

THE ROLE OF UNCERTAINTY
IN TRANSACTION COST AND RESOURCE-BASED THEORIES OF THE FIRM

DISSERTATION

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ABSTRACT

While uncertainty has been considered as one of the most important factors in the strategic management field, the impact of uncertainty on governance decisions has been controversial. There are at least two issues. First, recent studies have raised questions on the role of uncertainty found in transaction cost economics. This implies that the role of uncertainty on governance decisions may be more complex than that developed in transaction cost economics. Considering that uncertainty is a multidimensional concept, more studies may be needed to uncover how various types of uncertainty may result in different organizational governance outcomes. Second, despite the fact that firm resources and capabilities may have a significant impact on the firm's governance decisions, it seems that no clear concept for uncertainty of this kind has been developed yet. Some studies suggest that opportunism-independent factors may affect the firm's governance decisions, but a concept of uncertainty in resource-based theory has not been fully developed.

This study develops a concept of uncertainty in the context of resource-based theory, and finds its impact on the firm's governance decisions. This study suggests 'causal ambiguity within the firm' as a type of uncertainty in the context of resource-based theory. When a target firm has causally ambiguous resources and capabilities that

a bidding firm cannot easily absorb, the bidding firm will have difficulties in integrating two firms' resources after acquiring the target firm. This post-acquisition integration problem may decrease the acquiring firm's rent-generating potential. So, high level of causal ambiguity will lead a firm to take less hierarchical governance.

Specifically, this study compares two types of uncertainty in two theories of the firm. In transaction cost economics, *behavioral uncertainty* is found that is based on the threat of opportunism in the market transactions. In resource-based theory, *process uncertainty* is found that is based on the threat of causal ambiguity within the firm. While transaction cost economics implicitly assumes that rent-generating potential from asset-specific investment is not questionable, process uncertainty in resource-based theory directly question this point.

Process uncertainty is operationalized in this study by cross-citation rate in patents to measure how two firms may understand each other's capabilities and how well the capabilities can be integrated. Higher cross-citation rate means that two firms share similar technological capabilities, thus low level of process uncertainty may exist. For behavioral uncertainty, this study examined the existent of technological content in a previous transaction. More importantly, this study tests interaction effects between process and behavioral uncertainty, because these types of uncertainty may not be independent.

Empirical tests supported the effect of uncertainty in transaction cost economics and in resource-based theory. In addition, the interaction between the two types of uncertainty was not significant. From this result, this study argues that the type of

uncertainty that is found in resource-based theory plays a significant and independent role for governance choice of the firm.

This study has an implication for resource-based theory. The impact of resources and capabilities on governance decisions is more clarified by finding a construct of uncertainty. Therefore, this study supports that resource-based theory is a theory of the existence of the firm, as well as a theory of firm rents.

Dedicated to my family, Kibin, Sang-Mi (Grace), and Sang-Eun (Emily),
to our parents, Jong-Hee Choi, Kye-Hyun Kim, Jung-Soon Nam,
to my father, Dong-Young Shin who is in heaven since 1991,
and to Jesus Christ.

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CHAPTER 1

INTRODUCTION

Uncertainty has been considered as one of the most important factors in strategic management field (March and Simon, 1958; Thompson, 1967; Pfeffer and Salancik, 1978). Especially, researchers have regarded uncertainty as a major determinant when a firm chooses governance mode (Williamson, 1975; Porter, 1980; Balakrishnan and Wernerfelt, 1986; Rumelt, Schendel and Teece, 1991). Empirical studies have tested the relationship between a specific type of uncertainty and governance choices of the firm.

However, uncertainty is a multidimensional concept (Milliken, 1987; Sutcliffe and Zaheer, 1998). Various types of uncertainty may have different impacts on the firm's governance decisions. For instances, studies in organizational sociology (Burns and Stalker, 1961; Lawrence and Lorsch, 1967; Lorsch and Allen, 1973), economics (Koopmans, 1957; Arrow, 1974), and organizational economics¹ (Coase, 1937; Williamson, 1975; Klein, Crawford and Alchian, 1978) have developed various types of uncertainty that affect the firm's governance decisions either directly or indirectly. The

¹ Organizational economics might be thought as a part of economics, but in this study they are separated in the sense that the level of analysis of organizational economics is organizational decision-making regarding governance choice while that of economics is mostly individual decision-making.

field of strategic management has used the concepts of uncertainty from these disciplines and applied them to the issues of the firm, including the existence and the boundary of the firm.

Transaction cost economics has developed a clear definition of uncertainty and answers the questions of the existence and boundary of the firm. Transaction cost economics explains that the firm exists to reduce the threat of opportunism, or behavioral uncertainty of exchange partner, that occurs in the market transactions (Williamson, 1975; 1985). Uncertainty, in this sense, can be avoided when the firm is established and the transaction is internalized. The boundary of the firm is determined by the degree of behavioral uncertainty that is involved in a specific transaction. The degree of behavioral uncertainty has been operationalized by asset specificity (Folta, 1998; Delios and Beamish, 1999). When asset specific investments are made, the threat of opportunism may also increase, so more hierarchical governance is preferred.

However, this study finds an unidentified issue in transaction cost economics that may be relevant to capability-related questions. While transaction cost economics focuses on the uncertainty in the market, it seldom questions about possible uncertainty that may exist in the hierarchy.

This study argues that this unidentified issue can be discussed in resource-based theory, but only with clear definitions of uncertainty in the context of resource-based theory. Resource-based theory has been accepted as a theory of firm rents and a theory of competitive advantage (Mahoney, 2001). However, the role of uncertainty in this theory seems not yet fully developed, although this theory has received much attention

over a decade. Uncertainty must be one of the most important factors in managing resources, but the role of uncertainty in resource-based theory seems to have been relatively underdeveloped.

Unclear definition of uncertainty in resource-based theory leads to a question of whether in fact resource-based theory is a theory that explains the firm existence and the firm boundaries (e.g. Priem and Butler, 2001). However, as Mahoney (2001) claims, a theory of firm rents sufficiently explains the existence of the firm. In other words, the existence of rent generating potential of the firm should explain why the firm should exist.

Given that transaction cost economics explains the existence and boundary of the firm in terms of uncertainty, it seems that resource-based theory should have such a concept in its context to sufficiently explain the existence and boundary of the firm. Previous studies in resource-based theory have focused on abnormal performance of the firm, firm growth, firm governance, and so forth, but uncertainty plays very limited role in those topics.

Therefore, search for a type of uncertainty in resource-based theory also allows us to compare the role of uncertainty in the two alternative theories of the firm. There seems to be an imbalance with respect to a concept of uncertainty between the theories. Once a concept of uncertainty in resource-based theory is developed, it will be easier to see if the two theories of the firm are complementary under some situations, and

contradictory under other situations. Developing comparable concepts may help us to embrace 'integrationism' rather than 'isolationism' to avoid a biased view of the firm (Foss, 1999).

This study compares basic statements in both theories. This study recognizes that transaction cost economics has two statements:

- (1) Firms exist to minimize transaction costs.
- (2) Uncertainty exists in the market and it can be removed within the firm.

In comparison, resource-based theory in this study has alternative statements:

- (1) Firms exist to create and appropriate rents.
- (2) Uncertainty exists both in the market and within the firm.

First comparison is about the existence of the firm. Transaction cost economics and resource-based theory have different answers on why firms exist. In transaction cost economics, the firm exists because it reduces transaction costs that occur in the market exchanges. In resource-based theory, the firm exists because it creates economic rents that may not be obtained in the market exchange.

This comparison on the reasons of the existence of the firm leads to the second comparison on how uncertainty works in the two theories of the firm. In transaction cost economics, uncertainty exists in the market. Once asset-specific investments are made, transaction partners can obtain economics rents from the investments. But asset-specificity also increases the threat of opportunism that a transaction partner might expropriate the obtainable economic rents, whenever any unanticipated events that are not covered by contracts take place. Therefore, rent-creating asset-specific investments

are impeded in the market because of the threat of opportunism. This type of uncertainty, the possible opportunistic behavior of a transaction partner, can be avoided when the firm is established. Williamson (1975) argues that managerial fiat can effectively remove the threat of opportunism within the firm. In other words, uncertainty in transaction cost economics exists in the market in the form of opportunism.

On the other hand, this study argues that uncertainty in resource-based theory can be found within the firm as well as in the market. First of all, uncertainty in resource-based theory is identified in terms of the concept of causal ambiguity (Lippman and Rumelt, 1982; Reed and DeFillippi, 1990). In the market, causal ambiguity exists in the sense that any economic actor may not perfectly understand another economics actor's causal connections between actions and results. Since an economic actor may not recreate another actor's production functions without uncertainty (Lippman and Rumelt, 1982), the actor need to begin to make asset specific investment with another actor. Therefore, cooperative production may be established. Secondly, uncertainty within the firm also exists when heterogeneous capabilities are brought by vertical integration. When hierarchical governance may create causal ambiguity within the firm and decrease rent generating potential, the firm will avoid hierarchical governance.

This study develops a clear definition of uncertainty in resource-based theory. Also, the roles of uncertainty are examined and compared in resource-based theory and transaction cost economics. To begin with, this study recognizes that transaction cost economics focuses on *behavioral uncertainty* that comes from possible opportunistic behavior of economic agents. Higher level of behavioral uncertainty leads a firm to take

more hierarchical governance according to this logic. Then, this study suggests a type uncertainty in the context of resource-based theory, *process uncertainty*. Process uncertainty comes from possible problems in the process of rent creation within the boundary of the firm. Process uncertainty is created within the firm when heterogeneous resources and capabilities may reduce rent generating potential of the firm, so higher level of process uncertainty may lead a firm to take less hierarchical governance.

After finding these types of uncertainty in the two theories, the interactions among these types of uncertainty are examined. Multidimensionality of uncertainty does not necessarily mean that types of uncertainty are mutually independent. So, the interrelations between types of uncertainty and their roles in governance choice of the firm may be complex. The relationship between the types of uncertainty is also of interest in this study.

This study recognizes that causal ambiguity is the source of uncertainty in resource-based theory. In fact, the concept of causal ambiguity has been used in a limited context to explain firm heterogeneity in the market (Dierickx and Cool, 1989; Reed and DeFillippi, 1990). This study, however, argues that resource-based theory may affect the governance choices of the firm because of causal ambiguity. Individuals, like firms, are heterogeneous in resources and capabilities and this heterogeneity may remain over time because individuals cannot easily obtain or imitate others' resources and capabilities. When an individual needs others' resources and capabilities that the individual cannot create or obtain through the market because the resources and capabilities are causally ambiguous, the individual may have to make a firm to get access to those causally

ambiguous resources and capabilities. In this sense, inter-personal causal ambiguity may explain the existence of the firm. At the firm level, inter-firm causal ambiguity may explain when firms use hierarchical governance rather than market governance. On the other hand, another kind of causal ambiguity, causal ambiguity within the firm, explains why firms may avoid hierarchical governance in spite of inter-firm causal ambiguity. It is suggested that high level of causal ambiguity within the firm is associated with less hierarchical governance because hierarchical governance may make inefficiency in creating economic rent. This study focuses on the causal ambiguity within the firm and provides empirical evidence that a type of uncertainty in the context of resource-based theory affects governance choices of the firm.

The rest of this study is organized as follows. First, the research on uncertainty in organization studies, economics, and strategic management are reviewed and the scope of this study is determined. Second, based on this review, two alternative theories of the firm, transaction cost economics and resource-based theory, are briefly reviewed. The role of uncertainty in each theory is examined. Third, causal ambiguity is revisited in the context of process uncertainty in resource-based theory. Testable hypotheses, empirical tests and results, and discussions and implications follow.

CHAPTER 2

LITERATURE REVIEW ON UNCERTAINTY

In this chapter, studies on uncertainty are briefly reviewed to see what uncertainty has meant to scholars in various areas of research. It is impossible to review all the studies on uncertainty, but in the beginning, some classics that have opened the research on uncertainty are introduced and compared. Next, selective studies on uncertainty in organizational sociology, economics, and organizational economics are reviewed.

2.1. Classics

Knight's (1933) view

Knight (1933) defines uncertainty as a state that there is 'no valid basis of any kind for classifying instances' to determine a probability from past experience or statistical calculation (p. 225). Knight separates uncertainty from risk in that while risk can be measured by a prior probability or a statistical probability, uncertainty cannot be measured at all.

Our preliminary examination of the problem of profit will show, however, that the difficulties in this field have arisen from a confusion of ideas which goes deep down into the foundations of our thinking. The key to the whole tangle will be found to lie in the notion of risk or uncertainty and the ambiguities concealed therein... But uncertainty must be taken in a sense radically distinct from the familiar notion of risk, from which it has never been properly separated (p. 19).

Knight emphasizes the separation of risk and uncertainty because he believes that the separation helps to avoid confusions about the cause of profit. While other scholars believe that profit is generated from change of economic environments, Knight argues that change *per se* cannot be the cause of profit, but only a necessary condition under which profit can arise.

It cannot, then, be change, which is the cause of profit, since *if the law of the change is known*, as in fact is largely the case, no profit can arise. The connection between change and profit is uncertain and always indirect. Change *may* cause a situation out of which profit will be made, *if it* brings about ignorance of the future. Without change of some sort there would, it is true, be no profits, for if everything moved along in an absolutely uniform way, the future would be completely foreknown in the present and competition would certainly adjust things to the ideal state where all prices would equal costs. It is this fact that change is a necessary condition of our being ignorant of the future (though ignorance need not follow from the fact of change and only to a limited extent does so) that has given rise to the error that change is the cause of profit (p. 37, italics in original).

Therefore, the reason that Knight emphasizes uncertainty, as opposed to risk, is that it is the source of profit. In perfect competition, every economic agent has the same information, including the nature of changes. Even though the conditions of demand and

supply may change, if uncertainty does not exist, there must be no profit. Only under the condition of imperfect competition, through uncertainty, profit can arise.

Knight's view has an important implication on the study about uncertainty.

Uncertainty is not considered as the source of threat, but as the source of opportunity. In fact, entrepreneurs tend to pursue uncertainty rather than avoid, because they seek to new opportunities that can hardly be found in a stable environment. Therefore, Knight points out a positive aspect of uncertainty. Knight suggests that uncertainty may affect the firm's vision for performance.

Penrose' (1959) view

Penrose (1959) defines uncertainty as the level of 'the entrepreneur's confidence in his estimates or expectations' (p. 56). Like Knight (1933), she also distinguishes uncertainty from risk, which she refers to 'the possible outcomes of action, specifically to the loss that might be incurred if a given action is taken (p. 56). As one can see from her definition of uncertainty, Penrose emphasizes the role of uncertainty with respect to the ability that an entrepreneur takes an action with confidence. Uncertainty works as a limit that an entrepreneur is subject to admit, especially as a limit to the growth of the firm. However, managerial resources can decrease the threat of uncertainty, because more able managers can cope with uncertainty better, according to Penrose.

But is this passive acceptance of risk and uncertainty the only possible entrepreneurial response?

Are there not ways open to the entrepreneur of reducing uncertainty and avoiding risk which will enable him to use fully all of the managerial resources at his disposal? If there are such ways,

uncertainty and risk, though affecting it only to the extent that managerial resources are unavailable to deal with it. If we admit that uncertainty and risk can limit the amount of expansion and if we agree that managerial resources can also limit the amount of expansion, which one of these provides the effective limit will depend on which comes into operation first (p. 58).

Specifically, the role of information is emphasized in decreasing uncertainty, because entrepreneurs can be confident when they have enough information to estimate the possible course of future events. 'Uncertainty resulting from the feeling that one has too little information leads to a lack of confidence in the soundness of the judgment that lie behind any given plan of action' (p. 59). The amount of information will vary across firms because firms are assumed to have heterogeneous resources and capabilities². Therefore, each firm experiences different levels of uncertainty. Firms with lower level of uncertainty will expand more aggressively, because managers of those firms can be more confident in their actions. That is why firms have different sizes.

In principle, therefore, uncertainty which a firm's entrepreneurs refuse to tolerate because it arises from a lack of confidence in the completeness of planning, and which they believe could be eliminated by future information and more detailed planning, will limit expansion only to the extent that managerial resources are limited. When more resources become available, more information can be obtained, more uncertainty eliminated, and more expansion planned (p. 60).

² This is a fundamental assumption in resource-based theory, and more details will be discussed in the following chapters.

Uncertainty can be decreased, but only costly. Penrose describes that the cost can be expressed by managerial services that are required for actions such as planning, collecting information, and executing plans. For Penrose, firm resources and capabilities affect the growth of the firm and the level of uncertainty mediates the relationship.

Risk and uncertainty clearly do affect the amount and variety of managerial services *required* for expansion, both because they force firms to obtain certain types of information before acting and because they affect the composition of its expansion plans – the variety of products, the time ‘structure’, even the type of process used. Thus, for any given amount of experienced managerial services, risk and uncertainty will effectively limit expansion. On the other hand, for any degree of uncertainty, the supply of managerial services will determine the amount of expansion undertaken by the enterprising firm. The overcoming of uncertainty has its cost, which could conceivably be expressed in terms of the managerial services required for the task. But its restraining effect on expansion depends on the resources available to meet it (p. 64, italics in original).

Penrose’ view has also important implications. First, Penrose describes uncertainty as a determinant of the growth of the firm. The relationship between uncertainty and a firm’s growth strategy is emphasized. Second, Penrose argues that each firm face different level of uncertainty because firms have different resources and capabilities. The relationship between firm resources and the level of uncertainty is also emphasized.

Thomson’s (1967) view

In his *Organizations in Action*, Thompson (1967) sees uncertainty as a critical factor that distinguishes closed- and open-systems. A closed-system is a system where

‘the variables and relationships involved few enough for us to comprehend’ and where ‘we have control over or can reliably predict all of the variables and relations’ (p. 4). In closed-systems, planning and controlling are central issues in management. Causal relations between actions and results are explicit.

Having focused on control of the organization as a target, each employs a closed system of logic and conceptually closes the organization to coincide with that type of logic, for this elimination of uncertainty is the way to achieve determinateness. The rational model of an organization results in everything being functional – making a positive, indeed an optimum, contribution to the overall results. All resources are appropriate resources, and their allocation fits a master plan. All action is appropriate action, and its outcomes are predictable (p. 6).

On the other hand, an open-system is found where ‘a system contains more variables than we can comprehend at one time’, or where ‘some of the variables are subject to influences we cannot control or predict’ (p. 6). In open-systems, firms have only incomplete understanding about the environment, so searching and learning are central issues in management.

In this view, the organization has limited capacity to gather and process information or to predict consequences of alternatives. To deal with situations of such great complexity, the organization must develop processes for *searching* and *learning*, as well as for *deciding*. The complexity, if fully faced, would overwhelm the organization, hence it must set limits to its definitions of situations; it must make decisions in *bounded rationality* (Simon, 1957) (p. 9, italics in original).

Organizations are affected by uncertainty from environmental factors that organizations cannot control. Organizations, then, respond to those factors by actions that decrease uncertainty. For example, Thompson suggests that vertical integration is ‘a major way of expanding organizational domains in order to reduce or eliminate significant contingencies’ (p. 41). By internalizing contingencies into closed-system, an organization can pursue rational decision-makings without uncertainty³. In fact, while organizations in closed-system can seek goal achievement through internal control, organizations in open-system must shift their attention ‘from goal achievement to survival’ (p.13) because they cannot control external factors. Therefore, organizations in open-system should cope with both internal control issues and external uncertainty problems. One way to solve this problem is vertical integration. Vertical integration allows organizations to control unexpected events in advance and to seek goal achievement in closed-system.

Vertical integration, however, is not simply an historic phenomenon; it is a current movement of many industrial organizations in a variety of fields. With the recent shrinkage of profit margins, which led to renewed emphasis on rationality norms, major meat packers have moved backward behind the livestock auction markets to establish contractual relationships with livestock feeders. By owning the livestock and feed, and contracting to have livestock fed, the packers can control the flow of animals into slaughterhouse and can calculate their costs in advance, both of which are serious contingencies when packers depend on irregular volume and fluctuating prices in action markets (p. 41).

³ In this sense, the transformation from open-system to closed-system is similar to the transformation from market to hierarchy that is suggested in transaction cost economics.

Thompson's view has implications to the study of uncertainty. First, Thompson suggests that organizations seek to eliminate uncertainty to use strategies that work in closed-system rather than in open-system. Second, vertical integration is introduced as a way of eliminating uncertainty that affects organizations' profit.

The three selective views are summarized in Table 2.1. These studies have defined the concept of uncertainty and how uncertainty may affect organizations (profit, growth, governance, etc.). However, these classics do not seek to operationalize uncertainty but treat it at a conceptual level. Empirical studies have followed that directly measure how people perceive uncertainty.

Authors	Definitions	Issues	Implications
Knight (1933)	A state with no information from past experience or statistical calculation	Profit from uncertainty in imperfect market	The relationship between uncertainty and firm performance
Penrose (1959)	An entrepreneur's lack of confidence in his/her estimates or expectations	Trade-off between managerial capability and level of uncertainty	The relationship between uncertainty and firm growth
Thompson (1967)	A set of uncontrollable factors found in open-system rather than closed system	Transformation from open-system to closed-system by reducing uncertainty	The relationship between uncertainty and vertical integration

Table 2.1: Three selective views on uncertainty

2.2. Perceptual views of uncertainty

Perceptual views of uncertainty emphasize individual differences in ways to perceive uncertainty. They are based on psychology and sociology. Early studies of this view are those of Burns and Stalker (1961), Lawrence and Lorsch (1967) and Lorsch and Allen (1973). Burns and Stalker (1961) utilize the concept of uncertainty in the interpretation of contingency theory propositions. They suggest two types of organizations, mechanical and organic models, which cope with stable and unstable environments. They operationalize the concept of uncertainty by describing the environments of 20 British firms, but without using any systematic measures for isolating dimensions of uncertainty. Their study implicitly shows that perceived uncertainty

affects organizational structures and performances. Lawrence and Lorsch (1967) extend Burns and Stalker's (1961) study but using more specific dimensions of uncertainty. Based on the survey conducted on 10 U.S. industrial firms, they state that uncertainty is composed of three elements - lack of clarity of information, uncertain causal relationships, and time span of feedback about results. They find that environmental uncertainty, measured by the three elements, varies across firms in different industries. Lawrence and Allen (1973) further extend Lawrence and Lorsch's (1967) work in a study of six multidivisional firms. In their study, even in the same firm, different divisions perceive different levels of uncertainty.

The characteristic of these studies is that they operationalize uncertainty in psychological measures. To obtain data on the level of uncertainty that is perceived by managers, researchers rely on questionnaires and interviews. The weakness of this survey method is that constructs of environmental uncertainty are different from researchers to researchers. For example, when Tosi, Aldag and Storey (1973) replicate Lawrence and Lorsch's (1967) study with 122 managers in 22 firms, they find low internal scale reliability among the three dimensions of uncertainty. When Tosi et al (1973) regroup subscales of uncertainty by factor analysis, Lawrence and Lorsch's results are no more significant.

There are more debates on how to measure perceived uncertainty (Duncan, 1972; Downey, Hellriegel and Slocum, 1975; Downey and Slocum, 1975). It is hard to compare the constructs of uncertainty among studies, and 'research generally has yielded inconsistency and often difficult-to interpret results' (Milliken, 1987, p. 133). However,

it does not mean that the concept of uncertainty needs to be restricted to one meaning. Instead, studies have sought to find various dimensions of perceived uncertainty to reexamine the nature of uncertainty. For example, Duncan (1972) identifies three components of uncertainty - the lack of information regarding the environmental factors, the lack of knowledge about the organizational consequences of a specific decision, and the lack of ability to assign probabilities as to the effects of a given environmental factor on organizational success or failure. Similarly, Milliken (1987) suggests three types of uncertainty of state, effect, and response uncertainty, which respectively refer to the lack of knowledge about the state of nature, the lack of knowledge about cause-effect relationship, and the lack of knowledge to predict the likely consequences.

To sum, although there have been debates on internal reliability issues and other construct-related problems, perceptual views of uncertainty contribute to the research on uncertainty in at least two ways. First, individual perception of uncertainty is emphasized that can be affected by various factors. Specifically, sub-environments, such as industries, firms, and divisions, are studied because the factors of those sub-environments may be more closely related to individuals' perception on uncertainty. Second, perceptual views of uncertainty have developed variety of dimensions of uncertainty. Multidimensionality of uncertainty is more developed through the studies in this stream.

2.3. Studies on uncertainty in economics

In economics, models have been developed that explain how uncertainty is incorporated into economic actors' decision making (Arrow, 1974; Koopmans, 1957; Hirshleifer and Riley, 1979; Milgrom and Roberts, 1982; Machina, 1987). Uncertainty is generally defined as a lack of knowledge about the state in the future. Arrow (1974) describes the nature of uncertainty as follows:

Uncertainty means that we do not have a complete description of the world which we fully believe to be true. Instead, we consider the world to be in one or another of a range of states. Each state of the world is a description which is complete for all relevant purposes. Our uncertainty consists in not knowing which state is the true one (pp. 33-34).

If it is possible to prescribe the contingencies that may occur in the future, economics actors may have conditional contracts that specify every term of contracts in every situation. Then, Arrow asserts, 'the standard theory of the competitive economy without uncertainty can be reinterpreted to give a theory of competitive equilibrium under uncertainty' (p. 34) because the value of commodities can be just replaced by expected value of commodities. If so, proper insurance may effectively eliminate uncertainty. However, it is not realistic in the real world for several reasons that Arrow suggests.

First, there are too many contingencies that a contract should specify, and drawing up such a contract would be expensive. Second, it is difficult to distinguish genuine risks and risks from moral hazard. Arrow uses an example:

The outbreak of a fire may be due to a combination of exogenous circumstances and individual choice, such as carelessness or, in the extreme case, arson. Hence, a fire insurance policy creates an incentive for an individual to change his behavior and ceases to be a pure insurance against an uncontrollable event (p. 36).

Lastly, Arrow points out the problem of adverse selection (Akerlof, 1970) that comes from information asymmetry between the insured and the insurer.

The insured may know his risks better than the insurer, for example, in life insurance. The insurer may start by choosing its rates on some actuarial basis. But then the high-risk groups will buy more of the insurance than the average, while the low-risk group will buy less. Hence, the experience of the insurer, as weighted by dollars, will be less favorable than the actuarial. The rates will have to be raised, but this will drive still more of the low-risk groups out. Clearly a situation will be created in which there are many whose risks are inadequately covered, because it is not known how low those risks really are. The essential cause is an inequality of information between the two parties to the contract (p. 36).

Numerous contingences, moral hazard, and adverse selection problems are the reasons that economic actors cannot assign proper probabilities to the states of nature in the future. In addition, another source of uncertainty can be found in other economics

actors' behaviors that affect the consequences of decisions. Koopmans (1957) points out this kind of uncertainty. He distinguishes between primary and secondary uncertainty in the sense that primary uncertainty refers a lack of knowledge about states of nature, while secondary uncertainty refers a lack of knowledge about other economic actors.

In a rough and intuitive judgment the secondary uncertainty arising from lack of communication, that is from one decision maker having no way of finding out the concurrent decisions and plans made by others (or merely of knowing suitable aggregate measures of such decisions or plans), is quantitatively at least as important as the primary uncertainty arising from random acts of nature and unpredictable changes in consumers' preferences (pp. 162-163)

Studies on uncertainty in economics suggest the importance of information. Not only they emphasize the importance, but also they are interested in the value and cost of information. When the benefit of collecting and processing information about the future states of nature exceeds the cost of it, an economic actor will pay the cost. For instance, firm may conduct a survey to get information about customers' preferences on a new product. The firm pays the cost of survey, but may decrease uncertainty on the new product's sales. Likewise, a firm may find other ways to decrease uncertainty about the future. One possible way is choosing a proper governance mode. More discussions on this issue are found in organizational economics.

2.4. Uncertainty in organizational economics

Organizational economics denotes that study of organizations and organizational phenomena using concepts taken from organization theory, organizational behavior, and microeconomics (Barney and Ouchi, 1986). This stream of studies includes the issues of the existence of the firm, firm boundaries, firm heterogeneity, firm performance and so forth. The role of uncertainty has been found in some of these issues.

Coase's (1937) view

In his seminal work '*The nature of the firm*', Coase (1937) does not explicitly mention the characteristic or role of uncertainty, because his focus is not in uncertainty *per se*. However, he views uncertainty as a reason that even a long-term contract, as well as a short-term contract, may be avoided. This is how he treats uncertainty as a reason of the existence of the firm.

It may be desired to make a long-term contract for the supply of some article or service. This may be due to the fact that if one contract is made for a long period, instead of several shorter ones, then certain costs of making each contract will be avoided. Or, owing to the risk attitude of the people concerned, they may prefer to make a long rather than a short-term contract. Now, owing to the difficulty of forecasting, the longer the period of the contract is for the supply of the commodity or service, the less possible, and indeed, the less desired it is for the person purchasing to specify what the other contracting party is expected to do... When the direction of resources (within the limits of the contract) becomes dependent on the buyer in this way, that relationship which I term a "firm" may be obtained (p. 84).

For Coase, a fundamental question is why the firm emerges out of market transactions that are regulated by the price mechanism. Coase recognizes that markets and firms are ‘alternative methods of coordinating production’ (p.82). Outside the firm, price movements direct production. Within a firm, these market transactions are eliminated by the entrepreneur-coordinator who directs production. Then Coase asks; ‘Yet, having regard to the fact that if production is regulated by price movements, production could be carried on without any organization at all, well might we ask, why is there any organization?’ (p. 82).

Though the article, Coase argues that the cost of market transactions can be saved within organizations where an entrepreneur directs production. Uncertainty is one of the factors that make market transactions costly, even though it is mentioned only implicitly. Since Coase (1937), uncertainty becomes an important issue of the theories of the firm.

Klein, Crawford and Alchian’s view (1978)

Klein, Crawford and Alchian (1978) develop Coase’s (1937) insight and add ‘one particular cost’ of using the market system that is the possibility of post-contractual opportunistic behavior (p. 297). Their focus is appropriable specialized quasi rents that probably lead opportunistic behavior. The problem of uncertainty in organizational economics, raised by Coase (1937) in implicit terms, is now developed by Klein, Crawford and Alchian in terms of a more specified concept, appropriable quasi rents.

Appropriable quasi rents are defined as ‘the increased value of an asset protected from market entry over the value it would have had in an open market’ (p.299). the concept is different from monopoly rent in the sense that monopoly rent can be easily transferred to some other users at no reduction in value, while at the same time, entry of similar assets is restricted. This is how Klein, Crawford and Alchian distinguish the case of bilateral monopoly and the case where appropriable quasi rents exist. Both cases give firms to motivations of vertical integration, but for different reasons.

A related motive for vertical integration that should be confused with our main interest is the optimal output and pricing between successive monopolists or bilateral monopolists (in the sense of marginal revenue less than price). A distortion arises because each sees a distorted marginal revenue or marginal cost. While it is true that this successive monopoly distortion can be avoided by vertical integration, the results of the integration could, for that purpose alone, be achieved by a long-term or a more detailed contract based on the true marginal revenue and marginal costs... However, we investigate a different reason for joint ownership of vertically related assets – the avoidance of postcontractual opportunistic behavior when specialized assets and appropriable quasi rents are present (p. 299-300).

In other words, motivations of vertical integration in the existence of appropriable quasi rents are closely related to uncertainty, while vertical integration for monopoly rents has nothing to do with uncertainty. More importantly, Klein, Crawford and Alchian suggest a way of measuring such uncertainty. To show that, they present examples of specialized quasi rents that affect vertical integration decisions. They illustrate two types of capital: physical and human capital. In both cases, when specific

physical or human capital is involved, the opportunism problem gets more complex, and incentive to vertically integrate is increased.

The concept of appropriable quasi rents is important because it explains how a certain type of uncertainty may arise. For Klein, Crawford and Alchian, appropriable quasi rents are the reason for one particular type of uncertainty. Two types of capital – physical and human – lead a firm to vertical integration because there are increased appropriable quasi rents. Without the rents, a related type of uncertainty might not exist, and governance change might not be necessary.

Williamson's (1975, 1985) view

Williamson (1975) emphasizes that uncertainty *per se* does not result in market failure, but the joining of uncertainty with human factors, such as bounded rationality and opportunism, gives rise to exchange difficulties (p. 7). Uncertainty in Williamson's term is a little different from previous ones in that he considers human factors as critical condition that uncertainty affects organizations. Especially, Williamson (1985) considers both the primary and secondary uncertainty described by Koopmans (1959) as 'innocent' and 'non-strategic' because these types of uncertainty do not show a type of uncertainty that comes from human nature that is often opportunistic. Based on the assumption of opportunism as human nature, Williamson (1985) suggests another type of uncertainty, *behavioral uncertainty*.

Williamson's view of uncertainty will be discussed in detail in the following chapters, so it is just briefly introduced here. Table 2.2 summarizes the studies on

uncertainty in perceptual views, economics and organizational economics. From these studies, some important characteristics of uncertainty can be suggested. First, uncertainty may have various dimensions. Second, uncertainty decreases when more information is available. Third, uncertainty and governance decisions of the firm have close relationship. Taking these together, this study suggests that different types of uncertainty and information may have different role in governance decisions.

Disciplines	Focuses	Implications
Perceptual views	Perceived uncertainty affects individual decision making	Variety of dimensions of uncertainty developed
Economics	Uncertainty on the states of nature can be decreased by more information	The cost of information emphasized
Organizational economics	Uncertainty can be decreased by governance decisions	Uncertainty as a determinant of market vs. firm transaction

Table 2.2: Studies on uncertainty in selective disciplines

2.5. Multidimensionality of uncertainty and the scope of this study

Research in organizational economics has been extended to find more dimensions of uncertainty that the firm faces. Sutcliffe and Zaheer (1998), for example, seek to find various sources of uncertainty that are relevant to decisions about firm scope. In addition to primary and supplier (behavioral) uncertainty that fall into Koopmans (1959) and Williamson's (1985) categorization, Sutcliffe and Zaheer (1998) use the term of competitive uncertainty to see the effect of uncertainty arising from potential or actual competitors' actions. Since the potential or actual competitors are not direct transaction partners, competitive uncertainty may not be relevant to behavioral uncertainty on which transaction cost economics focuses. In fact, they find that only supplier uncertainty is positively related to decisions to vertical integration.

This result implies that there may be various dimensions of uncertainty that affect organizational reactions, such as vertical integration decisions, in various ways. Various dimensions of uncertainty can be found in various theories of the firm, because they have different assumptions about the nature of uncertainty. Specifically, transaction cost economics assumes that economic rent created from the transaction between economic agents is positive and constant. The nature of uncertainty in this context is that it is unknown *who*, among transaction partners, will appropriate economic rent that arises from the transaction. On the other hand, resource-based theory assumes that existing resources or capabilities of a firm affect the rent generating potential of acquired

resources or capabilities. The nature of uncertainty in resource-based theory is that it is uncertain *whether* positive economic rent will be created or not in vertical integration situations.

Another dimension of uncertainty – uncertain future *value* of resources or capabilities – are found in real options theory, which focuses on uncertain future events and their impact on the value of target resources a firm seeks to acquire (Kogut, 1991; Kogut and Kulatilaka, 1994). The nature of uncertainty in real options theory is that the value of economic rent can vary. So, in addition to transaction cost economics and resource-based theory, real options theory suggests another type of uncertainty. For example, a firm may want to make a transaction with another firm to develop a new technology. According to the three theories of the firm, there can be at least three types of uncertainty involved here. First, according to transaction cost economics, a transaction partner may opportunistically make use of the knowledge that is obtained through the transaction. To decrease this type of uncertainty, a focal firm may want to choose hierarchical governance to prevent partner firm's opportunistic behavior. Second, according to resource-based theory, resources and capabilities of transaction partners may or may not be well integrated. When it is expected that an acquisition of a target firm may destroy rent generation potential of integrated firm, hierarchical governance will make high level of uncertainty. To decrease this type of uncertainty, a focal firm may want to choose less hierarchical governance rather than outright acquisition. Third, according to real options theory, the value of a new technology may be uncertain even though transaction partners successfully develop the technology. If there are other

options (different kinds of technology in this example) in which a focal firm can invest, the focal firm may make less hierarchical governance with several transaction partners, rather than acquire just one target firm. These three dimensions of uncertainty are summarized in Table 2.3.

	Main concern	Source of uncertainty	Governance stability
Uncertainty on rent <i>appropriation</i>	Expropriation of economic rent	Possible Opportunism	Stable
Uncertainty on rent <i>creation</i>	Inefficiency in creating rent	Possible capability mismatch	Stable
Uncertainty on rent <i>valuation</i>	Investment in valueless assets	Possible adverse future events	Changeable

Table 2.3: Dimensions of uncertainty and the scope of this study

While transaction cost economics and resource-based theory does not question the value of economics rent, real options theory does. Indeed, real options theory suggests that once uncertainty about the value of economic rent disappears, a firm may exercise the option or just abandon it. Therefore, governance decision in real options theory is not a final decision. Whenever market situations change the value of economic rent that a firm seeks to acquire, the firm can choose between the two options, just like financial options: exercise or abandon.

This study distinguishes between ‘changeable governance’ and ‘stable governance’, and focuses on types of uncertainty that affects ‘stable governance’ only. Thus, this study does not question the value of economic rent that can be affected by future market

situations, but seeks to find the effects of uncertainty about rent appropriation and rent creation on relatively stable governance decisions.

In sum, while behavioral uncertainty is relevant to *rent appropriation*, the type of uncertainty in resource-based theory is relevant to *rent creation process*. Thus, this study names the type of uncertainty in resource-based theory *process uncertainty*. Since transaction cost economics and resource-based theory suggest different nature of uncertainty, it would be important to compare the two theories in terms of how they view uncertainty in detail. The following chapters review the two theories.

CHAPTER 3

TRANSACTION COST ECONOMICS AND UNCERTAINTY

3.1. Review

Concepts

Transaction cost economics focuses on the cost of market transaction to explain the existence of the firm. As Coase (1937) suggests, ‘the main reason why it is profitable to establish a firm would seem to be that there is a cost of using the price mechanism’ (p. 83). Citing Knight (1933), Coase (1937) points out that uncertainty and human nature would be the sources of the cost that is created in market transactions. Since some market transactions may be costly compared to transactions inside a firm, such market transactions are internalized within the firm. On the other hand, transactions inside a firm also carry cost, such as governance cost, so transactions are not unlimitedly internalized. Firm boundaries are determined through this economizing process in balancing between market transaction cost and internal governance cost (Williamson, 1991; Madhok, 1997).

Williamson (1975) uses several concepts to develop this theory. In his framework, there are two kinds of factors: human factors and environmental factors. Among human

factors, bounded rationality refers to human behavior that is ‘intendedly rational, but only limited so’ (Simon, 1961). The other human factor is opportunism, which involves ‘self interest seeking with guile’ (p. 26). Among environmental factors, uncertainty/complexity refers a condition where ‘it is very costly, perhaps impossible, to describe the complete decision tree’ (p. 23). Also the small numbers refer a condition that only a few partners can be found.

Another important concept is asset specificity, which is referred to the degree to which an asset can be redeployed to alternative users and by alternative users without sacrifice of productive value (Klein, Crawford and Alchian, 1978). Williamson (1985) defines asset specificity as ‘durable investments that are undertaken in support of particular transactions, the opportunity cost of which investments is much lower in best alternative uses or by alternative users should the original transaction be prematurely terminated’ (p. 55) and focuses on asset specific investment as a condition of small numbers, because asset-specific investments have little value outside of a particular relationship. So, the transaction partners should continue the relationship even when contractual environments change. Williamson (1975) describes the process of transformation from large-numbers to small-numbers.

Although a large-numbers exchange condition obtains at the outset, it is transformed during contract execution into a small-numbers exchange relation on account of (1) idiosyncratic experience associated with contract execution, and (2) failures in the human and nonhuman capital markets (p. 29).

Operationalization of concepts

Empirical studies in transaction cost economics have tested how uncertainty and opportunism, respectively or together, affect on governance decisions. Key variables – governance, asset specificity, and uncertainty – have been operationalized in various ways. To begin with, this study examines empirical studies that operationalize these variables separately –especially asset specificity, environmental uncertainty and measurement uncertainty. Next, the problems that this separation makes are suggested.

Governance - Governance as a dependent variable has been operationalized by the degree of integration of distribution channel (Anderson and Coughlan, 1987), the use of coercive power in franchise relationship (John, 1984), the level of commitment of manufacturers and distributors to channel relationship (Anderson and Weitz, 1992), the importance of salary relative to commissions or bonuses (John and Weitz, 1989), the use of direct sales force rather than sales representatives (Weiss and Anderson, 1992), and so force.

Asset specificity - Asset specificity has been operationalized in six types (Williamson, 1985, 1991). The explanations and examples are summarized in the Table 3.1.

Types	Explanations	Examples
Specific site	Facilities are located so that inventory and transportation expenses are minimized	A calciner which is built adjacent to a coker but has access to alternative coke suppliers (Goldberg and Erickson, 1987)
Specific physical asset	Assets are developed or customized to a particular use or purpose	Specialized dies and the equipment in which those dies are installed (Walker and Weber, 1987)
Specific human asset	Employees develop firm specific skills or knowledge	Human assets tailored to the transaction (position) are specialized knowledge and working relationship (Anderson, 1985)
Specific dedicated asset	Additional investments are made to existing plant for the expectation of selling significant product to a particular customer	In JIT relationships, investment in specialized durable assets are common (Frazier, Spekman and O'Neal, 1988)
Brand capital	Investments in reputation	Advertising intensity can be used as a measure of brand name equity in the specific markets (Gatignon and Anderson, 1988)
Temporal specificity	Specificity which arises when timely responses by on-site human assets is vital	In ship building, the timing and coordination of construction projects are critical (Masten, Meehan and Snyder, 1991)

Table 3.1: Studies on the types of asset specificity

First, site specificity refers to situations in which successive production facilities are located close to each other. Goldberg and Erickson (1987) show an example of site specification in a case study of petroleum coke. Second, physical asset specificity refers to situations in which assets are developed or customized to particular use or purpose. Walker and Weber (1987) find an example of specialized dies for this kind of specificity. Third, human asset specificity refers to individual skills that are needed for an

organization. Anderson (1985) reports an example of sales persons' specialized knowledge and skills that are obtained from their sales position. Forth, dedicated asset specificity refers to investments in general plant and machinery for a particular buyer. Frazier, Spekman and O'Neal (1988) present an example of Just-In-Time relationships for this kind of specificity. Fifth, brand name capital refers to an investment in reputation. Gatignon and Anderson (1988) suggest an example of advertising intensity ratio as a proxy of brand name equity in the specific market. Sixth, temporal specificity refers to situations in which timely responses by on-site human assets are vital. Masten, Meehan and Snyder (1991) show an example of a ship building process, where timing and coordination of construction project are critical.

Uncertainty - Uncertainty has been operationalized either in terms of environmental, measurement or behavioral. Environmental uncertainty refers to unanticipated changes in environments surrounding an exchange. But when operationalized in empirical studies, 'among all the transaction cost analysis construct, environmental uncertainty seems to be the most problematic from a measurement standpoint (Rindfleisch and Heide, 1997, p. 42). For example, Anderson (1985) measures environmental uncertainty using survey questions asking perceived environmental turbulence. Heide and John (1990) conceptualize environmental uncertainty as volume unpredictability and technological unpredictability. Moreover, Klein (1989) and Klein, Frazier and Roth (1990) operationalize environmental uncertainty as a two-dimensional concept that entails elements of both unpredictability and changeability. These studies are summarized in Table 3.2.

Operationalizations	Authors	Findings
Environmental turbulence	Anderson (1985)	Not significant to in-house sales force preference
Volume unpredictability and technological unpredictability	Heide and John (1990)	Volume unpredictability is positively related to the extent of joint action, but technological unpredictability is negatively related
Unpredictability and changeability	Klein (1989)	Unpredictability is positively related to hierarchical governance, but changeability is negatively related
Expected deviation between forecast and actual sales	Anderson and Schmittlein (1984)	Not significant to integration of the sales force
Demand uncertainty	Harrigan (1985)	Not significant to vertical integration decision
Volume uncertainty and technological uncertainty	Walker and Weber (1984)	Volume uncertainty is positively related to hierarchical governance, but technological uncertainty is not
Uncertainty from exogenous source	Sutcliffe and Zaheer (1998)	Negatively related vertical integration decision

Table 3.2: Operationalization of environmental uncertainty using primary data

Environmental uncertainty also has been operationalized using secondary data. For example, Balakrishnan and Wernerfelt (1986) measure technological instability by the average age of plant and equipment in use during 1974-1976. Levy (1985) use stock market returns as an indication of unanticipated events. Gatignon and Anderson (1988) measure unpredictability by country risk index. Table 3.3 summarizes these studies.

Operationalization	Authors	Findings
Technological instability	Balakrishnan and Wernerfelt (1986)	Technological instability is negatively related to vertical integration decision
Unanticipated events	Levy (1985)	Unanticipated events are positively related to the degree of vertical integration
Country risk and cultural distance	Gatignon and Anderson (1988)	Country risk and cultural distance are negatively related to hierarchical governance (selectively for cultural distance)

Table 3.3: Operationalization of environmental uncertainty using secondary data

Measurement uncertainty is operationalized by the degree of the difficulty associated with assessing the performance of transaction partners. Some scholars see measurement uncertainty as same as behavioral uncertainty (e.g. Anderson, 1985; John and Weitz, 1989; Rindfleisch and Heide, 1997; Peng and York, 2001) and others not (e.g. Poppo and Zenger, 1998). To avoid confusion, this study separates measurement uncertainty from behavioral uncertainty. Measurement uncertainty has far fewer operationalized compared to asset specificity and environmental uncertainty (Rindfleisch and Heide, 1997). Anderson (1985) assesses measurement uncertainty focusing on such factors as the degree of team sales and the accuracy of sales records. Anderson and Schmittlein (1984) and Poppo and Zenger (1998) measure perceived difficulty of evaluating individual's performance. These studies generally support positive relationship between measurement uncertainty and hierarchical governance. Table 3.4 summarizes these studies.

Operationalization	Authors	Findings
Degree of team sales and accuracy of sales record	Anderson (1985)	Measurement uncertainty is positively related to sales force integration
Difficulty in evaluating performance	Anderson and Schmittlein (1984)	Measurement uncertainty is positively related to sales force integration
Difficulty in evaluating performance	Poppo and Zenger (1998)	Measurement uncertainty is positively related to vertical integration

Table 3.4: Operationalization of measurement uncertainty

Redefining “uncertainty”

From the discussion above, many empirical studies show mixed and contradictory results against what transaction cost economics predicts, especially for the concept of uncertainty. How can this contradiction be solved?

It can be suggested that these contradictory results against transaction cost economics are resulted from the fact that transaction cost economics does not cover all types of uncertainty. The role of uncertainty in transaction cost economic is that it results in market failure that increase transaction cost in the market. However, every type of environmental uncertainty does not lead to market failure. In fact, as briefly discussed earlier in the previous chapter, Williamson (1975) admits that environmental uncertainty *per se* may not lead to market failure. Then under what conditions environmental uncertainty lead to market failure? Williamson (1975) points out that human factors must be joined with environmental factors. ‘Unless joined, however, by a related set of human

factors, such environmental conditions need not impede market exchange' (p.9). He clearly notes that uncertainty is a necessary condition that bounded rationality problem arises.

As they point out, most decision problems, unlike board games such as chess, are not deterministic but involve decision-making under uncertainty. For these, the comprehensive decision tree is not apt even to be feasible... As long as either uncertainty or complexity is present in requisite degree, the boundary rationality problem arises and an interesting comparative institutional choice is often posed (p. 23).

In this regard, uncertainty found in transaction cost economics is not uncertainty in a universal term but uncertainty that accompanied with possible opportunistic behaviors that make use of the uncertainty. Williamson (1979) asserts that firms should react to volatility by avoiding ownership, because hierarchical governance may not be appropriate when the next environmental shift occurs.

From these discussions, it can be suggested that types of uncertainty may vary but transaction cost economics only concerns a particular type of uncertainty that is relevant to human factors, such as opportunism. Williamson (1985) names this type of uncertainty *behavioral uncertainty* that refers to the exchange partner's strategic nondisclosure, disguise, or distortion of information. Transaction cost economics concerns this behavioral uncertainty that exist in the market. Behavioral uncertainty, therefore, is the very reason that transaction cost economics explains as the existence of the firm, and other types of uncertainty that are not relevant to opportunism are not what

transaction cost economics is interested in. Then, asset specificity and uncertainty are not separate concepts. As Godfrey and Hill (1995) assert, asset specificity is used to measure unobservable *ex ante* probability of opportunism that creates behavioral uncertainty.

3.2. Critiques

Transaction cost economics has not been free from critiques. Regarding uncertainty, transaction cost focuses behavioral uncertainty that increases transaction cost in the market. However, there may be other types of uncertainty that increase other types of cost. This issue is suggested by Demsetz (1988), who argues that transaction cost economics only considers the cost of transaction and ignores other kinds of important cost, such as production cost⁴. This is somewhat ironical because transaction cost economics is initially introduced to call attention to transaction cost economizing, which has been ignored before, rather than focusing on technology and production costs (Williamson, 1975). Anderson and Schmittlein (1984) describes:

Traditionally, economists have focused on production costs to the exclusion of transaction cost.

Consequently, technology costs are viewed as the principal determinant of integration. The dominance of this paradigm led Coase (1972) to lament the state of affairs in industrial organization research at that data and to call for a more direct approach focusing on governance features (p. 394).

⁴ Some transaction cost economics based studies do emphasize performance measures, including production efficiency, as a part of transaction costs (Walker and Poppo, 1991; Masten, 1993; Poppo and Zenger, 1998). These studies acknowledge the importance of production efficiency in choosing between market and hierarchy. Demsetz (1988), however, seems to go further to see differences in production efficiency between firms.

As transaction cost has been developed as the principal determinant of integration, in turn, transaction cost economics has been criticized for not considering production cost. Demsetz (1988) argues that transaction cost is important, but it is not all that we should concern.

The cost of transacting is one element of the cost of purchasing from others, but not only one. There are a variety of others, including what we ordinarily call production costs.... The emphasis that has been given to transaction cost (or that has been claimed to be given) dims our view of the full picture by implicitly assuming that all firms can produce goods or services equally well (pp. 146-147).

Demsetz (1988) uses an example to emphasize the importance of production cost. When a firm has negative production cost, which means the firm can produce a product more efficiently inside the firm than in the market, then the firm may choose hierarchical governance to produce the good even though transaction cost is zero and management cost is positive. Negative production cost implies that a firm has more efficient production function than other firms in the market. Therefore, Demsetz's (1988) argument is quite straightforward: production efficiency may be different from transaction efficiency and may affect governance choice of the firm. Against this argument, Williamson (1991) responds that Demsetz (1988) has a terminological problem.

One of the problems that Demsetz has with transaction cost economics is terminological: rather than use transaction costs symmetrically to describe cost differences among alternative forms of governance, he urges that the term *transaction cost* should be reserved for markets and *management cost* be used for firms. The absence of a generic cost category complicates comparisons, however, especially when hybrid forms of organization (franchising, joint ventures, etc.) are introduced (p. 10, italics in original).

However, if transaction cost describes *all* cost differences among alternative forms of governance, it would make transaction cost economics tautological⁵. In other words, as known as the Coasian tautology, the assertion that ‘hierarchical forms of governance will be chosen when the costs of market governance are greater than the costs of hierarchical governance’ is just not refutable if the costs mean all kinds of costs. This tautological logic ‘deprives transaction cost theory of any predictive content’ (Demsetz, 1988, p. 147). To avoid this tautology, the term of transaction cost needs to mean to a specific concept that may have predictive contents. Williamson (1985) parametrizes the attributes of transactions to make it possible to have predictive contents, and asset specificity is one of the attributes of transactions he identifies. However, asset specificity may not be relevant to production cost, by definition (Demsetz, 1988). Separating transaction cost from production cost and considering both of them to predict governance decisions of the firm are needed not to make transaction cost economics tautological.

⁵ Williamson (1996) defines transaction costs as ‘the *ex ante* costs of drafting, negotiating, and safeguarding an agreement and, more especially, the *ex post* costs of maladaptation and adjustment that arise when contracts execution is misaligned as a result of gaps, errors, omissions, and unanticipated disturbances; the costs of running the economic system’ (p. 379).

While Demsetz (1988) criticizes transaction cost economics by suggesting another type of *cost* – production cost - that should be considered in addition to transaction cost, other scholars emphasize *value* side of transaction and argue that transaction cost economics ignores this side (Zajac and Olson, 1993; Madhok, 1997). For example, Zajac and Olson (1993) argue that interdependence of the exchange partners plays an important role in creating value of transactions, but transaction cost economics does not specify it.

The underlying problem (and research opportunity) with this structuralist approach to transactional issues is that Williamson's notion of a 'fundamental transformation' is in fact a *process* that is never fully specified in standard transaction cost analysis. Transaction cost analysis views dyadic exchange relationships solely in terms of their having certain structural properties before contract execution and other structural properties after contract execution (p. 136, italics in original)

In other words, transaction cost economics does not focus on the value generating process through fundamental transformation that may affect governance decisions of the firm⁶. Transaction cost economics compares the cost side characteristics between governance structures, but does not explain the value side characteristics of the process from market exchange to hierarchical exchange. Transaction cost economics considers uncertainty as the source of cost differences between governance structures, but does not consider possible uncertainty on rent generating potential that may be created in the

⁶ Monteverde (1995) investigates a type of specialized human assets named "unstructured technical dialog" that may enhance post-integration efficiency in the hierarchy and finds a significant result for vertical integration. He conducts this study to support transaction cost economics, but admits that this results can be also consistent with efficiency-based approach suggested by Demsetz (1988).

process of governance transformation. In fact, if uncertainty on rent generating potential is considered, new types of uncertainty can emerge that are not found in transaction cost economics.

3.3. Unidentified issues

Transaction cost economics explains the positive relationship between asset specificity and hierarchical governance to minimize behavioral uncertainty, assuming that rent generating potential is constant through the governance decision (Figure 3.1).

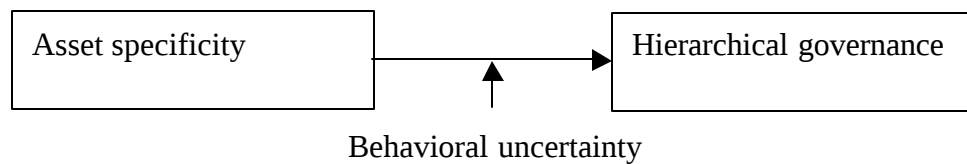


Figure 3.1: Behavioral uncertainty in transaction cost economics

However, this simplified model does not explain at least two related issues. First, is the rent generating potential constant regardless of governance choice? Second, isn't there any type of uncertainty that can be found within the firm?

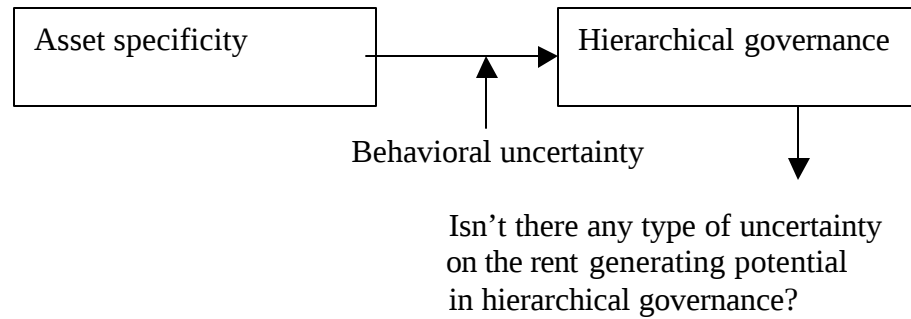


Figure 3.2: Unidentified issue

These issues are all related to firms' heterogeneous and inimitable resources and capabilities. Since firm resources are costly to understand from outside, rent generating potential of resources may be uncertain when they are moving across firm boundaries. However, these issues are not identified in transaction cost economics.

CHAPTER 4

RESOURCE-BASED THEORY AND UNCERTAINTY

4.1. Review

Concepts

Resource-based theory of the firm suggests that firm resources and capabilities influence the growth and performance of the firm (Penrose, 1959; Barney, 1991; Mahoney and Pandian, 1992). The firm is defined as a set of productive resources and administrative organization (Penrose, 1959). Distinctive resources and their immobility across firms make firm heterogeneity, resulting in performance heterogeneity.

The primary question of resource-based theory when this theory is first introduced is that what characteristics of resources can generate sustained competitive advantages. Specifically, the question is why firms may have different performances even within the same industry. Four indicators of firm resources to generate sustained competitive advantage are suggested by Barney (1991).

Valuable resources – Firm resources can be a source of competitive advantage when they are valuable. Resources are valuable when they enable a firm to conceive of

or implement strategies that improve its efficiency and effectiveness. For example, when resources can have the effect of reducing a firm's costs or increasing its revenues, the resources can be considered as valuable resources.

Rare resources – Firm resources possessed by large numbers of competing or potentially competing firms cannot be source of competitive advantage. A firm may get a competitive advantage when it is implementing a value-creating strategy not simultaneously implemented by large numbers of other firms.

Inimitable resources – Valuable and rare resources can be sources of sustained competitive advantage if firms that do not possess these resources cannot easily obtain them. Various factors, such as a firm's unique history, causal ambiguity, and interconnectedness among resources, may increase inimitability of resources.

Nonsubstitutable resources – Firm resources that do not have strategically equivalent resources are nonsubstitutable resources. If other firms have strategically equivalent resources, the firms can implement the same strategies in different ways using different resources. A firm may get sustained competitive advantage when other firms may not obtain the same competitive advantage using different resources.

Using these basic concepts of firm resources, empirical studies have tested resource-based logic in various contexts. However, this study argues that the concept of uncertainty has not been of interest in empirical studies. The reason could be found in two ways.

First, the concept of uncertainty may not exist in resource-based theory because the theory is not developed for it. Resource-based perspective is used mostly to explain the

relationship between the possession of valuable, rare and inimitable resources and abnormal economic rent. If the *possession* of valuable, rare and inimitable resources means that the firm *knows* how to use the resources, there may be no room that uncertainty should be considered. Then, any efforts to include variables for uncertainty in resource-based theory would be meaningless, because the theory already assumes that there is not any type of uncertainty about the use of resources.

Second, the concept of uncertainty in resource-based theory may not be clear just because it is not develop yet, even though it does exist in the theory. In other words, resource-based theory may not have been developed to find an important variable that this theory should have. For example, as Mahoney (2001) asserts, a theory of firm rents would also explain the existence of the firm. Since the existence of the firm has been dominantly explained by the role of uncertainty - especially, behavioral uncertainty - in transaction cost economics, it may be reasonable that resource-based theory also has an equivalent uncertainty variable that explains the existence of the firm. The variable may not just be underdeveloped.

This study adopts the second perspective and seeks to develop types of uncertainty in the context of resource-based theory. To begin with, this study reviews specific topics in resource-based theory and how uncertainty is incorporated in these topics.

Resources, performance and uncertainty

Empirical studies have investigated the characteristics of a firm's resources and seek to correlate these characteristics with a firm's performance. However, they seldom

focus on the uncertainty that might occur between the possession of valuable resources and firm performance. Instead, some studies note that the value of resources are determined in different contexts, so implicitly suggest that there may be uncertainty on how the value of resources are determined.

For example, Hall (1992) examines that UK executives recognize intangible resources as the source of a firm's sustainable competitive advantage. However, this study does not question under what conditions intangible resources may not be related to sustainable competitive advantage. Rao (1994) finds that some firms develop reputation that enhances the likelihood of survival in the U.S. auto industry, but does not raise a question of uncertainty on the value of reputation. Makadok (1999) also find that firms in money market industry have heterogeneous marginal efficiency to size due to heterogeneous resources and capabilities, and this differences among firms result in different firm performance, measured by subsequent market share. But uncertainty is not the focus of this study.

Uncertainty on the value of resources is implicitly suggested by Collis (1994), who argues that the value of resources and capabilities may be context dependent.

Organizational capabilities certainly can, in principle, meet the conditions for the existence of sustainable competitive advantage, but they are not the end of the research for sustainable competitive advantage. In fact, organizational capabilities are, along with more tangible resources and reputations, just another level in the explanation of sustainable competitive advantage with no

greater claim to precedence than any other level... The source of sustainable competitive advantage is likely to be found in different places at different points in time in different industries (pp. 150-151).

In fact, Barney (1991) points out this type of uncertainty on the value of resources in terms of exogenous determination of the value of resources. The value of resources must be determined by models of the competitive environment within a firm competes. In this respect, proper operationalization the valuable resources would be critical (Godfrey and Hill, 1995). Empirical studies often specify valuable resources in the context of a certain industry or environment. For example, Henderson and Cockburn (1994) test whether competence of a firm has positive effects on firm performance. They find that both component competence for day-to-day problem solving and architectural competence for integration of component competence enhance research productivity in pharmaceutical industry. Miller and Shamsie (1996) find that property-based resources captured by movie star contracts and theaters controlled by studios affect abnormal performance of the studios in stable environment, while knowledge-based resources captured by award-winning ability and large-scale investment affect abnormal performance in uncertain environment in the context of Hollywood film industry. Brush and Artz (1999) also find that different types of capabilities captured by different types of veterinary services affect performance of medical service providers captured by client retention rate in the context of veterinary medicine industry. These studies do not explicitly mention about uncertainty on the value of resources and firm performance. But by identifying different types of resources and capabilities that might have different

impacts on firm performance, these studies implicitly suggest that the value of resources may vary in different competitive environment. However, again, the studies on the relationship between valuable resources and firm performance have recognized only limited sense of uncertainty.

Resources, firm growth and uncertainty

Compared to the studies on the relationship between firm resources and performance, studies on the relationship between firm resources and firm growth identify the concept of uncertainty more clearly. Discussions of the issues of firm growth have the question of how to exploit and develop firm resources and capabilities. The growth of the firm, in this sense, is the process through which a firm can accumulate its resources and capabilities to obtain better performances. A firm's existing resources and capabilities, therefore, give directions and limits to the process of new capability accumulation.

Penrose (1959) points out that internal obstacles and internal influence the direction of firm growth. Internal obstacles arise when particular direction is limited due to the lack of managerial capacity and technical skills. Internal inducements arise from the 'existence of a pool of unused productive services, resources, and special knowledge, all of which will always be found within any firm' (p. 66). Underutilized capabilities, therefore, affects the direction of firm growth, or entry area.

Then, what if a firm has no underutilized capabilities? In other words, what if a firm reaches 'an equilibrium point' where no incentive to acquire further resources?

Penrose (1959) explains that a firm cannot avoid underutilized capabilities for three reasons. The first reason is the indivisibility of productive services of resources. One unit of resource produces several kinds of productive services and they are indivisible. Firms use only a part of those productive services, so firms will try to use the unused part of services to increase the efficiency of resource utilization. However, the utilization of important resources may require firms to produce a new product, which demands an acquisition of new resources. Then indivisible productive services attached to the new resources will be brought within the firm, composing new underutilized capabilities. The second reason is the specialized use of resources. As a firm grows its size, specialization can take place to increase the efficiency of resource utilization. The same resources can be used in a specialized manner, or can produce different kinds of productive services. This change leads a firm to produce new products to use those services. Once new products are added, new types of resources are required, and by using new underutilized capabilities, further specialization may go on. The third reason is that new productive services can be created continuously in the ordinary operations. The same resource can render different services to different firms because the people who work with the resource may have different ideas about how to use it. As soon as any resources are acquired in the market, the resources may produce unique services in a particular firm. The interaction between the resources and a firm's personnel creates the new productive services. As the experience and knowledge of a firm's personnel are accumulated, these new services, or underutilized capabilities, are continuously created.

Since underutilized capabilities generally exist for these reasons, firms will try to expand its boundary to make use of the capabilities. The direction of expansion will be decided to use these capabilities efficiently. Studies in diversification and internationalization have shown the relationship between the direction of firm growth and firm capabilities. Monopolistic advantage theory (Hymer, 1976) reflects the fact that firms are going overseas to exploit underutilized capabilities, like monopoly power in domestic market, in new markets. Diversifying firms tend to utilize productive resources that are surplus to current operations (Chatterjee and Wernerfelt, 1991).

Specifically, studies on diversification focus on the relatedness among business units as a determinant of diversified firms' performance. Scales of diversification have been developed in various ways (e.g. Montgomery, 1982; Palepu, 1985; Nayyar, 1992) and the degree of relatedness is considered to affect performance. For example, Robins and Wiserna (1995) show that interrelationships within corporation portfolios enhance a firm's financial performance, as resource-based theory predicts. Based on the argument that shared resources and capabilities may create scope economies (Teece, 1982, 1984), they measure interrelatedness of business portfolios by making technology flow matrix. Then, they find that relatedness among portfolios and firm performance is positively related. This study has an important implication on the issue of uncertainty in the context of resource-based theory, because it points out that shared resources among business units may encourage technology flow inside the firm. It suggests that if business units do not share resources and capabilities inside the firm, there might be difficulties in transferring technology even within the firm. Therefore, when a firm seeks to vertically

integrate a new business unit, the firm needs to consider a type of uncertainty on the interrelationship between existing units and a new unit.

Resources, governance and uncertainty

In addition to firm performance and firm growth, the impact of firm resources and capabilities on governance decisions has been studied (Connor, 1991; Argyres, 1996; Barney, 1999). Since governance issue is the main topic of transaction cost economics, resource-based theory and transaction cost economics may be compared well in this respect. Argyres (1996) suggests that firm capabilities play an independent role in make-or-buy decisions that transaction cost economics does not explain.

The capabilities approach contradicts transaction cost theory by suggesting that differential production costs play an important, *independent* role in make-or-buy decisions, and arise from different firm-specific capabilities rather than from scale economies. For example, managers often say, in effect, ‘our company doesn’t do activity X because we’re not good at it (p. 130, italics in original).

Argyres (1996) makes this argument in his qualitative case study of a cable connector producer. When the firm decides on whether to outsource or make in-house, Argyres (1996) observes that the firm considers both transaction cost approach and capabilities approach, and also finds that relative firm capabilities seem to mostly matter when there is very little overlap between partners’ technological bases. When the firm has superior capabilities that rely on experience, intuition, or tacit knowledge, it would be

hard for the firm to transfer the capabilities to potential suppliers, so the firm will vertically integrate the activities that need those capabilities.

However, this logic does not fully consider the type of uncertainty that may be involved in the governance decisions of the firm. While this logic recognizes uncertainty that may occur when the firm vertically integrates activities that the firm has superior capability to do, but does not recognize uncertainty that may occur inside the firm. In other words, this logic seems to suggest that if a firm has the most superior capabilities, the boundary of this firm would be unlimited⁷. In transaction cost economics, behavioral uncertainty increases market transaction cost while management cost increases hierarchical transaction cost, thus firm boundary is determined to minimize the sum of the two types of costs. In resource-based theory, however, the cost of hierarchy has not been studied except a few studies (e.g. Barney, 1999; Coff, 1999). Barney (1999) suggests that it can be costly to use acquisition to gain access to capabilities when (1) there may be legal constraints on an acquisition, (2) an acquisition may reduce the value of the capabilities that are held in the acquired firm, (3) an acquisition can be costly to reverse if it turns out not be valuable, (4) there may be substantial “unwanted baggage”, and (5) leveraging acquired capabilities throughout an acquiring firm can be costly (p. 142). If acquisition is costly because of some of these capability-related reasons, the firm will take less hierarchical governance, thus firm boundary will be limited. Coff (1999) suggests that three types of uncertainty – uncertain quality of target’s value, uncertain

⁷ Penrose (1959) recognizes that internal (managerial) and external (uncertainty) constraints limit the growth of firms. She insists that ‘when more resources become available, more information can be obtained, more uncertainty eliminated, and more expansion planned’ (p. 60). Therefore, under given uncertainty, managerial capability may determine the boundary of the firm.

transferability due to turnover or tacitness, and uncertain synergy – affect buyers' acquisition strategy. When these types of uncertainty are expected to increase the cost of hierarchical governance, Coff (1999) finds that the firm tries to decrease the risk of acquisition by offering low bid premia, offering non-cash payment, and seeking more information from the target. Even though Coff's (1999) study does not directly examine the relationship between capability-related hierarchical cost and the firm boundary decisions, it suggests several types of uncertainty that may make hierarchical governance costly in the context of resource-based theory.

The types of uncertainty that might be involved in the selective topics of resources based theory are summarized in Table 4.1. Again, however, these types of uncertainty have not been developed enough to make resource-based theory more comprehensive as compared to transaction cost economics as a theory of the firm existence. The critiques on resource-based theory begin with this point in the following chapter.

Topics	Findings	The types of uncertainty that might be involved
Resources and firm performance	The firm that possesses valuable resources obtains abnormal performance	The value of resources is context-dependent, so may be uncertain <i>ex ante</i>
Resources and firm growth	The firm's underutilized resources induce the growth of the firm	Relatedness of resources may be hard to define
Resources and firm governance	Comparative capability of the firm affects make-or-buy decisions	When considering another firm's capability, uncertain synergy does matter

Table 4.1: Types of uncertainty that might be involved in resource-based theory

4.2. Critiques

While resource-based theory has been accepted as a ‘theory’ by some scholars (e.g. Conner, 1991; Grant, 1991; Conner and Prahalad, 1996), it is commonly called as a ‘view’ yet. It is probably because resource-based theory has not fully answered the two questions that are believed to be requisites for a theory of the firm: why the firm exists and how the boundary of the firm is determined. Priem and Butler (2001) argue that resource-based “view” does not explain the key issues that should be addressed to be a theory of the firm.

We do not address whether the RBV represents a new theory of the firm (e.g., Conner, 1991), because in the RBV set forth by Wernerfelt (1984) and Barney (1991), key issues explained in theories of the firm are not addressed. These issues include why the firm exists in place of alternate

systems for organizing economic activities and what determines the scope of the firm (e.g., Alchian and Demsetz, 1972; Alchian and Woodward, 1987; Coase, 1937; Seth and Thomas, 1994). (p. 25).

While Priem and Butler's (2001) argument claims that a theory of the firm should explicitly explain the issues of firm existence and firm boundary decisions, Mahoney (2001) argues that even when a theory does not explicitly explain the existence of the firm, it also can show why the firm exist, and thus can be a theory of the firm. Mahoney (2001) names that resource-based theory as a theory of firm rents and transaction cost economics as a theory of the existence of the firm, and he admits that a theory of firm rents would also explain the existence of the firm.

In fact, the two theories can be connected in the following way: resource-based theory seeks to delineate the set of market frictions that would lead to firm growth and sustainable rents, while transaction costs theory seeks to delineate the set of market frictions that explain the existence of the firm. Further, I conjecture that the set of market frictions that explain sustainable firm-level rents would be *sufficient* market frictions to explain the existence of the firm. (p. 655, italics added)

If a theory of the firm rents *sufficiently* explains the existence of the firm, the theory of the firm rent should have explanatory variables that the theory of the existence of the firm. Moreover, the assumptions that the theory of the firm existence has may not be necessarily excluded in the theory of the firm rent. Changing assumptions may make it hard to compare the theories of the firm.

Indeed, scholars in knowledge-based view of the firm argue that the existence of the firm can be explained by using resource-based perspectives, even without the assumption

of opportunism (Connor, 1991; Kogut and Zander, 1992; Grant, 1996). According to this view, the firm exists because the cost of knowledge transfer is lower within the firm than in the market. Teece (1977) is probably the first scholar who raised the issue of the cost of knowledge transfer. In his study about the technology transfer by multinational firms, Teece (1977) finds several factors, such as transferee's experience and the maturity of knowledge, affect the cost of knowledge transfer. His finding is important because he empirically shows that knowledge transfer is not costless, as Arrow (1969) suggests. This idea about the cost differences in knowledge transfer is used to explain the existence of the firm. Conner (1991) argues that the firm exists because of the firm has advantages over market contracts in the efficiency of knowledge transplantation.

The resource-based view thus implies a theory of the firm's existence that turns on advantages (over the market contracts) in *inter-component knowledge transplantation* and in the creation-redeployment of specific assets. The resource-based view's implicit theory of firm scope (again relative to market contracts) also turns on advantages in creation-redeployments of specific assets, with the magnitude of these advantages depending on the strength of firm-level linkages (p. 141, italics added).

Kogut and Zander (1992) suggest that knowledge transfer within a firm is more efficient than knowledge transfer across firms, especially when the knowledge is tacit. Empirically, Kogut and Zander (1993) hypothesize that tacitness of knowledge is positively related to hierarchical ownership when the knowledge is transferred to foreign subsidiaries. The tacitness of knowledge is measured by three constructs of codifiability,

complexity and teachability. Using the survey data from 82 technical directors, they find that codifiability and teachability are negatively, and complexity is positively related to the choice of wholly owned subsidiaries rather than the choice of license or joint venture.

Although Kogut and Zander's (1993) study highlights that the cost of knowledge transfer does matter in a firm's boundary decisions, they assume that only focal firms have knowledge to transfer. This unilateral knowledge transfer may occur when a firm wants to exploit its resources and capabilities in a new area. However, firms often make boundary decisions when they need to acquire knowledge that they do not have. Also, bilateral knowledge transfer is needed when synergy effect of complementary knowledge is desired. Therefore, what type of knowledge transfer will be expected is case-specific. Boundary decisions of the firm will be affected by these situations.

Knowledge-based view claims that the existence of the firm can be explained without the assumption of opportunism that lies at the core of transaction cost economics. On this assertion, Williamson (1999) argues that opportunism cannot be assumed out as knowledge-based view contends. Williamson (1999) describes the world of no opportunism as 'utopian fantasies' where only a peer group or ideal merit assignment will exist.

My main response to this argument is that zeroing out opportunism has different and more pervasive organizational consequences than Conner and Prahalad (1996) describe. The general effect of presuming the absence of opportunism is that we enter the world of what Frank and Fritzie Manuel

describe as ‘utopian fantasies’ (1979, p. 1)... the ideal forms of organization that that will be observed under zero opportunism will take the form of a peer group (if every member has the same ability) or ideal merit assignment (if abilities differ) (p. 1099).

Foss (1996) also points out that knowledge-based perspective gives not sufficient but only necessary conditions for the existence of the firm. For example, Foss (1996) suggests that even when much knowledge is surely shared in Silicon Valley, firm boundaries are still determined on contractual basis. Also, he raises a question that ‘tacit knowledge may tend to be more proprietary and therefore at greater risk of expropriation by contractual partners’ (1999, p.740). Choate (1997) also suggests that tangible assets might be more asset-specific to the purposes of the firm, even though asset tangibility is not a perfect proxy for asset specificity.

Mahoney (2001) argues that routines and culture would develop within the firm not *in the absence of opportunism*, but *precisely because opportunism exists*. He insists that in the absence of opportunism, recurrent market contracts could achieve the efficiency of internal organization within the firm. The superior knowledge transfer within the firm is because of ‘superior attenuation of opportunism relative to recurrent contracting’ (p. 654).

From these assertions, it seems that opportunism and tacitness of knowledge may be interdependent rather than independent. If so, it would be more proper to include opportunism under consideration than to assume it out.

4.3. Search for uncertainty in resource-based theory

Even though a concept of uncertainty has not been well developed in resource-based theory, early studies in resource-based theory already have the concept of uncertainty. The studies of Penrose (1959) and Rumelt (1984) are among them. After reviewing these studies, it will be discussed how the concepts of uncertainty included in their studies can be developed.

Penrose's (1959) view

As Penrose (1959) suggests, this type of uncertainty depends on the information that a manager can obtain, and also the resources available within a firm. So the first constraint to the governance decisions of the firm would be found outside a firm.

Uncertainty resulting from the feeling that one has too little information leads to a lack of confidence in the soundness of the judgments that lie behind any given plan of action. Hence one of the most important ways of reducing subjective uncertainty about the future course of events is surely to obtain more information about the factors that might be expected to affect it: and it is reasonable to suppose that one of the most important tasks of a firm in an uncertain world will be that of obtaining as much information as is practicable about the possible course of future events (p. 59).

Also, the second constraint to the governance decisions of the firm would be found within a firm.

The overcoming of uncertainty has its cost, which could conceivably be expressed in terms of the managerial services required for the task. But its restraining effects on expansion depends on the resources available to meet it (p. 64)

The first constraint, the amount of information obtainable outside a firm, determines a degree of environmental uncertainty that is not much different across firms. Of course, since capabilities of managers may be different, some managers would get more confidence than other managers with the same amount of information. The second constraint, the resources available inside a firm, makes more fundamental differences in the degree of uncertainty across firms. As resources and capabilities differ across firms, the degrees of uncertainty that each firm experiences would also differ across firms.

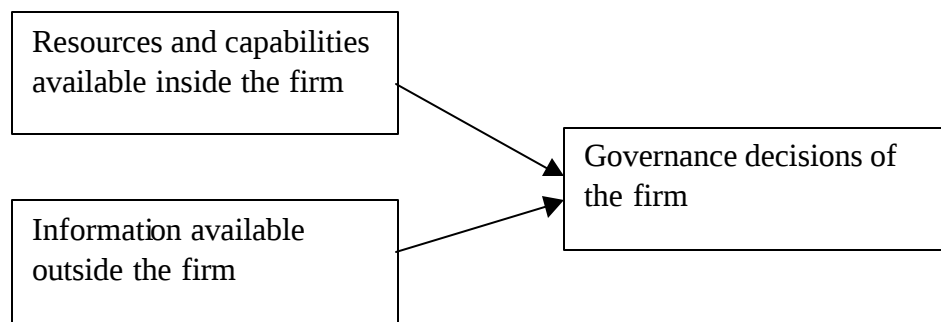


Figure 4.1: Two types of constraints to governance decisions of the firm

Rumelt's (1984) view

Rumelt (1984) emphasizes the concepts of entrepreneurship and resource heterogeneity that are normally omitted in neoclassical economic theory. In addition, uncertainty plays an important role for the existence of resource heterogeneity that are created by entrepreneurs.

Given uncertainty, the *ex post* results of entrepreneurial activities will necessarily be resource heterogeneity. At the most primitive level, firms may simply differ in the relative efficiency with which they extract or process homogeneous goods. However, in the absence of perfect intermediate markets for these goods, firms will have incentives to integrate. Thus is born the *strategic* firm, characterized by a bundle of linked and idiosyncratic resources and resources conversion activities (p. 561, italics in original).

For Rumelt, firm heterogeneity is due to the fact that entrepreneurs cannot perfectly imitate other firms' operations. Since there is irreducible uncertainty on taking a new business or activity, entrepreneurs need to consider the uncertainty on the possible rent generating potential of a new activity.

Which activities should the entrepreneur combine? The general answer is, *Those that will exhibit strongly dependent postentry efficiencies*. Given a bundle of activities with total postentry efficiency determined by the random variable X, adding new activities that involve sunk costs can never be profitable if their efficiencies are uncorrelated with X. Thus new activities are added until the point where further additions would not add sufficiently large expected profits or profit variance to justify the added sunk capital (p. 565, italics in original).

Thus, Rumelt explicitly points out that the benefit of hierarchical governance, the cost of hierarchy, and uncertainty involved in governance decisions, that can be comparable to the logic of transaction cost economics. First, the benefit of hierarchical governance for Rumelt is large expected profit or profit variance to cover the cost of governance, while the corresponding benefit in transaction cost economics is managerial fiat or control that can decrease opportunistic behaviors. In other words, while Rumelt's incentive to expand the boundary of the firm is to appropriate economic rents, the incentive for hierarchical governance in transaction cost economics is to minimize costs by increasing control. Second, the cost of hierarchical governance for Rumelt is added sunk capital for added resources, while the corresponding cost in transaction cost economics is bureaucratic cost that occurs due to complex interrelationships among contracts. Since Rumelt defines the firm as a bundle of unique resources and relationships, the cost of hierarchical governance for a resource is added sunk capital for the resource. In contrast, since transaction cost economics defines the firm as a nexus of contracts, the cost of hierarchical governance for a contract is added complexity for the contract. Third, uncertainty involved in governance decisions for Rumelt is uncertain postentry (or *ex post*) efficiencies that can be, for the worst case, randomly determined. Rumelt explains that *ex post* efficiencies can be randomly determined when 'there is ambiguity as to what the factors of production actually are and as to how they interact (p. 562). If this kind of ambiguity is low, profitability of new activities can be calculated, and governance decisions will be made based on the calculation. In contrast, uncertainty

involved in governance decisions in transaction cost economics is threat of opportunism that can be controlled in hierarchical governance. Therefore, here is the difference: Uncertainty in the context of transaction cost economics can be decreased in hierarchical governance, but it may increase bureaucratic cost. Uncertainty in the context of resource-based theory cannot be decreased even in hierarchical governance when *ex post* efficiency is randomly determined. The comparison between Rumelt's view and transaction cost economics regarding the benefit and cost of hierarchical governance and uncertainty involved in governance decisions is summarized in Table 4.2.

	Transaction cost economics	Rumelt's view
Benefit of governance	Managerial fiat to decrease opportunistic behavior	Expected profit to cover cost of governance
Cost of governance	Bureaucratic cost created by complex relationships among contracts	Added sunk capital for added resources
Uncertainty	Threat of opportunism that can be decreased in hierarchical governance	Uncertain <i>ex post</i> efficiency of production that can remain in hierarchical governance

Table 4.2: Rumelt's view and transaction cost economics

Together with Penrose's view, Rumelt's (1984) view gives important implications to the meaning of uncertainty in resource-based theory. First, uncertainty on rent generating potential is suggested. In particular, this type of uncertainty is not only about reducing costs, but also about rent appropriation by entrepreneurs.

Note that this logic is opposite to that underlying diversification. Here the entrepreneur's objective is not to reduce risk, as the expected level of efficiency provides an inadequate return. Rather, the entrepreneur is attempting to concentrate only on those activities that are closely connected with success or failure in the market. Adding extraneous activities not only produces an unnecessary increase in the costs of failure but also may obscure important information regarding the success of the main endeavor (p. 567).

Second, it can be suggested that uncertainty may be found both outside and within the firm. Uncertainty is found outside the firm because firms do not enough information about the causal relationships among the factors in another firm. Therefore, a firm cannot perfectly imitate and recreate another firm's production function that may be profitable.

But suppose that there exists an irreducible uncertainty connected with the creation (or production) of a new production function. Then the efficiencies achieved by entrants or major expansion program will vary (p. 562).

When a firm cannot perfectly imitate another firm's production function, one alternative is to acquire the firm to appropriate the economic rent of the firm. However, the acquiring firm may not appropriate the full economic rent that the acquired firm has produced, because there may be negative interactions between the production functions of both firms. Some production factors that are beneficial to the acquired firm may be harmful to the acquiring firm. Some factors that are not used in the acquired firm's production function may have negative effects on profitability in the acquiring firm's

production function. These kinds of negative interactions increase the uncertainty on rent generating potential of the acquiring firm. After all, the acquiring firm has uncertainty within the firm.

Since the resources and capabilities acquisition process is closely related to governance decisions of the firm, this type of uncertainty should be related to governance issues. When resources and capabilities acquisition process decreases rent generating potential of the acquiring firm, an acquisition of target firm's resources and capabilities should be avoided. In fact, post-acquisition process affects acquisition performance (Capron, 1999). If uncertainty exists on the post-acquisition process, less hierarchical governance will be preferred to outright acquisition that would bring poor performance.

This type of uncertainty – uncertainty on the efficiency of the process during which a focal and a target firm's resources and capabilities are integrated – comes from the fact that a firm cannot fully figure out complex cause-effect relationships between resources and performance. Resource-based theory emphasizes this kind of ambiguity as a term of causal ambiguity. However, resource-based theory has used this term only to show why firms are different, and the relationship between causal ambiguity and governance decision has been ignored. Revisiting the concept of causal ambiguity to identify a type of uncertainty in resource-based theory may make this theory more comprehensive.

4.4. Causal ambiguity revisited

4.4.1. The concept of causal ambiguity in general

Causal ambiguity is defined as ‘a basic ambiguity concerning the nature of the causal connections between actions and results’ (Lippman and Rumelt, 1982, p. 418). Lippman and Rumelt (1982) introduce the concept of uncertain imitability to explain firm heterogeneity in performance. In their mathematical model, uncertainty is operationalized as randomness of the outcomes of purposeful investment. One of the precursors of their work is Mancke’s (1974) study that constructs a simulation in which the profitability of firms is random variable. In his model, Mancke (1974) finds that interfirm differences in performance are not due to the differences in market power or scale economies, but due to ‘chance-caused’ differences (p.191). Nelson and Winter (1973) also construct a simulation model in which firms use technology that is randomly selected. While these studies focus on the generation of heterogeneity among existing firms over time, Lippman and Rumelt (1982) are interested in the generation of heterogeneity among firms including potential entrants. Potential entrants seek to produce a new production function, but irreducible uncertainty exists in the process. They use the concept of uncertain imitability to explain uncertainty that potential entrants face. Because of the uncertain imitability, firms can obtain economic rents in spite of free entry.

The assumption of uncertainty in the creation of new cost functions explains the origin of efficiency differences. The fact that the same uncertainty applies to all imitative and entry attempts explains their persistence despite free entry and raises the possibility that entry will cease before industry profits are eliminated (p. 420).

Uncertain imitability comes from either causal ambiguity or property rights in unique resources. Uniqueness, however, cannot be the sole reason for inimitability, because ‘the creation of a unique resource could be repeated and its uniqueness destroyed’ (p. 420). Therefore, uniqueness combined with causal ambiguity creates uncertain imitability.

Some scholars investigate how firms can enhance causal ambiguity to sustain firm heterogeneity in performance. Reed and DeFillippi (1990) suggest that causal ambiguity raises barriers to imitation, thus protects sustainable competitive advantage. Barriers to imitation, however, can be overcome by competitors over time. Therefore, they argue that managers need to reinvest in causally ambiguous capabilities to maintain the barriers.

Reinvestment in ambiguity should be aimed at the competencies on which advantage is based and from which ambiguity is derived. An analogy of how to reinvest in ambiguity comes from research and development expenditure... Investing in the same manner in causally ambiguous competencies, to maintain barriers to imitation, will also produce a future payoff from sustained advantage (p. 98).

To identify causally ambiguous capabilities, they suggest characteristics of tacitness, complexity, and specificity. Tacitness refers to ‘disorganized, informal and relatively inaccessible’ nature of a certain capability (Wagner and Sternberg, 1985, p.

439). Complexity refers to ‘large numbers of technologies, organization routines, and individual- or team-based experience’ (Reed and DeFillippi, 1990, p. 91). Specificity refers to ‘durable investments that are undertaken in support of particular transactions’ (Williamson, 1985, p. 55). Reed and DeFillippi (1990) argue that tacit, complex and specific nature of capabilities is what the firm should invest in to gain strategic advantage.

These studies emphasize causal ambiguity among competitors as a barrier to imitation, but causal ambiguity within a firm is also considered to affect firm performance. If causal relationships are easily understood and packaged to move within a firm, it may be difficult to keep these relationships from leaking out of the firm (Badaracco, 1991). Thus, a paradoxical nature of causal ambiguity is found (King and Zeithmal, 2001). On the one hand, causal ambiguity benefits a firm because it protects a firm’s competitive advantage from imitation. On the other hand, causal ambiguity may impede transfer of valuable resources and capabilities within the firm.

Therefore, causally ambiguous resources increase a type of uncertainty that those resources are not perfectly understood and rent creating potential is not fully exploited. This type of uncertainty can be found within the firm, while behavioral uncertainty is found in the market. In the next section, causal ambiguity as a type of uncertainty is examined.

4.4.2. Causal ambiguity as a type of uncertainty within the firm

Borrowing Lippman and Rumelt's (1982) terms, when the production functions of the acquiring and acquired firms are integrated, a new production function will be created. The issue is, how the new production function can be efficient in the acquiring firm. If the two firms have too different production functions that seem not to be integrated, there will be high level of uncertainty about the rent creating potential of the acquiring firm. Although Reed and DeFillippi (1990) describe that it is an extreme case, they also recognize that causal ambiguity within the firm may exist.

At the extreme, ambiguity may be so great that not even managers within the firm understand the relationship between actions and outcomes... This work is not concerned with conditions of extreme ambiguity. Where ambiguity is so great that managers do not understand intrafirm causal relationships, or factor immobility exists, it may be impossible to utilize competencies for advantage (pp. 90-91).

Empirical studies that examine this 'extreme' case are rare. One of a few empirical studies on causal ambiguity within the firm is King and Zeithaml's (2001) study, where they find different types of causal ambiguity that affect firm performance in different ways. They find that one type of causal ambiguity, linkage ambiguity, adversely affects firm performance, while the other kind of uncertainty, characteristic ambiguity, positively affects firm performance. This result suggests that some types of causal ambiguity within the firm may lead low performance.

Another example may be found in Sorenson's (2003) study that firms with vertically integrated activities gain less benefits from learning-by-doing than firms without vertical integration. This is because "interdependence (among activities) obscures the link between actions and outcomes, hindering the identification of effective routines" (p. 449). Even though Sorenson did not use the term of causal ambiguity, the study suggests that vertical integration may increase causal ambiguity that leads to low performance.

From this logic, this study suggests that causal ambiguity within the firm will affect governance decisions. If integration of production function may decrease rent generating potential, firms will choose less hierarchical governance. In other words, when high level of causal ambiguity within the firm exists, less hierarchical governance will be preferred.

4.5. Transaction cost economics and resources-based theory: A synthesis

4.5.1. Answers for unidentified issues

In the chapter 3, some unidentified issues in transaction cost economics are suggested. After reviewing resource-based theory, it is found that those unidentified issues are discussed at least briefly. Figure 4.2 shows how uncertainty in resource-based theory is related to the issues in transaction cost economics.

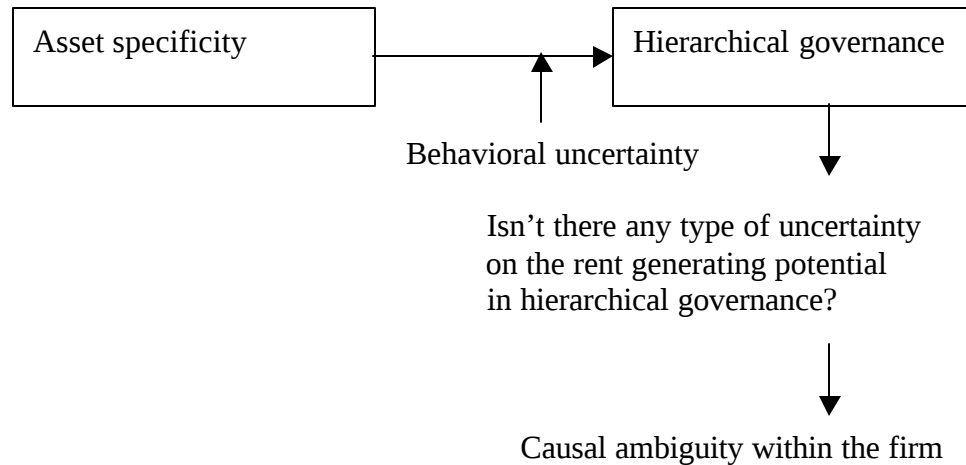


Figure 4.2: Seeking to answers for unidentified issue

The unidentified issue in transaction cost economics, the type of uncertainty that may exist in hierarchical governance, can be expressed by causal ambiguity within the firm. Behavioral uncertainty that cause market failure may be decreased in hierarchical governance by managerial fiat, but another type of uncertainty, which exists only in hierarchical governance, may be increased instead. Therefore, firm boundary decisions that are based only on behavioral uncertainty and the decisions that are based on both behavioral and intra-firm ambiguity will differ. Generally, it is expected that causal ambiguity within the firm will have negative impacts on hierarchical governance.

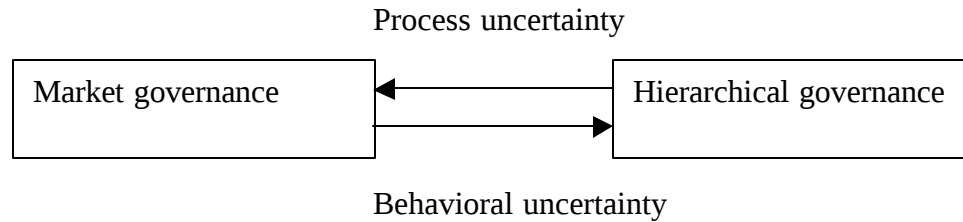


Figure 4.3: Governance decisions under behavioral and process uncertainty

Some scholars suggest post-acquisition transaction cost issues that might look similar to the issue of process uncertainty. Process uncertainty is distinguished from post-acquisition transaction cost issues in the following ways. First, as Hennart (1988) and Hennart and Reddy (1997) note, post-acquisition transaction cost is high when undesired assets should be acquired as a package. Hennart and Reddy (1997) measure ‘indigestibility’ as whether or not target assets are large and undivisionalized.

One potential impediment to acquisitions is when the desired assets are hard to disentangle from undesired ones (Hennart, 1988)... Hence the fact that a partner’s desired assets are linked to its undesired assets, while it makes acquisitions costly, does not cause problems for joint ventures, since the flow of services from the assets counts as a contribution to the joint venture, yet is still available for the parent’s other business. Joint ventures may therefore be preferred when the many other assets owned by the parents re large and not divisionalized (p. 2).

However, process uncertainty does not focus on target firm’s asset size or asset structure only, but both acquiring and target asset characteristics. More importantly, indigestibility problem is related to management cost for undesired assets, implicitly

assuming that rent generating potential would be the same even with those undesired assets. On the other hand, process uncertainty is on the rent generating potential itself.

Second, as Balakrishnan and Koza (1993) assert, information asymmetry between acquiring and acquired firms causes an adverse selection problem that impedes acquisition. Since post-acquisition valuation can be different from pre-acquisition valuation of a target firm, post-acquisition transaction cost can be high.

Acquisition of the complementary assets is desirable to economize on the transaction costs that are associated with market mediated contracts for the supply of intermediate products. When the relevant assets are not homogeneous and information about their quality, performance characteristics, and value is not common knowledge, the costs of redistributing ownership rights over the assets are non-trivial... A joint-venture is primarily a mechanism for getting around this problem. It avoids a terminal transaction that transfer ownership rights and allow piecemeal and continuous reassessment of the individual contributions to the venture (p. 100).

Process uncertainty arises due to asymmetric information, in a broad sense, but it does not focus on target firm's value *per se*, but rent generating potential when an acquiring and a target firm's resources are integrated. Even though a target firm has valuable resources and capabilities, if not well integrated to the acquiring firm's resources and capabilities, the resources may not be fully used to generate economic rent in an acquiring firm.

4.5.2. Conner and Prahalad's (1996) quadrant

Conner and Prahalad (1996) also suggest that transaction cost economics and resource-based theory may be compared for firms' governance decisions. They show a quadrant where the two theories of the firm may predict different governance decisions.

		Resource-based theory Firm provides, on net, the more valuable, opportunism-independent knowledge	
		Yes	No
Opportunism-based theory Probability of opportunistic behavior is:	High	RB-firm (i) OB-firm	RB-firm or market (iv) OB-firm
	Low	RB-firm (ii) OB-market	RB-market (iii) OB-market

From Conner and Prahalad (1996), p. 489

Figure 4.4: Comparison of resource- and opportunism-based predictions

Even though they don't use the concept of uncertainty, they differentiate resource-based predictions from opportunism-based predictions on the basis of knowledge utilization. In the cells of (i) and (iii), the predictions that opportunism-based transaction cost theory and resource-based theory are the same. However, in the cells of (ii) and (iv), the two theories have different predictions. This implies that opportunistic potential based on transaction cost economics is not all that a firm should consider in choosing an organizational mode.

From the perspective of resource-based theory, Conner and Prahalad find two types of effects that governance mode may have on the knowledge. They refer these effects as the “knowledge-substitution” and “flexibility” effects of organizational mode. The first effect, the knowledge-substitution effect, occurs that one party voluntarily acts according to the other party’s judgment rather than in conformity with its own. By doing this, the two parties can avoid costs of knowledge transfer, which is especially high when the knowledge is tacit. Prahalad and Conner use an example that individual Z has superior knowledge to individual Y.

As an autonomous contractor, Y may doubt the value of a particular action suggested by Z, and hence not undertake it, because of Y’s lack of experience with – and consequent lack of personal knowledge about – such a step. Under firm organization, on the other hand, Z simply can tell Y to take the action(thereby substituting Z’s knowledge for corresponding element of Y’s). Y’s anticipation of knowledge-absorption difficulties can cause it to favor a firm, because this mode is the organizational mechanism through which Y allows Z’s judgment to dominate corresponding elements of Y’s own (p. 485).

The second effect, the flexibility effect, occurs when future unanticipated knowledge acquisition and applications may affect the two parties’ roles in duties and responsibilities. The changes of duties and responsibilities of the parties bring contract renegotiations. Under market contracting, this renegotiation costs may be high when newly acquired knowledge have different as well as important impacts to both parties.

Under firm organization, the mechanism is an inherent part of the employment contract itself.

Without engaging in contract renegotiation, Z, as manager, can reformulate previous directions or issue new ones. Under market contracting, in contrast, changes in duties and responsibilities require renegotiating the market contract itself, aside from those changes pre-determined in the original market contract to become operative if certain, specified events occur. As to the latter, it will be difficult, if not possible, for market contracts to provide for unanticipated acquisition of new knowledge, since it is axiomatic that the content of knowledge that may be obtained in the future is unknown at the present. Thus market contracting flexibility as to unforeseen developments or new knowledge is achieved through engaging in a *series* of contracts (p. 487, italics in original).

This argument is very close to that of transaction cost economics in the sense that unanticipated future events may increase the cost of market transactions. In fact, Conner and Prahalad themselves use the term of “knowledge-based transaction costs” (p.478). In this regard, they try to figure out resource-based types of uncertainty that may affect opportunism-independent transaction costs, and ultimately affect governance mode. Thus, Conner and Prahalad’s study and this study share a similar perspective on this point.

On the other hand, this study develops Conner and Prahalad’s model by loosening some assumptions. Conner and Prahalad explicitly assume that one party has superior knowledge and both parties accept it.

The difference in the knowledge that is brought to bear under the two organizational modes, *once anticipated*, impacts the choice of mode itself (p. 484, italics added).

If, for example, Y and Z come to diametrically opposite conclusions as to what needs to be done, market contract negotiation will be difficult and costly. This factor implies that firm organization is more likely to be preferred, all else equal, the greater is the initial difference in the knowledge, culture, etc. of Y and Z (*provided that Y evaluates elements of Z's knowledge as superior to Y's*) (p. 486, italics added).

However, if Y does not accept that Z really has superior knowledge to Y, then Y may not easily give itself in as an employee of Z. Even when Y accepts Z's superiority, if Z's knowledge is so tacit that even Z may not fully transfer the knowledge to Y, Y will not make a firm with Z. Conner and Prahalad recognize this point, too. They admit that the gains from knowledge-substitution will vary, and sometimes knowledge-substitution may be counterproductive or impossible.

Some discernment (such as how to create a new product idea, strategy, or marketing campaign) may be so tacit that important aspects of it cannot be communicated. Even if it wants to, the "manager" may not be able to give sufficient directions to permit an employee to come up with the next breakthrough (p.486).

This is what Reed and DeFillippi (1990) describe as an extreme case where "ambiguity may be so great that not even managers within the firm understand the relationship between actions and outcomes" (p. 90). If we assume out this extreme case and suppose that a manager ("Z" for Conner and Prahalad's term) can handle tacit knowledge, then Conner and Prahalad's expectation about knowledge-substitution effect would be correct. If we accept the case that parties may not be sure about knowledge

superiority of one party, then the expectation would be different. In other words, possible causal ambiguity within the firm may lead both party to make market contracts rather than firm organization.

Another assumption that Conner and Prahalad make is that Y's knowledge is almost ignored and substituted by Z's knowledge.

A primary effect of firm organization – of the authority relationship – is to cause an individual to use the knowledge of another *before* the former fully understand or agrees with it. Conversely, a main effect of market contracting – of an autonomous relationship – is to oblige knowledge to be internalized before the individual agrees to modify its actions on the basis of that knowledge (p. 485, italics in original).

According to Conner and Prahalad, under firm organization, employee's knowledge does not have any importance. Once Y acknowledges that Z has superior knowledge to itself, all Y has to do is to be an employee of Z. Therefore, there can hardly exist any kind of uncertainty within a firm. "Z simply can tell Y to take the action (thereby substituting Z's knowledge for corresponding elements of Y's)" (p. 485).

However, there can be the case that Y has valuable knowledge that Z wants to utilize rather than substitute for. In other words, Z's knowledge may not superior in every element of Y's, but Z and Y may have different but complementary knowledge. Then Z should consider whether Y's knowledge is simply different or still complementary. If Y's knowledge is just different from Z's, there will be low rent generating potential in firm organization. If Y's knowledge is complementary, Z may

utilize Y's knowledge rather than just substitute Z's knowledge for it. So, the fact that Y's knowledge may be valuable can make differences.

A knowledge-based theory suggested by Conner and Prahalad gives an opportunity to test the impacts of resource-based variables on governance mode. In fact, Conner and Prahalad depict a situation that resource- and opportunism-based variables can be compatible to be empirically tested.

For example, will we ever observe a situation in which the probability of opportunistic behavior is low, but the firm nonetheless provides, on net, the more valuable opportunism-independent knowledge?... To show that these two sets of factors can be compatible, we supply a specific example. If Y and Z each stand to gain the same amount from cooperation and each must make the same size idiosyncratic investment in order to make the cooperative work, then opportunistic potential is balanced between the parties... Yet, equal specific investment by Y and Z and equal gain from cooperation does not imply that the factors giving rise to the knowledge-substitution and flexibility effects of firm organization must be absent (p. 489).

Based on this argument and introducing the concept of uncertainty, this study tests the role of uncertainty in transaction cost and resource-based theories of the firm. Again, a type of uncertainty found in transaction cost economics is behavioral uncertainty that arises from possible opportunistic behaviors of transaction partners. A type of uncertainty found in resource-based theory is process uncertainty that arises from causal ambiguity within the firm. This study empirically tests Conner and Prahalad's model by using these types of uncertainty variables.

CHAPTER 5

HYPOTHESES

This study defines two types of uncertainty, behavioral uncertainty as highlighted in transaction cost economics and process uncertainty as highlighted in resource-based theory. The study goes on to describe the different role that these two types of uncertainty have on organizational governance decisions.

5.1. Behavioral uncertainty and governance

The transaction cost economic theories of Williamson (1975, 1985) and Klein, Crawford and Alchian (1978) predict that a high level of behavioral uncertainty, together with the condition of small number, will lead a firm to choose hierarchical governance. As discussed above, this study narrowly defines uncertainty in transaction cost economics

as behavioral uncertainty that should be relevant to opportunistic behavior⁸. This is a base proposition to compare to another type of uncertainty found in resource-based theory.

Hypothesis 1. As behavioral uncertainty increases, a firm will prefer more hierarchical governance.

5.2. Process uncertainty and governance

Integration is the process by which the firm coordinates and deploys its different resources (Grant, 1991). It includes functional activity arrangements, organizational structures, and cultures of combining organizations. Through the integration process, combined resources can generate synergetic performance. On the other hand, not all the combined resources can generate such synergetic performance. Therefore, there exists a type of uncertainty on the process of resource integration.

A number of studies have found that post-acquisition performance is affected by the resource and capability profiles of acquiring and target firms (Anand and Singh, 1997; Capron, 1999; Ahuja and Katila, 2001). While these studies use different terms such as resource reconfiguration (Capron, Dussauge and Mitchell, 1998; Karim and Mitchell, 2000), redeployment (Anand and Singh, 1997) or recombination (Galunic and Rodan,

⁸ For example, measurement uncertainty can be one proxy for the likelihood of opportunism (Rindfleisch and Heide, 1997; Peng and York, 2001), but as discussed in the previous chapters, this study separates measurement uncertainty from behavioral uncertainty. It is assumed that behavioral uncertainty is about appropriability issues rather than assessment issues.

1999), the logic behind each of these arguments is quite similar. Firms differ in their ability to integrate different sources of knowledge. Citing Schumpeter (1934), Galunic and Rodan (1999) suggest that innovation can occur through new combinations of firm resources. In this argument, acquisitions may help acquiring and target firms to reconfigure their resources to achieve Schumpeterian rents⁹. After acquisition, acquirers often use resources from targets to change their resource profiles (Karim and Mitchell, 2000). This redeployment of resources is needed to augment existing activities or to undertake substantial transformation of routines and resources (Capron, 1999).

The technology strategy literature also focuses on resource integration (Iansiti, 1995, 1997; Robbins and Stylianou, 1999; Zahra and Niesen, 2002). For example, Iansiti (1995) proposes that technology integration facilitates technological evolution that is critical for a firm to survive in a radically changing environment. Technology integration process, therefore, can be a source of technological performance.

Although acquiring firms may achieve economic performance through resource redeployments or resource integration, researchers have also found the situations under which acquisitions may not be successful. Acquisitions may suffer from the incompatibility of the acquiring and target firms (Singh and Montgomery, 1987). For example, if an acquirer selects a target firm that possesses technologies that have great potential but don't work well with the acquirer's technology, it can end up with a product that is hard to manufacture or is late getting to market (Iansiti and West, 1997). In

⁹A branch of transaction cost economics also considers integration issues in that integration enhances the communication codes that support idiosyncratic investment (e.g. Arrow, 1974; Monteverde, 1995; Leiblein, Reuer and Dalsace, 2002).

technology-related acquisition, the objective is not obtaining technological potential *per se*, but obtaining technological yield that can be achieved through the process of successful technology integration (Iansiti, 1997). Without an effective integration process, technological potential may not be transferred into technological yield.

For another example, Anand and Singh (1997) find that defense-civilian acquisitions do not perform better than defense-defense acquisitions because defense-civilian acquisitions can redeploy their resources only limitedly. They argue that the value of resources may be eroded in the absence of a suitable context¹⁰, and that a new application of resources may provide economic rents with some uncertainty attached to them. In other words, Anand and Singh (1997) show that there exists uncertainty on the value of resources when the resources are not in a suitable context. They express that redeployment of assets within the firm is ‘a poor strategy’ when an acquirer tries to redeploy its resources by acquiring a target from unrelated businesses (p. 115). They suggest that firms in this situation should use market transaction rather than hierarchical transaction.

In sum, while previous studies have found that the redeployment and integration of both an acquirer and a target can increase post-acquisition performance, there still exists uncertainty within a firm in the process of such redeployment and integration. Faced with such type of process uncertainty that may incur post-acquisition inefficiency, firms may choose less hierarchical governance to avoid such type of uncertainty.

¹⁰ The ‘context’ here may mean organizational compatibility, which includes appropriate organizational conditions that enhance absorptive capacity (Cohen and Levintal, 1990) within a firm.

Hypothesis 2. As process uncertainty increases, a firm will prefer less hierarchical governance.

5.3. Interaction between behavioral uncertainty and process uncertainty

The prior hypotheses implicitly assumed that behavioral uncertainty and process uncertainty are uniquely determined and independently affect the choice of governance form. Process uncertainty is assumed to affect governance by affecting overall rent generating potential. Behavioral uncertainty is assumed to affect a partner's propensity to engage in opportunistic behavior. Behavioral uncertainty is about *who* will own the economics rent from asset specific investment, process uncertainty is about the magnitude of the overall economics rent. This difference comes from the fact that the two types of uncertainty are based on different theories of the firm, the theories that have different emphases about the roles of uncertainty regarding the firm's governance choice.

However, the fact that uncertainty plays different roles in these two theories does not necessarily mean that the two types of uncertainty are independent from each other. First, as this study implicitly assumes, variables found in resource-based theory may be opportunism-independent (e.g. Conner, 1991), so there may be no interactions between

the types of uncertainty. Second, even seemingly opportunism-independent factors may be affected by opportunism in some ways (e.g. Foss, 1996), so there may be positive or negative interactions between the types of uncertainty.

The knowledge-based view of the firm suggests that the existence of the firm can be explained without the assumption of opportunism (Connor, 1991; Kogut and Zander, 1992; Grant, 1996). According to this view, the firm exists because the cost of knowledge transfer and coordination is lower within the firm than in the market. Teece (1977) is probably the first scholar who raised the issue of the cost of knowledge transfer. In his study on the technology transfer by multinational firms, Teece (1977) finds several factors, such as transferee's experience and the maturity of knowledge, affect the cost of knowledge transfer. His finding is important because he empirically shows that knowledge transfer is not costless. This idea about the cost differences in knowledge transfer is used to explain the existence of the firm. Conner (1991) argues that the firm exists because the firm has advantages over market contracts in the efficiency of knowledge transplantation.

The resource-based view thus implies a theory of the firm's existence that turns on advantages (over the market contracts) in *inter-component knowledge transplantation* and in the creation-redeployment of specific assets. The resource-based view's implicit theory of firm scope (again relative to market contracts) also turns on advantages in creation-redeployments of specific assets, with the magnitude of these advantages depending on the strength of firm-level linkages (p. 141, italics added).

Kogut and Zander (1992) also suggest that knowledge transfer within a firm is more efficient than knowledge transfer across firms, especially when the knowledge is implicit, and it results in the existence of the firm. In addition, they argue that opportunism is not a necessary condition for the existence of the firm.

Opportunism is not a necessary condition to explain why technology is transferred within a firm instead of the market. Rather, the issue becomes why and when are the costs of transfer of technology lower inside the firm than alternatives in the market, independent of contractual hazards... The decision which capabilities to maintain and develop is influenced by the current knowledge of the firm and the expectation of the economic gain from exploring the opportunities in new technologies and organizing principles into future market development. (p. 394).

From these arguments, behavioral uncertainty based on opportunism may not interrelated with process uncertainty.

Hypothesis 3-1. The level of behavioral uncertainty (process technology) will not significantly affect the relationship between process uncertainty (behavioral uncertainty) and organizational governance form.

On the contrary, several scholars support for the second hypothesis that opportunism should interact with other variables that affects the existence of the firm. Williamson (1999) argues that opportunism cannot be assumed out as knowledge-based

view contends. Williamson (1999) describes the world of no opportunism as ‘utopian fantasies’ where only a peer group or ideal merit assignment will exist.

My main response to this argument is that zeroing out opportunism has different and more pervasive organizational consequences than Conner and Prahalad (1996) describe. The general effect of presuming the absence of opportunism is that we enter the world of what Frank and Fritzie Manuel describe as ‘utopian fantasies’ (1979, p. 1)... the ideal forms of organization that that will be observed under zero opportunism will take the form of a peer group (if every member has the same ability) or ideal merit assignment (if abilities differ) (p. 1099).

Foss (1996) also points out that knowledge-based perspective gives not sufficient but only necessary conditions for the existence of the firm. For example, Foss (1996) suggests that even when much knowledge is shared within a regional agglomeration such as Silicon Valley, firm boundaries are still determined on contractual basis. Also, he raises a question that ‘tacit knowledge may tend to be more proprietary and therefore at greater risk of expropriation by contractual partners’ (1999, p.740). Choate (1997) also suggests that tangible assets might be more asset-specific to the purposes of the firm, even though asset tangibility is not a perfect proxy for asset specificity.

Mahoney (2001) argues that routines and culture would develop within the firm not *in the absence of opportunism*, but *precisely because opportunism exists*. He insists that in the absence of opportunism, recurrent market contracts could achieve the efficiency of

internal organization within the firm. The superior knowledge transfer within the firm is because of ‘superior attenuation of opportunism relative to recurrent contracting’ (p. 654).

From these assertions, even the uncertainty on the efficiency of knowledge transfer and integration, which is seemingly independent of opportunism, may have some kinds of interactions with opportunism. In other words, even though process uncertainty and behavioral uncertainty have been constructed from different theoretical bases, there may be some kinds of interactions.

Hypothesis 3-2. The level of behavioral uncertainty (process technology) will significantly affect the relationship between process uncertainty (behavioral uncertainty) and organizational governance form.

CHAPTER 6

METHODOLOGY

6.1. Sample and data

The biotechnology industry provides an ideal context to study the role of behavioral and process uncertainty on governance because of at least two reasons. First, the industry has been driven by a number of innovative activities that are critical for this study. Since this study requires patent activities to operationalize the characteristics of firms' capabilities, abundant patent data were needed. Second, many biotechnology firms rely on large pharmaceutical or chemical firms to fund their development, commercialization, and distribution activities, so there are many types of transactions in this industry. This study needed sufficient number of different types of transactions, in terms of whether the transactions involve technological contents and whether the transactions involve equity investments, to examine the relationship between those types of transactions. Therefore, the biotechnology industry was suited for this study.

In addition, this study used data from a single industry because the characteristics of transactions in a single industry can be comparable. For example, Oxley, (1999) and

Gulati and Singh (1998) show that industries may have different levels of appropriation regime. As a result, firms in some industries may prefer more equity participation than firms in other industries. Moreover, firms may use patents more intensively in some industries than in other industries because the effect of patent protection may be different across industries (Mansfield, 1986; 1985). Therefore, patent data may not be a suitable source to examine process uncertainty in other contexts, such as low-tech industries. A single industry study may decrease this contextual variance.

The data used in this study involving biotechnology firms were obtained from the North Carolina Biotechnology *Actions* database, which contains information on over 13,000 transactions and other types of events (IPOs, facility establishments, etc.) among biotechnology firms during 1982-1996¹¹. For patent data, *Micropatent* 1979 – 1996 patent abstract CDs were used.

This study adopted a unique way to measure behavioral uncertainty. While other studies used cross-sectional data to see the relationship between behavioral uncertainty and governance choices which are determined at the same time (e.g. Gatignon and Anderson, 1988; Meyer, 2001), this study used longitudinal data to see the effect of previous transaction's characteristics on the following transaction's governance choices. The reason that this study adopted this method is to control the effect of past experience, which may be critical for governance choices (Gulati, 1995). In other words, the governance of a transaction may be affected by the characteristics of previous transactions. Transaction cost economics has been criticized that the theory considers

¹¹ This period was chosen because they were obtainable at the time this study was written.

every transaction independent and ignores possible relationships between transactions (Ring and Van de Ven, 1992; Zajac and Olsen, 1993). In some sense, therefore, this study used ‘adjusted’ measure of asset specificity that includes the effect of past experience.

By adopting this way to measure behavioral uncertainty, the sample size was greatly reduced from 13,000 to 5,200, because only firms that have multiple transactions can remain in the sample. The sample needed to be reduced further, however, because many transactions had an equity transaction as the first one, and non-equity transactions as subsequent ones. Once firms had equity transactions, the following non-equity transactions have nothing to do with governance choices, unless the firms increase or decrease equity investments to the partner. But this study did not consider the change of governance as a dependent variable, so this study deleted the cases that have equity transactions as previous experiences (Table 6.1). Some studies found that governance structure of the early transaction affects the nature of later transactions (Hayward, 2002; Harzing, 2002; Gulati, 1995). Therefore, the governance structure of the previous transaction should be controlled. Through this process, all the remaining transactions had a non-equity transaction as the first transaction, which were 798 transactions.

Previous transaction	Following transaction	Decision
Non-equity	Non-equity	Selected as non-equity transaction
Non-equity	Equity	Selected as equity transaction
Equity	Non-equity	Not selected
Equity	Equity	Not selected

Table 6.1: Sampling scheme of this study

Although there are advantages in using longitudinal data as addressed above, there can be some disadvantages to dramatically reduce the sample. One of them is the sample selection bias. This study compares the characteristics of the original database and of the sample in two ways (Table 6.2 and Table 6.3). First, individual firms' attributes, such as sales, number of employees and profit/sales are compared¹². Second, the characteristics of transactions and events, categorized as licensing agreements, research agreements, manufacturing agreements, etc., are compared. The original database includes non-transaction events, such as private placements, new facility establishments, and patents granted, and they are not included in this study.

¹² COMPUSTAT data was used to so this.

Characteristics of records	Original database	Sample
Combined or unspecified	1,979 (14.4%)	224 (28.2%)
Investment of cash, stock, etc	3,050 (23.0%)	215 (26.9%)
Licensing agreement	3,050 (22.2%)	150 (18.8%)
Research agreement	1,029 (7.5%)	89 (11.1%)
Marketing agreement	708 (5.2%)	79 (9.9%)
Joint clinical trial	518 (3.8%)	22 (2.8%)
Production agreement	1031 (7.5%)	19 (2.4%)
Private placement, offering, etc.	1,314 (9.6%)	0 (0%)
Patent granted	542 (3.9%)	0 (0%)
New facility establishment	415 (3.0%)	0 (0%)
Total	13,740 (100.1%)	798 (100.1%)

Table 6.2: A comparison between original database and the sample

Characteristics of firms	Non-selected firms (N=188)	Sample firms (N=135)
Average sales	\$214.5 million	\$832.3 million***
Average number of employees	1,048	4,606***
Average profit	\$26.6 million	\$103.7 million**
Average number of transactions	9.6	32.37***

* $p < 0.1$

** $p < 0.05$

*** $p < 0.01$

Table 6.3: A comparison between the sample and non-selected firms¹³

¹³T-test was conducted to see if the sample and non-selected firms are different. Firms in SIC 283 (Drugs) were drawn for this test from the database. As a result, firms from the sample group had greater sales, more employees, higher profits, and more transactions than firms in the non-selected group. This implies that the more transactions a firm experiences, the bigger the size, the more likely the firm is to be selected in the sample. However, the profitability per employee was not significantly different between the groups.

Therefore, the final sample includes 798 transactions, or 399 ‘coupled’ transactions between the same partners. Among them, 137 transactions had an equity transaction and 262 transactions had a non-equity transaction as the subsequent transaction. These non-equity transactions included research arrangements, license agreements, co-marketing, etc.

After finalizing the sample, patent data was collected for the firms participating the transactions. From *Micropatent* database, patents and citation data were drawn for the participating firms. The number of patents and citations were counted during 7 years before the second transaction is made. This study assumes that patent citations that are older than 7 years are not strategically important (e.g. Miller, 2000). The number of patents ranged from 0 to 4,134, and the number of patent citations ranged from 0 to 33,213.

While some scholars have been critical of the use of patent data because the use of patents varies across industries and the number of patents may not represent a firm’s innovation abilities (Levin et al., 1987). This study avoids the possible problems for the following reasons. First, a single industry analysis allows this study to control variances across industries. So, the variable proclivity to patent across industries does not matter. Second, biotechnology firms have generally used patents to protect their intellectual property, so the patent data in this industry can be used as an index for firms’ capabilities (Lee, Lee and Pennings, 2001). Therefore, in the context of the biotechnology industry, patent data can represent a firm’s technological capability. In addition, as a requirement of the patent application process, an inventor must submit a list of citations to all relevant

patents acknowledging the existing inventions that are nearest in technical content to the proposed invention. Patent citations, therefore, show how close any two patents are in terms of technological similarity, which is critical for this study.

6.2. Model

The binary logit methodology has been used to test the effects of the independent variables on the likelihood of adopting an equity transaction ¹⁴. The specification of the model was as follows:

$$\log [P(M_i = 1) / (1 - P(M_i = 1))] = A_0 + B_i(X_i)$$

Where $P(M_i = 1)$ is the probability that alliance transaction i is equity based and X_i is the vector of independent variables.

6.3. Measures

Dependent variable

The dependent variable of this study is the mode of governance. Since the existence of equity can be an important component for hierarchical governance (Hennart, 1988; Pisano, 1989), this study determined mode of governance by the existence of equity. Equity-based governance was identified by the terms of equity investments, share

¹⁴ There is another model of binary choice model, the probit model, but the difference between the two methodologies is not much except that the logit has slightly fatter tails (Pindyck and Rubinfeld, 1998). When this study tested using the probit model, the result was the same.

purchases, and so on¹⁵. Non-equity based governance was identified by the terms of only contracts and agreements without the terms of equity¹⁶. This study coded “1” if a transaction was equity based (more hierarchical governance) and “0” if it was not (less hierarchical governance).

Variable	Definition	Prediction
<u>Dependent</u> Governance	Dummy variable (1 = equity governance, 0 = non-equity governance)	Dependent variable
<u>Independent</u> Behavioral uncertainty	Dummy variable (1 = presence of technological component in the transaction, 0 otherwise)	+ (H1)
Process uncertainty	Ratio of common patent citations over total citations between partners	- (H2)
Interaction	Behavioral * Process uncertainty	Not sig. (H3-1) Significant (H3-2)
<u>Control</u> Technological size	The sum of the number of patents of partners	No prediction
Experience	The number of transactions between partners during 1982-1996	No prediction
Nationality	Dummy variable (1 = partners are from different countries, 0 = partners are in the same country)	No prediction

Table 6.4: Variable descriptions and descriptive statistics

¹⁵ For example, *Actions* recoded “Ophidian Pharmaceuticals and Eli Lilly and Co. announce that they will jointly develop a new type of pharmaceutical for the treatment of gastrointestinal infections. Under the agreement, Ophidian could receive up to \$12.4 million in *equity* investments, milestone and other precommercial payments, and will manufacture the compound for Lilly. Lilly will conduct clinical testing, register and market the drug worldwide” (italics added).

¹⁶ For example, *Actions* recoded “Celltech to *supply* Ortho w/ bulk anti-D MABs. Ortho to market the MABs w/w in its new blood typing reagent, Anti-D Bioclone, for use in hospitals/transfusion ctrs” (italics added).

Independent variables

Table 6.4 summarizes the variables included in the analysis. This study measured behavioral uncertainty by asset specificity that partner firms have had over time. Behavioral uncertainty arises when a firm has highly appropriable assets that may be opportunistically used by transaction partners (Subramani and Venkatraman, 2003; Coff, 2003; Oxley, 1999; Klein, Crawford and Alchian, 1978). Technology has been considered as a highly appropriable asset and technological leakage has been of interest in designing governance structure (Gulati and Singh, 1998; Robertson and Gatignon, 1998; Monteverde, 1995; Pisano, 1990; Teece, 1986). For example, Pisano (1990) observed that high transaction costs were measured as the presence of technological component in the alliance.

The *Actions* database describes summaries of transactions so that researchers can figure out what types of transactions they are. This study follows Gulati and Singh (1998) in measuring asset specificity in terms of whether a transaction contains technological content. Transactions that include such expressions as joint research, joint development and research collaboration were regarded as high level of asset specificity (coded as 1). Transactions that include only licensing, marketing, production, and supply agreements were considered as low level of asset specificity (coded as 0). Table 6.5 shows some examples of this categorization.

Technological content exists	Technological contents does not exist
- “Abbott to fund 3 yr. joint research program to <i>develop</i> novel nucleic acid probe tests based on BioTechnica's ligase chain reaction amplification technol.” - “Allergan and Ligand Pharmaceuticals collaborate in the <i>development</i> of retinoid-based compounds for dermatological and ophthalmological applications.” - “Oncogene Science and Aston Molecules sign an <i>R&D agreement</i> covering Oncogene's drugs for the treatment of HIV and chronic myelogenous leukemia.” (italics added)	- “Chiron signs a marketing agreement with Hitachi Chemical whereby Hitachi will <i>manufacture and market</i> Chiron's rDNA EGF in Japan as an antiulcerative product.” - “Multi-million dollar <i>licensing agreement</i> whereby Lilly uses Cytogen's linking technology to attach vinca alkaloids with Lilly's RX and MABs.” - “The pharmaceutical division of Miles Inc. signs a three-year, \$35 million <i>supply contract</i> with North American Biologicals. Under the agreement, North American Biologicals will supply Miles with source plasma and certain hyperimmune plasmas through 1996 with provisions for an extension until 2000.” (italics added)

Table 6.5: Examples of records for technological content

The second independent variable, process uncertainty, was measured by the degree of technological overlap between firms (Mowery, Oxley and Silverman, 1998). When two firms share similar technological capabilities, they will experience fewer difficulties in integrating their capabilities to explore new technology (Cohen & Levinthal, 1990). The similarity between transaction partners is often measured by ‘shared capabilities’ that may affect transaction partner selection and transaction scope (Mowery, Oxley and Silverman, 1998). The measure of technological overlap used in this study counted the number of common patent citations that transacting firms were sharing and divided it by

total number of citations that participating firms have during 7 years prior to the transaction date (e.g. Miller, 2000). As discussed above, patent citations show a list of references to previous patents, known as “prior art”. Sharing many patent citations means that two patents come from similar prior art or the same technological branch. On the firm level, high common citation rates means that two firms have similar technologies that can be understandable easily.

Control variable

This study controls for the size and importance of transactions in technological terms. The *size* and importance of transaction was measured by the number of patents that are involved in the transaction. This control variable was selected because the level of other size measurements such as sales or number of employees may not properly characterize the transactions. This study considers that a firm that has many patents is “technologically big” even though the number of employees or the size of sales is not much big. For an extreme case, a firm that does not have any patent may not have a good technological capability in the context of biotechnology industry.

This study also controls *experience* of partners by counting the number of transactions during the target period (1982-1996). Transaction experience may be important in governance choices because partners are likely to have more asset specific investments as they have more transaction experiences.

Nationality describes whether partners have the same nationality or not. Different nationality may mean different legal system, culture, property right protection, etc, so

may increase the chance of hierarchical governance choices (Gulati and Singh, 1998; Oxley, 1999). For example, Oxley (1997) shows that global operations are associated with more hierarchical governance mode than domestic operations, suggesting that the cost of monitoring activities would be high in international alliances.

CHAPTER 7

RESULTS

Table 7.1 presents descriptive statistics and correlations for all variables. The sample includes 798 transactions, or 399 ‘coupled’ transactions¹⁷, among which 34% were equity-related transactions. 68% of the transactions were coded as high asset specificity, which means the transactions contained technological factors such as technology development, research collaboration, etc. The average number of patents that the partners have had during seven years prior to the transaction was 480. Minimum number of patents was zero and maximum number was 4,328¹⁸. The average number of common citations for each transaction was 2.71 and the average number of total citations for each transaction was 2,923, so average overlap ratio was about 0.001

¹⁷ ‘Coupled’ because two transactions have the same partners. Only the governance choices of the following transactions are considered.

¹⁸ Due to this wide range of patents, standard deviations of the number of patents (size) and the number of common citations (process uncertainty) are also high. This is not unusual in the studies that use patent data or patent citation data (e.g. Lee, Lee and Pennings, 2001; Frost, 2001).

Variable	Frequency		Means	s.d.	1	2	3	4	5	6
	0	1								
1. Gov	262	137	0.34	0.48						
2. Size		n/a	480	717	1.0					
3. Exp		n/a	2.41	0.86	0.160	1.0				
4. Natl	218	181	0.45	0.50	-0.040	0.013	1.0			
5. Beha	127	272	0.68	0.47	0.031	0.126	-0.097	1.0		
6. Pro		n/a	0.001	0.003	-0.055	-0.015	0.058	0.007	1.0	

Gov: Governance
Size: Technological size
Exp: Experience
Natl: Nationality
Beha: Behavioral uncertainty
Pro: Process uncertainty

Table 7.1: Descriptive statistics and correlations

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Constant	-1.713** (0.451)	- 2.061*** (0.487)	- 1.794 *** (0.455)	- 2.156 *** (0.492)	- 2.189*** (0.495)
Size	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Exp	0.559*** (0.134)	0.528*** (0.135)	0.558*** (0.134)	0.529*** (0.134)	0.524*** (0.135)
Nation	- 0.253 (0.217)	- 0.211 (0.219)	- 0.229 (0.219)	- 0.183 (0.221)	- 0.191 (0.222)
Behavioral Uncertainty		0.512** (0.246)		0.527** (0.248)	0.593** (0.259)
Process Uncertainty			- 66.091* (33.742)	- 68.150** (34.009)	- 117.823* (67.600)
Behavioral x Process					-72.722 (78.520)
N	399	399	399	399	399
Log- Likelihood	- 244.966	- 242.731	- 242.897	- 240.566	- 240.090
-2{LL-LL(0)}	23.371***	27.841***	27.509***	32.172***	33.124***
Increments (from 1)		4.470**	4.138**	8.801**	9.753**
(from 2)				4.331**	5.283*
(from 3)				4.663**	5.615*
(from 4)					1.048
Correctly Classified	69.42 %	69.92%	69.42%	70.43%	70.18%

Standard errors are in parentheses

* p < 0.1

** p < 0.05

*** p < 0.01

Table 7.2: Results of Binary Logit Analysis

Table 7.2 shows the binary logit estimates. The first column reports the base model including only constant and control variables. P value of this model was 0.0000338 (23.371 LR statistics with 3 degree of freedom), which is significant at $\alpha = 0.01$. All other models report that they are significant at $\alpha = 0.01$ ¹⁹.

Compared to the models that included only a transaction cost variable or a resources-based variable (Model 2 and 3), the model including both variables (Model 4) showed the highest significance (the chi-squared test statistics is 32.172 with 5 degrees of freedom, which is significant at $\alpha = 0.01$ level). Thus, this study suggests that transaction cost and resource-based variables jointly determine governance choice²⁰.

Hypothesis 1 was supported in Model 2. Transactions involving high level of asset specificity are more likely to be equity based. Thus, high level of behavioral uncertainty was positively related to hierarchical governance. This is in accordance with what transaction cost economics predicts, even after controlling the effect of previous transaction experiences.

Hypothesis 2 was also supported in Model 3. Transactions between partners who share patent citations, that means low level of process uncertainty, are more likely to be equity based. Therefore, this study shows that process uncertainty does have significant effects on governance choices of the firm, and that the high level of process uncertainty leads to less hierarchical governance as expected.

¹⁹McFadden R^2 represents the amount of total variation explained, and in each model it is quite low (0.046-0.064). However, some studies report low McFadden R^2 as well as high log-likelihood ratio (e.g. Angel, 2002).

²⁰ Log-likelihood ratio jumped from 27.509 to 32.172, so adding transaction and resource-based variables improved the model (significant at 0.05)

Hypotheses 3-1 and 3-2 were competing hypotheses, and 3-1 was supported in model 5. Behavioral and process uncertainty did not show a significant correlation (Table 13), and the interaction between them showed no significant effect on governance choice.

In addition, table 14 presents the classification tables corresponding to each of the models in table 14. All five models perform better than a random proportional chance model. The classification accuracy for a random model is $p^2 + (1 - p)^2$, where p is the probability of an event's having occurred that is 0.343 (137 / 399). So, the classification accuracy for a random model was $0.343^2 + (1 - 0.343)^2 = 0.549$. All the five models showed that their percentages of correctly classified cases are above 0.69, so they were all superior to the random model²¹.

²¹ This study does not show a big jump when independent variables are added in the model as much as log-likelihood ratio shows. However, other studies that used this 'correctly classified' also reported small variances (e.g. Chen and Hennart, 2001; Chang and Rosenzweig, 2001; Gulati, 1995).

CHAPTER 8

DISCUSSION

8.1. Summary of literature review

Through this study, various dimensions of uncertainty have been reviewed and their impacts on government decisions of the firm have been examined. Especially, this study compared two theories of the firm in terms of the concept of uncertainty. Some scholars have contributed to strategic management to develop the concept of uncertainty, so this study started with reviewing the selective scholars to review the brief history of the study of uncertainty.

Knight (1933) is one of the earliest scholars who defined and developed the concept of uncertainty. Knight's distinguished view on uncertainty is that he sees uncertainty as a source of opportunities rather than a source of threats. He argues this based on the idea that uncertainty cannot be calculated or predicted from existing knowledge or experience.

His argument is closely related to the principles of microeconomics, because no one can get more profit than others in the perfect market situation. Perfect information is one of the key conditions of perfect market. Only when there is a change in the market and

nobody can calculate or predict the change there can be profit. In other words, under the condition of imperfect competition, through uncertainty, profit can arise. Knight suggests an important condition that can create firm heterogeneity in terms of profit.

Then who can make use of the uncertainty to gain profit? Penrose (1959) answers to the question that it is an entrepreneur who is confident in her/himself and able to cope with uncertainty. The confidence comes from capabilities of planning, collecting information, and executing plans. In other words, Penrose suggests that more able entrepreneurs may decrease the level of uncertainty.

Like Knight, Penrose focuses on imperfect information as a condition for firm heterogeneity. However, Penrose further suggests that the amount of information will vary across firms because firms are assumed to have heterogeneous resources and capabilities. Having different capabilities, the level of confidence to cope with uncertainty should be different. For Penrose, this is why firms have different growth paths.

Penrose's view on uncertainty raises new issues. Penrose describes uncertainty as a determinant of the growth of the firm, so the relationship between uncertainty and governance is addressed. Even though Penrose does not directly focus on governance issues, she addresses the concept using the term of the growth of the firm. Also, Penrose points out that the level of uncertainty is different across firms because firms have different resources and capabilities. In other words, she argues that there is a relationship

between firm resources and the level of uncertainty. The two issues, the relationship between uncertainty and governance and the relationship between uncertainty and resources are the starting point of this study.

Thomson (1967) further examines the relationship between uncertainty and governance. Especially, Thomson argues that vertical integration is a major way to reduce or eliminate uncertainty. Thomson distinguishes closed-systems from open systems in that closed-systems have more explicit relations between causes and effects than open systems do. In closed systems, managers can reliably predict all of the variables and relations, so using Knight's term, there is no uncertainty in closed-systems. On the other hand, in open systems, there is uncertainty that managers cannot fully understand or cope with. This uncertainty forces managers to deal with both internal control issues and external uncertainty problems. To internalize contingencies into closed-systems, managers can pursue vertical integration to control unexpected events in advance and seek only internal control issues.

While Penrose focuses on an entrepreneur's resources and capability to cope with uncertainty, Thomson focuses on governance strategy, such as vertical integration, to cope with uncertainty. So, they seem to have different starting points. Penrose starts with firm heterogeneity, while Thomson starts with governance heterogeneity. Penrose considers firm resources as possible determinants of the level of uncertainty, while Thomson considers control mechanisms as possible determinants of the level of uncertainty.

These differences between Penrose and Thomson's view seem to represent the differences between the resource-based and transaction cost theories of the firm. To see the arguments of the theories of the firm, it would be good to review more related studies that are relevant to the concept of uncertainty.

Uncertainty has been of interest of scholars in various fields. This study finds at least three fields of studies, organizational sociology, economics and organizational economics, which have developed various concepts of uncertainty. First, scholars in organizational sociology have developed multiple perceptual views of uncertainty. Scholars in this field regard uncertainty as personal interpretation about external environments. Therefore, not objective but perceived uncertainty is of interest. The strength of this approach is that multidimensional characteristics of uncertainty can be expressed well. However, there have been debates on internal reliability problems and other construct-related problems because this approach should rely on questionnaires and interviews that may have different constructs from researchers to researchers. The implication of this approach to strategic management is that multidimensionality of uncertainty has been emphasized.

Second, scholars in economics have developed the relationship between uncertainty and economic actors' decision-making problem. Arrow (1974) describes uncertainty that no one has complete knowledge of the world. When an economic actor needs to make a decision, the actor needs to assign proper probabilities to the states of nature. But there are some obstacles for the actor to do so. For example, insurance company may not assign proper probabilities to the groups of insured. First, there can be so many

contingencies that the actor cannot specify all the states of nature. Second, it can be difficult to distinguish exogenous circumstances and individual choice, because there is always the risk of moral hazard. Third, there can be information asymmetry between the insurance company and the insured, so adverse selection problem may exist. Whether it is about the uncertainty about the state of nature or about another actor's behavior, those types of uncertainty make an economic actors' decision-making difficult. Uncertainty on other economic actors' behaviors has an important implication on the studies of uncertainty in strategic management.

Third, scholars in organizational economics have developed more detailed concepts on uncertainty, governance, and the cost of governance. Even though Coase (1937) does not directly focus on uncertainty itself, he recognizes that the cost of firm governance would be lower than the cost of market governance when all the contingencies cannot be easily specified. In this case, a director may control production within the firm to save the cost of market transactions. Klein, Crawford and Alchian (1978) introduce the concept of 'appropriable quasi rents' to explain the incentive to make vertical integration. Appropriable quasi rents are the increased value of specialized assets over the value it would have had in an open market. They argue that when specialized assets and appropriable quasi rents are present, post-contractual opportunistic behavior of the partner may be expected, and it would be a motivation of vertical integration.

Selective studies of Knight, Penrose and Thomson and selective disciplines of organizational sociology, economics and organizational economics have provided theoretical background for the study of uncertainty in strategic management. From these

definitions and concepts developed in previous studies, scholars in strategic management have articulated the various dimensions of uncertainty incorporated in the theories of the firm. This study recognizes at least three types of uncertainty in the literature of strategic management.

The first type of uncertainty is uncertainty on rent *appropriation*. The source of this type of uncertainty is possible opportunism of economic actors, especially partners. The background of this type of uncertainty can be found in economics (e.g. Arrow, 1974; Koopmans, 1959) and organizational economics (Coase, 1937; Klein, Crawford and Alchian, 1978). The main concern is who appropriate economic rents that are created from market transactions. Scholars in transaction cost theory of the firm argues that hierarchical governance can decrease the threats of post contractual opportunism about the appropriation of the rents. Vertical integration can allow managers to internalize external variances, including opportunistic behaviors of partners, and to control them (Thomson, 1967).

The second type of uncertainty is uncertainty on rent *valuation*. The source of this type is uncertain future value of transactions. Uncertainty on rent valuation is different from uncertainty on rent appropriation in that uncertainty on rent appropriation assumes the value of the rents as positive. If there will be no rents, it would not matter who appropriate the zero rents. Therefore, whether there can be any positive rents should be considered, and the consideration should affect governance decisions of the firm. The background of this type of uncertainty can be found in the studies on irreversibility in economics (e.g. Pindyck, 1991), but here the literature this type of uncertainty has not

been reviewed. The reason is that this study distinguishes between changeable governance and stable governance, and just focuses on the relationship between uncertainty and stable governance only. This does not mean that changeable governance is not important, but the scope of this study is limited.

The third type of uncertainty is uncertainty on rent *creation*. Uncertainty on rent creation comes from possible resource and capability mismatch within the firm. Penrose (1959) argues that the direction of the growth of the firm can be determined by the existing resource profile that a firm possesses because the firm will add external resources to fully make use of existing resources. Penrose does not find any uncertainty in this process, but she does mention about confidence of an entrepreneur to cope with external uncertainty. If an entrepreneur does not have enough confidence on the rent generating potential of newly added resource, the entrepreneur may not want to add the resources within the firm. This is the type of uncertainty that Penrose provides in her work.

This type of uncertainty is different from uncertainty on rent appropriation in that uncertainty on rent creation does not come from opportunism. Uncertainty on rent creation arises because of the lack of information on the resource integration process. This lack of knowledge is not behavioral uncertainty (Williamson, 1985), but is more likely close to primary uncertainty (Koopmans, 1957).

In addition, uncertainty on rent creation is different from uncertainty on rent valuation in that uncertainty on rent creation does not rely on market valuation. This study distinguishes ‘economic rents’ and ‘the value of economic rents’. The value of

economic rent is affected by market situations such as technological externality and market demand. However, uncertainty on rent creation does not consider the value of the rents, but only considers the creation of the rents.

A simple example may help distinguish the three types of uncertainty. Suppose firm Alpha has developed a technology that may be commercialized to treat one type of cancer. To commercialize it, firm Alpha needs a special technology that only firm Beta has.

First, uncertainty on rent appropriation arises when firm Alpha and firm Beta begin to make transactions. Over time, it is likely that the technology that firm Alpha has developed is spilled over firm Beta, and firm Beta may make use of the technology opportunistically by producing a product for itself or selling the technology to another firm, etc. Those behaviors can be prevented by contracts to some degree, but eventually firm Alpha may want to acquire firm Beta to control such behaviors. This logic has two assumptions: firm Alpha and firm Beta can actually make a product and the product will bring positive profits to the firms. Under these assumptions, uncertainty on rent appropriation will lead firm Alpha to acquire firm Beta, if appropriable rents from the acquisition exceeds the cost of acquisition.

Second, uncertainty on rent valuation arises when the sales of the product in the market is very unpredictable. Even though the commercialization will be successful, there can be another product that can treat the same kind of cancer. The number of people who suffer from the cancer can be dramatically decreased. From these

unpredictable future events, the value of the product can be very small. If the expected value of rents may not exceed the cost of acquisition, firm Alpha will not directly acquire firm Beta and wait, even though there are concerns about rent appropriation.

Third, uncertainty on rent creation arises when the resource integration process is on question. Even though there are concerns about rent appropriation, firm Alpha may not acquire firm Beta because there can be some reasons that firm Alpha and firm Beta cannot be integrated efficiently. The technology that firm Beta has may be so difficult that firm Alpha's technicians may not understand. Moreover, the two firms' organizational cultures may be so different that they cannot exchange information. Since acquisition will not bring enough rents to cover the cost of acquisition due to such impediments, firm Alpha will not acquire firm Beta. These impediments are not relevant to opportunism or market valuation.

While uncertainty on rent appropriation and uncertainty on rent valuation has been explicitly developed in the transaction cost and real options theories of the firm, uncertainty on rent creation, implicitly suggested by Penrose, has not been clearly found in resource-based theory. This is the motivation of this study.

Lastly, this study revisits a concept of causal ambiguity to identify a type of uncertainty within the firm. The concept of causal ambiguity was suggested by Lippman and Rumelt (1982) and Reed and DeFillippi (1990) and has been used to explain firm heterogeneity in the market. In the market, firms cannot perfectly copy other firm's

causal connections between actions and results. Therefore, even though a firm can see abnormal performance of another firm, it is costly to recreate the exactly same routines to produce such performance within the firm.

While scholars in knowledge-based view argue that hierarchical governance enhances information transfer within the firm (e.g. Kogut and Zander, 1992), this study argues that even within the firm, there exists causal ambiguity that leads to low performance. Reed and DeFillippi (1990) also describe the ‘extreme’ case that even managers do not understand causal relationships within the firm. This situation is plausible especially when resources and capabilities are brought from outside the firm. Then managers do not quite understand about the rent generating potential of resources when the resources are outside the firm, managers may not know how to integrate the resources into existing routines even after the resources are brought within the firm. Therefore, there can be a type of uncertainty in the process of resource integration to create economic rents. This is why this study names *process uncertainty* for the type of uncertainty on rent creation.

8.2. Summary of research model

This study examines the role of uncertainty in transaction cost and resource-based theories of the firm. To do so, this study tests three hypotheses drawn from the theories of the firm.

The first hypothesis is to test the relationship between behavioral uncertainty from transaction cost theory and governance choices of the firm. As scholars in economics and organizational economics suggest, behavioral uncertainty is expected to be associated with hierarchical governance.

Some scholars find more broad range of uncertainty in transaction cost theory. For example, environmental turbulence and measurement uncertainty have been considered as types of uncertainty (Rindfleisch and Heide, 1997). However, this study separates behavioral uncertainty from any other branches of uncertainty in transaction cost theory and focuses on appropriability problem.

H1. As behavioral uncertainty increases, a firm will prefer more hierarchical governance (from transaction cost theory).

The second hypothesis is to test the relationship between process uncertainty from resource-based theory and governance choices of the firm. This type of uncertainty has not been quite developed in resource-based theory, but as discussed above, implicitly suggested by Penrose.

This does not mean that resource-based theory has not had any concept about uncertainty. Resource-based theory has several topics that might involve the issues of uncertainty. For example, resource-based theory suggests that the firm's abnormal performance comes from valuable resources, along with the resource's rarity, inimitability and non-substitutability. However, the value of resources is hard to see *ex*

ante. The value of resources may be context dependent (Collis, 1994). Thus, there can be uncertainty on the value of resources that produce abnormal performances. But studies in resource-based theory have mainly specified valuable resources in the context of a certain industry or environment first, and examined the relationship between the resources and performance (e.g. Henderson and Cockburn, 1994; Miller and Shamsie, 1996; Brush and Artz, 1999). These studies find that valuable resources allow a firm to obtain abnormal performance, which resource-based theory argues, but do not explicitly mention about uncertainty on the value of the resources that might arises in a different context.

Rumelt (1984) find more explicitly that uncertainty is involved in governance decisions not because of opportunism but because uncertain *ex post* efficiency of production that can remain in hierarchical governance. Rumelt explains that post-entry efficiencies can be randomly determined when there is causal ambiguity. Thus, even in hierarchical governance, there is uncertainty on the efficiency of production, or rent generating potential of the resources. This is the type of uncertainty that this study focuses on. While transaction cost theory argues that hierarchical governance may effectively decrease behavioral uncertainty that arises in the market, resource-based theory may suggest that there can be another type of uncertainty, process uncertainty, which arises within the firm. This study empirically examines the effect of process uncertainty on governance decision.

H2. As process uncertainty increases, a firm will prefer less hierarchical governance (from resource-based theory).

Even though the existence of process uncertainty is found, there is still a question on the relationship between the two types of uncertainty. There have been debates among scholars on whether opportunism-independent variable can be considered to explain the existence of the firm (Connor, 1991; Kogut and Zander, 1992; Grant, 1996; Foss, 1996; Williamson, 1999; Mahoney, 2001). The third hypothesis test if the type of uncertainty suggest in this study is indeed opportunism-independent variable.

H3-1. The level of behavioral (process) uncertainty will not significantly affect the relationship between process (behavioral) uncertainty and organizational governance form.

H3-2. The level of behavioral (process) uncertainty will significantly affect the relationship between process (behavioral) uncertainty and organizational governance form.

8.3. Summary of the model and the result

This study tests above hypotheses by the binary logit model that is used to test the effects of the independent variables (types of uncertainty) on the likelihood of choosing among dichotomized types of governance (equity or non-equity governance).

Behavioral uncertainty is operationalized by the existence of technological contents in the previous transaction. Technological contents are believed to be associated with behavioral uncertainty because technology is one of highly appropriable assets (Oxley, 1999; Coff, 2003; Subramani and Venkatraman, 2003). Specifically, this study measures technological contents in previous transactions to obtain more conservative results by controlling transaction experience between partners.

Process uncertainty is operationalized by the degree of technological overlap between partners (Mowery, Oxley and Silverman, 1998). When partners have similar technologies, this study considers that there is low level of uncertainty on integrating the technologies to generate economics rents. Technological overlap is calculated by the common patent citations divided by the total patent citations from the patents that the partners have during the last 7 years, which is considered as reasonable time for technological viability (Miller, 1999) before the transaction arises.

The interaction effect is operationalized by the multiplicity of behavioral uncertainty and process uncertainty, and tested to see if this term has any significance and improves the model.

Control variables include technological size, transaction experience and nationality of partners. Technological size is measured by the total number of patents that partners have during the 7 years of interest. This study considers that a firm that has many patents is “technologically big” even though the number of employees or the size of sales is not much big. Transaction experience is measured by the number of transactions between partners during the 7 years of interest. The more transactions partners have, the more likely asset specificity increases, and so hierarchical governance is likely to be adopted. Nationality of partners is considered to see if partners are from the same country or not. Different nationality may affect on governance choices due to different legal systems, cultures, property right protection, etc.

The sample of this study is drawn from North Carolina Actions Biotechnology *Actions* database, and *Micropatent* database is used to get patent information. Biotechnology industry is chosen because this study requires patent activities, which is abundant in biotech industry, to measure process uncertainty. Transactions including technological contents to measure behavioral uncertainty are also abundant in biotech industry. Single industry study is conducted to avoid unexpected variances in the use of patents, appropriability regimes, etc.

The results of the test supported hypothesis 1 (significant effect of behavioral uncertainty on more hierarchical governance), hypothesis 2 (significant effect of process uncertainty on less hierarchical governance), and hypothesis 3-1 (no interaction between behavioral and process uncertainty). Adding both behavioral and process uncertainty variables improved the model (higher log-likelihood ratio). Thus, this study reports that

both behavioral and process uncertainty do affect governance choices of the firm, and process uncertainty can be considered as an opportunism-independent variable in biotech industry.

8.4. Implications

Recent studies have suggested an integrated view of transaction cost economics and resource-based theory (Madhok, 2002; Peng, 2001; Silverman, 1999; Combs and Ketchen, 1999; Poppo and Zenger, 1998; Argyres, 1996) and this study is among them. The distinguishing characteristic of this study is that the two theories of the firm can be compared with respect to the concept of uncertainty. By introducing a concept of uncertainty in the context of resource-based theory, this study suggests another integrative view of the firm.

This study starts with a fundamental question in strategic management: what is the role of uncertainty in the governance choice of the firm? Traditionally, transaction cost economics has provided a general solution for this question: high level of uncertainty leads a firm to have hierarchical governance. Williamson (1975, 1985) has developed well-defined concepts of opportunism and asset specificity, and their effects on governance have been supported in many empirical tests.

Recent studies, however, have shown that different types of uncertainty may have different impacts on governance decisions of the firm. The result may not be that surprising, however, considering that uncertainty is a multidimensional concept. As this

study reviewed, uncertainty has been studied in various disciplines such as organizational sociology, economics, organizational economics, and so forth. These studies give us diverse concepts of uncertainty. In a similar vein, since we have various theories of the firm in strategic management, it would be natural to say that different theories may have different views on uncertainty. In other words, the role of uncertainty in different theories of the firm may, or should, be different. This study seeks to examine the difference.

While additional theories of the firm may be considered, this study focuses on just two theories: transaction cost economics and resource-based theory. Transaction cost economics has a clear concept of uncertainty to date, behavioral uncertainty, and focuses on the relationship between behavioral uncertainty and governance. Resource-based theory has not developed a clear definition of uncertainty. This study reviewed possible concepts of uncertainty in resource-based theory as suggested by Penrose (1959) and Rumelt (1984). Penrose (1959) suggests that a firm's degree of uncertainty is based on resources that are heterogeneous among the firms. For Penrose, the information available outside the firm and the resources available inside the firm jointly affect the governance decisions of the firm. Rumelt (1984) points out that *ex post* (post integration) efficiency should be considered as an uncertain cost of hierarchy. These arguments provided the basis of this study to find more articulated concept of uncertainty.

This study introduces the concept of *process uncertainty* that exists in the process of resource integration to generate economic rent within the firm. This is compared to *behavioral uncertainty* that exist in the market in transaction cost economics. While

behavioral uncertainty is based on opportunism, process uncertainty is based on the resources characteristics that are causally ambiguous, which is inevitable because one firm cannot perfectly understand another firm's rent generating process (Lippman and Rumelt, 1982; Reed and DeFillippi, 1990). The concept of causal ambiguity has been used to explain why firms are heterogeneous and the heterogeneity is sustained. However, this study argues that causal ambiguity can be expanded as the type of uncertainty in resource-based theory because causal ambiguity does exist within the firm after integration to affect rent generating potential (King and Zeithaml, 2001).

This study measured process uncertainty by the degree of technological overlap between biotech firms. The less technological overlap firms have, the firms will experience difficulties in integrating resources, especially technological knowledge and know-how, to develop more advanced technology or products. Technological overlap was operationalized as the number of common citations over the number of total citations in the patents that were possessed by the firms. The result of this study showed that a low common citations ratio, or high process uncertainty, is associated with the use of non-hierarchical governance.

This study has an important implication for resource-based theory. One of the criticisms argues that resource-based theory has been based on its lack of a theoretical structure that addresses governance issues (Priem and Butler, 2001). This study suggests that resource-based theory is not only a theory of firm rents, but also a theory of the existence of the firm (Mahoney, 2001) by showing how a type of uncertainty found in the theory affects governance decisions of the firm. Specifically, this study provides the

empirical evidence that supports Barney's (1999) arguments. Barney (1999) asserts that when it is not clear for a firm to take full advantage of the capabilities of the firms they have acquired, the cost of integration would be high to offset the expected benefit of acquisition. These difficulties in integration stem from differences in culture, differences in systems, and differences in approach. This study tested one of the possible differences, differences in technology, and showed that firms decide to choose less hierarchical governance when faced with the possible differences that may result in inefficient integration process.

The result of this study is also in full accordance with transaction cost economics. This study examined how transaction experience may affect the current governance decision. This study shows that when a firm is involved in a transaction with high level of asset specificity, the more likely the firm will make hierarchical governance in the next transaction. Transaction cost economics has been often criticized because it ignores possible interdependence and relationships between transactions (Ring and Van de Ven, 1992; Zajac and Olsen, 1993).

Another contribution of this study would be that this study embraced 'integrationism' (Foss, 1999) to understand better about the firm's governance decisions. The progress of more likely to emerge from 'a combination of insights and research procedure' among theories of the firm (p. 725). Through the lens of the role in uncertainty, this study tried to give an integrative view on about the question of

governance decisions. The empirical result showed that the governance decision is explained better when both transaction cost and resource-based theory variables are used than any one theory is considered.

8.5. Limitations

Since this study is based on a single industry sample, the result of this study may be industry-specific. For example, this study adopted technological contents for behavioral uncertainty and technological overlap for process uncertainty, and showed the two types of uncertainty had no interactions. Even though the selection of the two measures was driven by theories of the firm, they may be not applied in different industries, especially in low-tech and slow-changing industries. In other words, technological overlap can be a good measure for high-tech industries, but for low-tech industries we may need more proper measures such as the overlap in organizational culture. In international business, this measure for process uncertainty may require more macro variables, such as legal system, cultural differences, etc. More empirical studies in different area may help generalize the relationship between process uncertainty and governance choices suggested in this study.

In more detailed aspects, while all the models showed high ‘correctly classified’ ratio, the increase of ratios before and after adding independent variables was not high (69.42% to 70.43%). For log-likelihood ratio, there was a bigger jump (23.371 to 33.124) but relatively small compared to other studies. Therefore, it can be said that the

explanation power of independent variables in these models are generally low. One way to improve this study would be that finding more variables that represent process uncertainty in the context of biotech industry. Due to the limitation of data, this study did not find more variables.

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