to the Literature

Our discussion about governance structure and how it affects various aspects of firms’ performance is built on the premise that contracts are incomplete. In fact, if parties in a partnerships could write comprehensive and enforceable contracts then governance structure was a trivial issue since parties could efficiently contract decision rights in any possible contingency. The impossibility of writing such contracts, however, implies that governance structure matters in partnerships. So our discussion rest fundamentally on incomplete contracting literature initiated by Grossman & Hart (1986) and (Hart & Moore, 1990).

Our discussion on governance structure and information acquisition is also related to the topic of formal versus real authority of Aghion & Tirole (1997). In contrast to their study, however, we take the information structure as given. That is, we assume that one party is always more likely to be informed but analyze how the allocation of decision making rights affects the use of this informational superiority.

The effect of communication, especially soft communications, Crawford & Sobel (1982), on centralization has been investigated in the organizational economics literature. Dessein (2002) 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. A series of follow up papers enriched the model of Dessein (2002) by incorporating the need for adapting to local knowledge and coordination between different divisions in an organization. See, for example, Dessein & Santos (2006); Alonso et al., (2008); Dessein, Garicano, & Gertner (2010). Our paper is different from these papers since we assume that both parties can collect information and then communicate, whereas these papers have 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 reflect the decision making process in partnerships well since in this type of enterprise all members can be more or less informed about an upcoming issue. In fact, as Levin & Tadelis (2005) argue, partnerships are also common in industries marked by high importance of human resource quality.

Finally, the relationship between the architecture and performance of decision making systems has been studied, among others, by Sah & Stiglitz (1986). In their analysis they compare how a hierarchical decision system differs from a polyarchical, or parallel decision system. While their study sheds light on the characteristics of each system and the importance of considering the environment when it comes to compare their performance, our paper differs regarding a number of important aspects. Mostly important, they assume perfect alignment of interests between decision makers and perfect homogeneity in terms of screening ability. Our paper analyzes the effect of heterogeneity in costs structures that implies imperfect alignment of interests, and also differences in terms of screening functions.

# The model

A partnership consists of two types of members; core and common. The total number of members is normalized to one. Without loss of generality, we assume that all common members are identical and all core members are also identical. Therefore, when analyzing the decision making, we assume there is a representative core and a representative common.

The partnership considers implementing projects that result in producing new products or delivering new services. The revenue θ of new projects is stochastic with known CDF F(θ), $θ\in [0,1]$. Without loss of generality, we assume that the costs of implementing projects is fixed across all projects but different for core and common. This cost can be thought of as opportunity costs of each member type. It is denoted by$ k\_{i}\in [0,1], i \in \left\{L,C\right\}$. The subscripts *L* and *C* refer to common and core, respectively. The difference between $k\_{C}$ and $k\_{L}$ reflects the heterogeneity or the divergence between the core and common members. We define $Δ≡$ $k\_{C}-k\_{L}$ and consider its absolute value as the measure of heterogeneity.

The sequence of decision making is as follows.

I: In the first stage, both members, independently, evaluate the project to know whether it is a good (G) or bad (B) project. A good project $G\_{i} $for type $i$ is a project whose return exceeds the costs for that type, that is, $θ$ ≥ $k\_{i}$. A bad project $B\_{i} $for type $i$ is a project whose return is less than the cost for that type$ i$,$ θ$ < $k\_{i}$. In evaluating projects, type $i$ learns the payoff of a project with probability$ q\_{i}$. With probability $1-q\_{i}$ type $i$ does not learn the payoff of a project and has to rely on the prior knowledge F(θ).

II: After evaluation, each type sends a message ($m\_{i}$) to the other type. The message can be anything from reporting a value or just a simple Y and N. One might expect that truthful communication might not be possible if interests diverge. We will shortly show that this is indeed the case but at this stage we don't put constraint on what can be communicated.

III: After evaluating projects and receiving the message from the other type, the party who has the decision rights makes the final implementation decision ($d$) on whether to approve (A) or reject (R) the project. Important to our analysis is that the decision maker does not observe whether the other type has learned θ or not. Therefore, when a type sends her default message, the decision makers does not always know if the sender has learned θ or not.

The decision rights is determined by the *governance structure* of the partnership. For expositional clarity we define two hypothetical governance structures. In the first structure, called Democratic, common has the decision rights. In the second structure, called Centralized, core has the decision rights. We then compare implementation decisions and efficiency in each governance structure. The word Democratic is an abuse of label and should not be interpreted as something that contrasts with dictatorship. Democratic governance only entails that the preference of majority is the determining factor in making the final implementation decision

The revenue of projects should be distributed between the members in some way. In this paper, we abstract from the exact procedure of distributing the revenue among the members but assume instead that the revenue is distributed equally among members. As a result, each member receives θ.

Message technology

We mentioned that in the communication stage each type sends a message to the other type and that this message exchanging happens simultaneously. In this section, we show that the message of common and core consists of only sending Y and N. But before doing that, it is worth to examine how each type conceives the message of the other type in terms of learning. That is, we mentioned in the previous section that learning is a private incidence so each type only knows if her/him self has learned but not about the other type. We should, however, add to this that sometimes the message reveals whether the sender has learned or not. For example, suppose that the expected value of θ is less than $k\_{L}$. Then a message from either type that implies a positive view about that project necessarily means that the sender has learned the payoff. The same logic applies to the mirror case, when the expected value of θ is larger than $k\_{C}$ then any message implying a negative view regarding the project means that the sender should have learned θ. We will elaborate on this point further but for now it is sufficient to be aware that sometimes the message implies learning.

We are now ready explore the message content. Given that each type learns θ with some probability, one may conjecture that it is possible for the two types to communicate in a richer way than just sending Y and N. For example, both members benefit from avoiding projects whose return is less than$ k\_{L}$. Therefore, one may wonder why it is not possible for the type who learns that θ is less than $k\_{L}$ to inform the other type. We show that this is not possible in one shot games. Consider Democracy. An efficient equilibrium is that Core informs Common whenever he learns that θ is less than $k\_{L}$ and Common believes Core and does not implement the project. This is, unfortunately, not a Nash equilibrium. To see why suppose it is. If Common believes Core then Core can benefit by deviating and saying θ is less than $k\_{L}$ even when it is $k\_{L}$ <θ< $k\_{C}$, knowing this Common will not believe Core. A similar argument also shows that why in Centralized structure Core does not believe Common when she says θ≥$k\_{C}$. As a result, the decision maker’s best inference, upon receiving a message Y, when implied learning, is that the sender has learned that the revenue is at least as large as the sender’s opportunity cost. Similarly, when receiving N, the receiver’s best inference is that the revenue is less than the sender’s opportunity cost. So we have established the following proposition.

***Proposition 1***: Truth telling cannot be supported in the communication stage. The equilibrium message of both types takes the form of simple Yes and No. In addition, the receiver *i* considers a Y message as an indication that θ≥$k\_{-i}$ and the N message as θ<$k\_{-i}$.

# Implementation Decision in the Absence of Cost Heterogeneity

In the introduction we mentioned Hansmann (1996) and Holmstrom (1999) viewpoints regarding the adverse effect of heterogeneity on decision making in cooperatives. In general, however, cooperative is just one form of partnership, therefore, we expect the adverse effects of heterogeneity to carry over to all kind of partnerships who at some points have to come to collective decision. In this section we analyze an extreme case, complete homogeneity, and show that the final decision is identical in Democracy and Centralized partnership. In addition, we show that absent heterogeneity, everybody benefits if the partnership is managed by the type that is more educated or have higher cognitive ability.

Let the partnership be completely homogenous. This means$ k=k\_{L}=k\_{C}.$ Assume, for concreteness, that Core and Common send Y only when they learn that θ is larger than k, that is, the default message of both type is N. Obviously, if both types send Y or both send N then the project does not get implemented in either governance structure. What happens when one type sends Y and the other sends N? given that the default message of both types is N, then sending Y implies that the sender has learned that the project’s return is larger than k. Therefore, both types would like the project to be implemented. It establishes that the project gets implemented in both governance structures. Therefore, in a completely homogenous partnership, when the messages are contradictory, the type who did not learn follows the type that has learned regardless of formal allocation of decision rights. Following the same logic, we get to the similar result when the default message of both types is Y. All in all, we showed that absent heterogeneity, the decision regarding project implementation is identical in both Democracy and Centralized governance.

 As mentioned before most partnerships, like other organizations, are managed by people with more expertise and experience than the rest of members. While the importance of professional management in corporations seems to be obvious, the principle of, for example, one-member-one-vote in cooperatives, and the public emphasis on member activism might cast doubt on the merit of delegating authority in partnerships. We show in a simple way that partnerships, like other enterprises, benefit from delegating authority to members with higher expertise.

Naturally, the type with decision making power has more incentive to learn the payoff as this authority gives her some private benefits, Hart & Holmstrom (2010). To reflect this difference, suppose that the probability of learning the return by Core is $q\_{CH}$ in centralized governance but $q\_{CL}<q\_{CH}$ in Democratic governance. For Common it is $q\_{LH}$ in Democracy and $q\_{LL}< q\_{LH}$ in Centralized governance. For simplicity let’s also assume$ q\_{LL}=q\_{CL}$, that is, when types do not have decision rights they are equally likely to learn θ. Finally, the higher ability of Core relative to Common implies that$ q\_{CH}>q\_{CL}$, i.e, motivating Core is more valuable than motivating Common. Assume the default message of both types is N. The absence of heterogeneity entails that a project gets implemented whenever at least one type sends Y or, equivalently, a project gets implemented unless both types send N.

The expected payoff of each type is the same and in Democracy is given by

$$E(π^{D})=\left[1-\left(1-q\_{LH}\right)\left(1-q\_{CL}\right)\right]\left(1-F\left(k\right)\right)R (2) $$

In Centralized governance structure, the decision rule regarding project implementation is the same but shifting the decision rights from Common to Core motivates the latter and demotivates the former. This changes $q\_{LH}$ to $q\_{LL}$ and $q\_{CL}$ to$ q\_{CH}$. As a result, the expected payoff of each type is

$$E(π^{C})=\left[1-\left(1-q\_{LL}\right)\left(1-q\_{CH}\right)\right]\left(1-F\left(k\right)\right)R (3)$$

Comparing the terms in square bracket in (2) and (3) we can check that $ q\_{CH}>q\_{CL}$ together with $ q\_{LL}=q\_{CL}$ imply$E\left(π^{C}\right)>E\left(π^{D}\right).$ Both type have higher expected payoff in centralized governance than in Democracy. Note that in (2) and (3) the term in the square bracket is the probability that the project gets implemented given that θ is larger than k. We denote this probability by $I^{i}\left(k\right),i\in \{C,D\}$. As a result, (2) and (3) can be restated as

$E\left(π^{D}\right)=I^{D}\left(k\right)\left(1-F\left(k\right)\right)R $ (2a)

$E\left(π^{C}\right)= I^{C}\left(k\right)\left(1-F\left(k\right)\right)R$ (3a)

Our analysis above shows that $I^{C}\left(k\right)>I^{D}\left(k\right)$.

We obtained the result that the expected payoff of both types are higher in Centralized governance than Democracy assuming that the default message is N. The same result can be obtained when the default message of both types is Y as well. The following proposition summarizes this section.

***Proposition 2***: Absent heterogeneity, the final decision regarding implementation of projects is independent of the governance structure. In addition, granting the decision rights to the type with higher cognitive ability increases the expected payoff of both types. In other words, absent heterogeneity, centralized governance is more efficient than Democratic governance.

The purpose of proposition 2 was to show, in the simplest way, that Centralized governance is more efficient given that heterogeneity is negligible. In the rest of the paper, we drop the dependency of $q\_{i}, i\in \{L,C\}$ on the governance structure for the sake of notational simplicity and instead take the premise that, absent heterogeneity, Centralized governance is more preferable to Democracy.

# Implementation Decision in the Presence of Heterogeneity

When $k\_{C}>k\_{L}$ the final implementation decision might depend on the identity of the decision maker, i.e, the governance structure. However, it can be shown that even in the presence of heterogeneity, the final decision is still identical in either governance structures as long as the heterogeneity is not higher than a threshold. Before showing this, we first need to elaborate on the effect of market condition on communication and, consequently, on the effect of communication on decision making. First we distinguish three type of markets based on the relationship between E(θ) and $k\_{C}$ and $k\_{L}$. This classification will also be very useful for the efficiency analysis.

## Market types

**Mature Market**: as the name suggests, mature market is defined as the one where there are few projects who benefits both types. Technically, we call a market mature when

 $E(θ)<K\_{L}<K\_{C}$ (4)

Note that (4) implies that if a type does not learn θ that type should send N based on the E(θ). therefore, the default message in mature market is N. This also means that if one type sends Y in mature market, it necessarily means that type has learned that θ is larger than her/his opportunity cost. However, when a type sends N, the receiver does not know whether this comes from learning that θ is less than the sender’s opportunity cost or it is a result of not learning and relying on prior. We highlighted this point for mature market but the principle applies to all market types: A message that is opposite of what a type would send shall she/he does not learn implies learning by that type. We call this type of message, a non-default message.

**Corollary 1**: sending a non-default message always implies learning by the sender.

**Nascent markets**: a nascent market is the opposite of a mature market, i.e.,. There are a lot of projects that benefit both types. Technically, a nascent market is defined as

$E\left(θ\right)>K\_{C}>K\_{L}$ (5)

Therefore, when either type does not learn she sends Y based on prior expectation. In other words, the default message is Y. Corollary 1 then implies that a N message should have come from learning. This is indeed true since a type sends N only when she learns that the revenue is less than her opportunity cost. Therefore, nascent market is the polar case of mature market and this is also reflected in the communications.

**Mixed markets**: a mixed market is something between a mature market and nascent market. This type of market is replete with projects that benefit one type but hurt the other one. Since core has a higher opportunity costs, it means that there a plenty of projects that common would like to implement but core does not. A mixed market, therefore, is defined as

$$K\_{L}<E\left(θ\right)<K\_{C}$$

## Communication and Decision Making

In the communication section we demonstrated that the message consists of Y and N. Therefore, in total four cases exist: “YY”, “YN”, “NY” and “NN” where, as a convention, the first letter always refers to the message of Common and the second letter refers to the message of Core. Examining these cases, however, shows that only one of them leads to different decision in Democratic than Centralized partnership. The cases where both types have negative “NN” or positive “YY” attitude toward a project are straightforward to analyze. Regardless of the governance structure, a project gets implemented whenever the message set is “YY” and is rejected whenever the message set is “NN”. Interestingly, the case “NY” also leads to the same decision in both governance structures. This is because $k\_{L}<k\_{C}$ implies that the message “NY” cannot be sent if neither type has learned or if both type has learned. If neither type has learned then “NY” means E(θ)< $k\_{L}$ but E(θ)> $k\_{C}$ that is impossible since $k\_{L}<k\_{C}$. In the same vain, if both types learned the revenue then it “NY” implies $k\_{C}$<θ< $k\_{L}$ that is also impossible. Therefore, “NY” can only stem from the situation where one type learns but the other does not. Suppose it is the common who learns, then N message implies that θ$<k\_{L}$ and so θ$<k\_{C}$ . As a result, core does not implement that project in Centralized partnership. If, on the other hand, it is the core who has learned then the message Y from him implies θ$>k\_{C}$ and so θ$>k\_{L}$. Therefore, Common will also implement the project in a Democratic partnership.

As a result, the only case which might lead to different implementation decision is “YN”. In this case both types might learn that $k\_{L}$<θ<$k\_{C}$ or neither type learn but $k\_{L}$<E(θ)<$k\_{C}$. The following corollary states this result.

**Corollary 1**: Given the assumption$ k\_{L}<k\_{C}$, the implementation decision in Centralized partnership might be different than Democratic partnership only if the message set is “YN”.

Implementation decision

Given proposition 1, the definition of market types and the above argument about the relevance of “YN” for decision making, we are ready to analyze the implementation decision in each governance structure.

Consider mature market. in a mature market, the message “YN” implies that common has learned that θ≥ $k\_{L}$ because otherwise she would have sent N according to (4). Core, on the other hand, might have or have not learned θ. As a result, the project gets implemented in a Democracy since it is profitable from common’s perspective. In a centralized partnership, however, the project does not always get implemented. If core has learned θ then the message N from him implies that $k\_{L}$<θ< $k\_{C}$ so core does not implement the project. If core did not learn himself, then he has to update his belief about θ based on new information received from common. Core approves the project only if

$E\left(θ\geq k\_{L}\right)-k\_{C}\geq 0$ (6)

Note that if heterogeneity is very low, Δ is close to zero, then (6) is always satisfied. On the other hand, for a given $k\_{L}$ if $k\_{C}$ is close to 1 then (6) does not hold. As a result, there exists a threshold $Δ^{\*}$ for heterogeneity such that if Δ≤$Δ^{\*}$ then (6) holds but if Δ>$Δ^{\*}$ then (6) never holds.

Next consider nascent market. In a nascent market “YN” implies that core has learned θ<$k\_{C}$ otherwise he would not send this message. Common, on the other hand, might or might not have learned θ. Obviously, core does not implement the project in Centralized partnership. Common, however, has to update her belief about θ if she did not learn it herself in Democracy. Specifically, common implements the project in Democracy if

$E\left(θ<k\_{C}\right)-k\_{L}\geq 0$ (7)

Following the same type of reasoning as we did in mature market, it can be concluded that there is threshold $Δ^{\*}$ for heterogeneity, this time for nascent market, such that if heterogeneity is higher than that threshold then (7) always holds and the project is implemented in Democracy.

Finally, consider mixed market. Contrary to mature and nascent markets, in this type of market, the message “YN” can emerge from learning or not learning by either type. In fact, in mixed market the default message of common is Y while the default message of core is N. Therefore, there are four cases regrading 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 Bayes formula. For example, if core does not learn in Centralized partnership, he will implement a project following “YN” if

$q\_{L}E\left(θ\geq k\_{L}\right)+\left(1-q\_{L}\right)E\left(θ\right)\geq k\_{C}$ (8)

Similarly, common implements a project in Democratic partnership when she does not learn θ and receives “YN” if

$q\_{C}E\left(θ<k\_{C}\right)+\left(1-q\_{C}\right)E\left(θ\right)\geq k\_{L}$ (9)

From (8) and (9) it can be seen that if $k\_{C}$ and $k\_{L}$ are close enough, heterogeneity is low, then core implements the project in Centralized partnership and common does not implement the project in Democratic partnership. That is, the implementation decision does not depend on the governance structure. If, on the other hand, heterogeneity grows large enough then the implementation decision is always different in Centralized versus Democratic partnership[[1]](#footnote-1). Therefore, we have the following proposition.

**Proposition 3**: in each market type j∈{mature, mixed, nascent} there is a threshold $Δ\_{j}^{\*}\geq 0$ such that if $Δ\_{j}>Δ\_{j}^{\*}$ then the implementation decision is different in Democratic and Centralized partnership following the message “YN”. If $Δ\_{j}\leq Δ\_{j}^{\*}$ then implementation decision is identical in either type of partnership.

Proposition 3 actually says that when heterogeneity is low, the interests of core and common are sufficiently congruent such that any project that is profitable for one type will be also profitable for the other type and vice versa. Consequently, if the heterogeneity is low, then the final decision regarding implementing projects would be identical in Centralized and Democratic partnership. To ensure that the governance structure has a bite we make the following assumption.

Assumption 1: $Δ\_{j}>Δ\_{j}^{\*}, j\in \{mature, mixed, nascent\}$

# Efficient governance structure

Proposition 3 together with assumption 1 ensure that the implementation decision in Centralized partnership is different than in Democratic partnership. The natural question is that which governance structure is efficient in terms of generating a higher surplus. Given corollary 1, we only need to consider the case where the message is “YN”.

Consider nascent market. Following “YN” Democratic partnership implements the project but Centralized partnership does not (due to assumption 1). In all other combination of messages, however, the implementation decision is identical in either governance structures. In addition, the message N from core in this market implies learning. Therefore, we can state the total surplus as the sum of surplus that goes to each type. The surplus that goes to type $i\in \{L,C\}$ after implementing such a project is

$E\_{S}=\left(1-q\_{L}\right)[(E\left(θ\leq k\_{C}\right)-k\_{i}]+q\_{L}[E(θ|k\_{L}\leq θ\leq k\_{C})-k\_{i}]$ (10)

The first term in (10) reflects the case where the Y message from common has come from relying on prior, i.e., she did not learn θ. The second term reflects the complementary event that Y from common stemmed from learning θ. The overall expected surplus can be stated as

$\left(1-q\_{L}\right)[2(E(θ|θ\leq k\_{C})-k\_{L}-k\_{C}]+q\_{L}[2E(θ|k\_{L}\leq θ\leq k\_{C})-k\_{L}-k\_{C}$] (11)

 It is useful to introduce the following notation and using them in the rest of the paper.

 $E\_{L}≡E(θ|θ\leq k\_{C})$, $E\_{M}≡E(θ|k\_{L}\leq θ\leq k\_{C})$, $E\_{H}≡E(θ|θ\geq k\_{M})$

Obviously, $E\_{H}>E\_{M}>E\_{L}$. We can now restate (11) as

$E\_{S}=\left(1-q\_{L}\right)[2E\_{L}-k\_{L}-k\_{C}]+q\_{L}[2E\_{M}-k\_{C}-k\_{L}]$ (10A)

If (10) is positive then Democratic partnership is more efficient than Centralized partnership since the overall surplus generated by implementing projects following YN is larger than zero. We will analyze (10) shortly but let’s first derive the corresponding expression for mature and mixed market as well.

Consider mature market. In the mature market YN implies learning by common otherwise she would not send Y. Core, however, might or might not have learned θ. As a result, the expected total surplus can be stated as

$E\_{S}=\left(1-q\_{C}\right)[2E(θ|θ\geq k\_{L}))-k\_{L}-k\_{C}]+q\_{C}[2E(θ|k\_{L}\leq θ\leq k\_{C})-k\_{L}-k\_{C}]$ (12)

Using our notation for conditional expectations, we can state (12) as

$E\_{S}=\left(1-q\_{C}\right)[2E\_{H}-k\_{L}-k\_{C}]+q\_{C}[2E\_{M}-k\_{L}-k\_{C}]$ (12A)

Finally, consider mixed market. In mixed market the message YN does not necessarily imply learning by any type. This is because common sends Y even if she does not learn θ. The same also applies to core with the difference that he sends N when he does not learn. Therefore, we have the following expression for the expected surplus in mixed market

$E\_{S}=q\_{C}q\_{L}[2E\left(k\_{L}\leq θ\leq k\_{C}\right)-k\_{C}-k\_{L}]+ \left(1-q\_{C}\right)q\_{L}[2E\left(θ\geq k\_{L}\right)-k\_{C}-k\_{L}]+q\_{C}\left(1-q\_{L}\right)[2E\left(θ\leq k\_{C}\right)-k\_{C}-k\_{L}]+\left(1-q\_{C}\right)\left(1-q\_{L}\right)[2E\left(θ\right)-k\_{C}-k\_{L}]$ (13)

Again using the notation, (13) can be stated as

 $E\_{S}=q\_{C}q\_{L}[2E\_{M}-k\_{C}-k\_{L}]+ \left(1-q\_{C}\right)q\_{L}[2E\_{H}-k\_{C}-k\_{L}]+q\_{C}\left(1-q\_{L}\right)[2E\_{L}-k\_{C}-k\_{L}]+\left(1-q\_{C}\right)\left(1-q\_{L}\right)[2E\left(θ\right)-k\_{C}-k\_{L}]$ (13A)

Note that in all of three types of markets, the project is implemented in Democratic partnership but not in the Centralized partnership. The following proposition summarizes this section on the expressions of expected surplus.

***Proposition 4***: Given assumption 1, the difference between the expected surplus generated in Democratic and Centralized partnership is given by

$$E\_{S}^{Nascent}= \left(1-q\_{L}\right)[2E\_{L}-k\_{L}-k\_{C}]+q\_{L}[2E\_{M}-k\_{C}-k\_{L}]$$

$E\_{S}^{Mature}= \left(1-q\_{C}\right)[2E\_{H}-k\_{L}-k\_{C}]+q\_{C}[2E\_{M}-k\_{L}-k\_{C}]$

$$E\_{S}^{Mixed}=q\_{C}q\_{L}[2E\_{M}-k\_{C}-k\_{L}]+ \left(1-q\_{C}\right)q\_{L}[2E\_{H}-k\_{C}-k\_{L}]+q\_{C}\left(1-q\_{L}\right)[2E\_{L}-k\_{C}-k\_{L}]+\left(1-q\_{C}\right)\left(1-q\_{L}\right)[2E\left(θ\right)-k\_{C}-k\_{L}]$$

 **To be completed…**

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1. As an extreme case, consider $k\_{L}=0$ and $k\_{C}=1$, then common implements all projects but core does not implement any! [↑](#footnote-ref-1)