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PART TWO: Industry Issues

13. A Transgenic Theory of the Firm

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Chapter 13

A Transgenic Theory of the Firm

*James R. Baarda*¹

Introduction

*“[I]f one wishes to model the behavior of organizations such as firms, then study of the firm as an organization ought to be high on one’s agenda.”*²

In this paper I propose that transactions, contracts and relationships being introduced in the agricultural industry to capture unique features of agricultural biotechnological innovations be collected and treated as a “firm” for purposes of exposition and analysis. No such firm exists, but a “transgenic firm” with appropriately assigned characteristics drawn from a myriad of existing inter- and intra-firm sources may serve as a useful construct upon which to base analysis of the dramatically changing world of genetic, economic, and legal innovation in agriculture.

In an effort to collect, coordinate, and offer a method by which the many forces and events at work in modern intellectual property rights (IPR)-based agriculture can be identified and analyzed, this paper concludes that a “transgenic firm” theory can be used to capture the changes. On the one hand, each firm in the chain from input through production and marketing to final sale loses some important autonomous characteristics of a firm and the theory of each must be modified accordingly. At the same time, the system as an organic whole takes on characteristics of a single firm, although not so identified. Thus, dual and parallel theories, a “transgenic” theory, is proposed to describe fully the economic impacts of the transitions in agricultural biotechnology on firms in the production chain.

The paper begins with a discussion of the utility of the concept of a firm in economics and law generally. Then follows a brief description of the agricultural production chain and some salient but summary impacts of biotechnological innovation on the system. The concept of a “transgenic” firm is introduced and described. Selected theories of the firm are described and, for each, parallel concepts in the transgenic firm are noted along with comment on the utility of the concept for analytical purposes. Finally, future research is suggested.

Why ‘Firms’?

If the introduction of a transgenic firm (TGF) is to provide any advantages over the present formulation of transactions, contracts and relationships within and among firms as firms now exist, then it must perform some role in law and economic theory. Ideally, it should play a role analogous to that of any other firm.

It is natural in both law and economics to speak of the “firm” as the basic actor on the stage of economic activity. The firm as an economic or legal entity is a concept without which economics and legal scholars alike would be hard pressed to conceptualize, let alone analyze, businesses, business law and economics with the sophisticated analysis now employed. If the concept of a firm is so universally recognized and accepted as a necessary element of law and economics, then it is only a short step to conclude that a change in the foundations upon which the concept rest lead to a reprise of the concept itself. Three generalizations applicable to both law and economics³ suggest the utility of the firm in law and economics.

Law

The importance of the concept of a firm in law can be found in a three-level description of what we generally think of as a firm and what it does. At the most basic level, anyone or anything that performs an economically significant function “acts.” “It” exerts control over something, whether it be an individual’s time and labor, physical resources or intangibles. As a fundamental part of its existence as a business and economic entity, it engages in exchange. In any society other than one in which custom or personal relations are the sole societal organizing force, legal principles are developed that apply to any such activities by whomever performed and for whatever reason they are conducted. The concept of a firm, therefore, plays a necessary role in a legal system.

At the next level of abstraction, a firm exhibits organization and sets of relationships within the firm itself and with other economic actors. Every firm exhibits some degree of organization and relationship sets that are common to all firms. As a consequence, legal principles can be developed that apply generally. These are rules that society, through its system of jurisprudence, has determined should be accepted, and indeed enforced. With the concept of a firm in place, rules may be applied that will have, over a period of time and over a range of applications, desirable results from society’s perspective. Without the concept of the firm, no such generalization could be made and each and every event would present a separate legitimacy problem to be solved after considering anew all possible consequences and the objectives of the jurisprudential system.

At an even more general level, formalization of the firm concept permits an institutionalization of the concept and an institutionalization of the law itself. Archetypical firms can be defined, and any set of relationships and activities that fit within an accepted definition will have the general set of rights and powers, as well as the general set of restraints, that any other firm

within that definition has. This utility of the concept of the firm is demonstrated by the development of the general nature of the corporation, although it is equally applicable to sole proprietorships, family businesses, partnerships, limited partnerships, close corporations, general corporations, limited liability companies, nonprofit organizations and other established relationships. The immense complexity of even a simple corporation, if every possible relationship had to be separately considered, bargained for, and established by binding agreements, has been eliminated by the expedient of defining a firm and assigning a pre-determined set of principles. The concept of the firm in law is thus institutionalized.

Economics

The role of the concept of a firm in economics is somewhat analogous to that in law, with three levels of consideration. At the most elemental level, economic action depends on an actor, and any such actor can be defined, in its broadest sense, as a firm. In this process, an actor engages in exchange or actions that affect the economic position of others. An act changes an existing state of affairs, and an exchange of some kind passes the impact of that action on to others.

A firm is also described in economics to account for the internal processes that implement change and exchange. Two internal processes described with the concept of a firm are the decision-making process that leads to the change and exchange inherent in a firm and the internal economics of a firm. Without the concept of a firm, the economic characteristics of such activity would be an unorganized conglomerate of unrelated and uncoordinated events. The firm establishes the framework in which such actions take place.

In the larger context, the concept of a firm is the building block upon which microeconomic theory and all of the outgrowths of microeconomic theory rest. The “theories of the firm” as exemplified in neoclassical theories of the firm, game theory, equilibrium theories, and the larger issues of entire economic systems, are the bases upon which conceptualization and analysis rest. This concept of the firm, in stylized forms, makes possible reasoned projection of the multiple impacts of firm behavior on all of economics.

Common Principles

Any new views of the firm or significant modifications of present theories of the firm must address two questions: Are current theories inadequate to fully account for new situations found in fact? and Does the new framework provide a useful addition to legal and economic theories? Firm theory and the concept of a TGF may be assessed with three principles of inquiry common to legal and economic concepts of the firm. The utility of the firm concept consists of three parts: (1) Abstraction and analysis, (2) behavior and consequences, and (3) engines of change.

Abstraction and Analysis. The uncountable events with legal and economic significance that occur on a daily and hourly basis cannot be understood in any meaningful way if they are treated as isolated and unrelated events. In law, if every action is entirely unrelated to any other, each action would need to be assessed, its implications estimated, its impact on others assessed as would the possible reactions of others to that action and the implications of those reactions. Any entity or individual with the ability to impose a course of action or pass a judgment on an action would have no guidance other than a single event – a sample of one in a population of one. If this were the case, no general rule of law could be developed or imposed because each act would stand entirely on its own. Similar difficulties would be faced in economics if every event with economic significance were a separate event unrelated to all others. The essential similarities of individual acts would not be useful. An exchange of a good or service would be only that, and other exchanges of the same or different goods or services could not be related in any meaningful way. No patterns would exist and no classes or kinds of exchanges or, for that matter, any other actions with economic significance could be grouped together into a comprehensible pattern.

The problem of individualized and isolated events as sole observation points is solved by abstraction. Some essential character is identified for an event that is the same for at least one other event. Properly defined abstractions permit all events that fit within the defined abstraction to be treated as a group. The extension to events can be simultaneous in which all such events at a given time are treated as a group. The extension may also be temporal and spatial so that events separated by time and space nevertheless lend themselves to a common treatment.

The concept of a firm in both law and economics is an abstraction of events. All of the events, principles, and patterns of actions that take place in the context of an organization as previously discussed are abstracted into the concept of a firm. The abstraction defines the firm and, very significantly, provides the foundations for analysis of the firm.

In addition to definition, abstraction makes analysis possible. Of course, abstraction itself is a result of analysis. Abstraction provides ways to analyze events better, investigate the reason they occur, assess their implications and the short- and long-run results, and project possible implications of a change in the institutions within which the events occur.

Action and Consequences. The concept of the firm provides the means by which behavior can be described in a meaningful fashion. A complex set of relationships can be agglomerated into a firm, and the firm can act. We need not then investigate all the internal relationships and activities within the boundaries of the firm before the firm's behavior can be described. The firm is identified as the actor, and its acts are the events of interest. We are also interested in the internal relationships and actions and the firm's behavior is an integral result of the internal relationships. With the concept of the firm in place, however, it is still convenient and useful to call such relationships and events a part of the firm's behavior, then focus only on the firm's actions. The totality of all firm's behavior can be agglomerated to determine the consequences of its behavior.

The firm and the behavior of an identifiable firm are the foundations of legal and economic analysis. The firm provides the epicenter of consequences. At the most basic level, the firm's existence provides the mechanism to assess the impact on the next economic unit, with the analysis of such consequences occurring at the "boundary" between firms.

In law, an act of one firm that is precisely the same as an act of another firm may have different significance depending on the existence and behavior of other firms. For example, a firm's sale of a commodity at a determined price may be viewed as benign if the firm is one of many engaging in that same exchange behavior, but as impermissible if the firm is the only one in the industry and the consequences are to destroy competition. In economics, the concept of the firm and its behavior relative to other firms is one of the fundamental features of microeconomics and the attempt to assess the system wide consequences of individual firm behavior in differing environments such as perfect competition, monopoly, monopolistic competition, or oligopoly. In each case, the concept of the firm makes possible a view, whether normative or positive, of the overall consequences of individual firm behavior.

The concept of the firm is inherent in the prevailing view of jurisprudence and economics in economies based on private capital ownership and market-based economic decisions. We assume, without a great deal of introspection, that the firm in our legal and economic system is a "natural" phenomenon. (Shaffer). The firm is an appropriate decision-maker, has capital to perform its functions, is imbued with the powers to control capital and labor, may adopt a structure and size also based on the selfish motives of the firm, and can make decisions and act largely for its own selfish purposes. General bounds on behavior are established, but those bounds themselves assume and accept the concept of the firm.

Engine of Change. All economic endeavor is, in the final analysis, human endeavor governed by the extremely complex forces that play in any human endeavor. The concept of the firm allows us to observe and isolate motivating forces in law and economics that drive and guide human endeavors with economic significance. The myriad of needs, desires, and abilities of individual human beings is captured in the concept of the firm. From the individual creator of an idea and the implementation of the idea into a legal and economic dynamic force, to the individual investor that makes funds available for an economic enterprise, to the individual manager with a personal dedication to the enterprise, to the individual consumer that is willing to compensate the production of a consumed good or service, the dynamic forces at work are consolidated in the concept of the firm.

This consolidation into the concept of the firm works two ways. The forces that lead the firm to do what it does, produce what it does, and act in the way it does, can be identified and analyzed using the firm as the focus of such forces. In the other direction, the forces at work behind and within the firm that cause it to respond to such forces can be focused in the concept of the firm. At all times, however, "it is only because individual human beings are limited to knowledge, foresight, skill, and time that organizations are useful instruments for the achievement of human purpose." (Simon, p. 68)

Firms From Beginning to End – Conceptual Framework

We first structure the agricultural production chain in terms of firms because it is from this chain and the relationships among all the firms in the chain that the TGF is derived.

The framework from which we can investigate the nature of the TGF may be simplified to that of a simple chain of firms that begin with raw materials and end with final product. Figure 1 shows a straight chain of firms. The starting point on the left represents resources to which no human economic activity has been applied – sunlight, virgin soil, natural resources in the ground, and naturally growing plants and animals.⁴ The ending point on the right is the final product of the chain, usually thought of as the final, consumed product.⁵

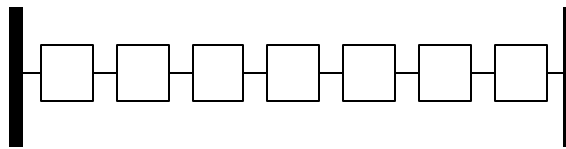


FIGURE 1 Chain of Firms

Each box in the diagram represents a “firm.” Each of these firms has a set of characteristics common to firms and theories of the firm can be applied to each. Each can be considered in terms of the abstraction and analysis, action and consequences, and the engine of change concepts discussed above.

One of the key elements in defining a firm is the separation of each firm from the adjoining firms in the chain. Figure 1 represents this separation by the connecting lines. The connecting lines represent several important characteristics of economic activity significant for descriptions of the firm and the theories of the firm. The connecting lines represent the boundaries of the firm and thus the definition of the firm. They represent all interactions with all other economic entities.⁶ All external factors upon which each firm bases its total set of decisions are shown by the connecting lines.

Biotechnology innovations and the methods devised to capture and allocate the value of the innovation have a profound impact on this production chain. The forces described below affect the transactions, contracts and relationships among adjoining firms, among non-adjoining firms, and within each individual firm in the chain.

Biotechnology and the Firm

Changes in the structure of agriculture have long been a subject of observation and concern to economists, legal scholars, and policy makers. Changes attributable to biotechnology-based

innovations are not clearly distinguishable from significant changes that have relatively recently been termed the “industrialization” of agriculture. (See Hamilton 1994a). For example, the integration of livestock production from completed integration in the poultry industry to new integration in swine production, production contracts that have been long-standing for some products but now increasing in grain, identity-preserved products leading to markets outside the usual market system, increasing size of production and other agribusiness units, and industrial use development for agriculturally produced products, all portend changes in agriculture regardless of biotechnology-based products. (Hamilton, 1994a). In broad terms, the two are parallel. Indeed, many integration, control and ownership issues are related to the development of the TGF proposed in the present paper.

The advent of agricultural biotechnological innovations by public and private sectors has lead to new methods of establishing relationships specially designed to capture the rewards of such innovations. The variety of such arrangements is not yet settled as experimentation with their utility and effectiveness are being explored. The future may, and almost certainly will, bring profound changes in the entire structure of the chain of units represented in Figure 1.

The typical assumption underlying firms in a chain of production that we use for our starting point is that goods and services are exchanged among firms. Upon transfer of ownership or satisfaction of an obligation between firms, each firm has realized the results of all earlier decisions. This sense of order and completion in the actions of a firm allows us to assign firm characteristics and apply the tripartite rationale for the concept of a firm. This description is, of course, very simplified. Arrangements exist among firms at all levels that defy the simple completion model. From relational agreements to formalized ventures that last for an indefinite period of time, ongoing relationships implicitly or explicitly extend the scope of the exchange among firms beyond that of a one-time event. Nevertheless, for most conceptions of the firm and most relations among firms, the relationships are defined as exchanges that are clear in what is exchanged and are limited in scope to some portion of the chain.

The commercialization of biotechnology advances in agriculture is founded on creation and protection of intellectual property rights. Unlike physical commodities, the intellectual content of IPR is available to anyone and can be reproduced in unlimited quantities. IPR owners’ efforts to capture the benefits of the IPR lead to three business and economic arrangements: The IPR itself may be sold as a good; the IPR may be inextricably associated with a physical commodity such that the price of the commodity incorporates the IPR value; or ownership of the physical commodity with which the IPR is associated may be retained by the IPR owners until the commodity’s final sale. Where an input IPR owner retains partial or complete ownership of the commodity or attaches conditions to the good that runs with the good regardless of ownership, the economic and firm characteristics of all firms in the production and marketing chain to the point of final sale are modified dramatically with significant consequences to the entire production and marketing coordination system and, indeed, the consumer.

New business arrangements that IPR owners use to capture the value of IPR have several kinds of impacts upon the production and marketing coordinating system. For example, the system becomes more integrated because each firm in the system no longer makes entirely autonomous decisions based on commodity costs and returns. Price signals to individual firms and the system play different roles, intermediate market units blend together, and vertical segmentation changes. The decision-making process not only changes in nature for individual firms but decision-making power, rewards, and risks change location along the chain. At the firm level, the internal economic decision-making process changes quantitatively and qualitatively, decision sets become more limited, pricing signals play a different role, the firm generates different products and becomes more oriented toward service and less commodity oriented, firm financing and use of resources change significantly, and the firm moves toward a niche, task-oriented entity.

Contemporary arrangements to achieve the panoply of purposes throughout the marketing chain may well change significantly in the near future. The structure of the agricultural production and distribution system has not felt the full impact of the biotechnological revolution and the resulting changes in the system. Some consequences of current experimentation in the methods designed to capture compensation for innovation and distribute the benefits will be found undesirable or inefficient as time passes, and new responses may well supplant what is now thought to be, and analyzed as, the “new solution.”

A “Transgenic Firm”

We need some specific way to capture the changes being brought about by biotechnological innovations and resulting changes in the production chain. More specifically, we need a mechanism by which order and analytical tools can be brought to bear upon the seeming disarray now facing participants in the agricultural production chain and those who analyze and give counsel. To do this I propose the introduction of the TGF.

If we insist on characteristics for the TGF and are analogous to the characteristics of a firm as commonly understood, how can we describe the TGF?

Formulation

A TGF is hypothesized to capture the multiplicity of arrangements, transactions, and events that occur between the beginning and ending points of the production chain. Ownership, control and governance, resource use, objectives, generation and distribution of benefits and allocation of risks should be addressed. The motivation for creating the TGF relates to the rationale for the firm. The TGF should provide a basis for abstraction and analysis, establish action and exhibit consequences, and reflect forces of change at work in the industry. The TGF is shown diagrammatically in Figure 2. The hypothesis requires that the initial view of a firm be relaxed to

allow for certain missing characteristics. With exceptions, however, the TGF is assigned characteristics of a business entity and is treated as such once its characteristics are determined. After accepting the entity nature of the TGF, its relationships with existing firms can be assessed. The firm is also part of the existing firms in the organization chain and, vice versa, existing firms are part of the TGF.

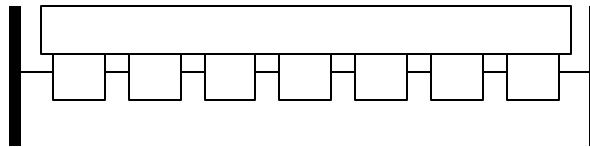


FIGURE 2 Transgenic Firm

A single interest, that of obtaining the greatest benefit from the biotechnological innovation, runs throughout the production chain and is shared by all units in the chain. This common desire to maximize benefit can be assigned to the TGF. Along with the commonality of benefits comes the commonality of risks. Both issues are, without the TGF, bargained among the firms, trying to gain more benefits and avoid more risks. To the extent that conflicts exist, the conflicts now revolve around a more central issue. With the introduction of the TGF, benefits and risks are identified in a different way.

The decision-making processes have also changed as a result of the introduction of new business arrangements in the production chain whose purposes are to recognize the source of value added by biotechnological innovations. From a process of decisions based exclusively, or nearly so, on each firm as an economic and legal entity separate from each of the other firms, the decision-making process no longer rests with each firm that looks only to its suppliers and buyers. Rather, decisions about what to create and how to operationalize, produce, and market the product cross vertical firm lines. Fewer and fewer independent decisions effectively determine the economics of the production chain. The introduction of the TGF recognizes that fact and incorporates the remaining determinative decision-making functions in a firm that represents the full range of the production chain for which decisions are made.

Limited rights transfers also expand and complicate the relationships among firms in the production chain. In particular, obligations and rights no longer begin and end at the firm's boundary. Firms are not free to do whatever they wish with the resources in their possession by which they produce their income. Rather, a pervasive set of restrictions follows the product through the production chain from firm to firm. This expanded relationship can be recognized by the introduction of the TGF and limited rights in the product. The sets of contractual arrangements that limit the rights of firms in the production chain are now internal to the TGF and the conflicts inherent in such contracts are diminished at least with respect to outside parties.

From a contractual perspective, the network of contracts that establish the rights and obligations necessary to organize the activities of all parties in the production chain are made more complex and more pervasive. (See, *e.g.*, Hamilton, 1994b). They extend over a greater portion of the production chain and are effective for a longer period of time. More contracts cross the boundaries between and among firms. As a result of this complexity, the incomplete contract problem increases. The introduction of the TGF provides a mechanism by which the incomplete contract problem may be reduced.

It is also clear that ownership not only of the product with transfer of limited rights but also of the resources supporting the production chain is modified. For some purposes, control follows the limited transfer naturally so that the limitation on transfer itself defines the distribution of control among participants in the production chain. On the other hand, ancillary and additional control is exercised outside of product ownership as a means to protect other rights. The introduction of the TGF incorporates the related issues of ownership and control.

How then may we define and describe the TGF? We may begin with a general definition and a note on the scope of the TGF:

The TGF is the collection, in a single locus, of selected transactions, contracts, and relationships that pertain directly to a product whose biotechnological innovation leads to a nontraditional set of rights regarding its valuation where those rights are based on IPR that requires modification of transactions formerly based primarily on simple exchanges of goods and services.

Some of these transactions, contracts and relationships would otherwise be inter-firm transactions, contracts and relationships but are now made part of the TGF's internal transactions, contracts and relationships.⁷ Others would otherwise be intra-firm transactions, contracts and relationships within individual firms in the production chain, but are now intra-TGF transactions, contracts and relationships.

The TGF is ultimately defined by the choice of which transactions, contracts and relationships are intra-TGF and which are inter-firm transactions, which are contracts and relationships relating the TGF to other firms, and which are inter-firm transactions, contracts and relationships between and among other firms in the production chain. The initial task is to identify the distinguishing characteristics of all the transactions, contracts and relationships in the total production chain that are assigned to and comprise the TGF – the intra-firm transactions, contracts and relationships to be distinguished from all others.

Intra-TGF transactions, contracts and relationships include those that define the product which is the subject of the biotechnological innovations. Intra-TGF transactions, contracts and relationships further define the ownership of the biotechnological product and divide up the bundle of rights associated with the ownership as those rights make their way through the production chain.

Transactions, contracts and relationships within the TGF establish the rights and obligations required or convenient to assign responsibilities and distribute income streams and utilize factors of production. They describe and establish the mechanisms by which the unique value of the biotechnology-based product are captured. They are the collection of transactions, contracts and relationships that define the ultimate consumer market into which the biotechnology-based product is sold and trace the flow of market information back through the production chain, in our formulation back through the TGF to primary inputs. They capture all the forces at work, as those forces are imposed from outside the firms in the production chain or internal to the production chain, that impinge upon the total system in which the biotechnology-based product progresses through the system. Finally, intra-TGF transactions, contracts and relationships establish, to a great degree, the internal organization of the TGF including hierarchies of decision-making and power structures.⁸

These generalizations are not completely satisfactory as a TGF definition. Greater TGF definition is drawn from the various theories which are the subject of this paper. Further description of the rationale for selecting some transactions, contracts and relationships for intra-TGF assignment while assigning others to inter-firm status is based on the particular theory of the firm being considered. In general, however, those transactions, contracts and relationships that are inseparable, either practically or economically, from the existence of the biotechnology-based product's production and distribution, given the requirements of the previous paragraph and the description of the changes brought to the production chain, are intra-TGF transactions, contracts and relationships. Once the TGF's characteristics are so established, transactions, contracts and relationships that are essential to that definition are also included in the intra-TGF bundle of transactions, contracts and relationships.

Transgenic Firm Characterizations

Generally, the introduction of limited rights transfer has a horizontal and a vertical effect on the basic structure of the production chain. The "horizontal" effect is that which diminishes the range of functions that each firm performs. To take the most dramatic example, suppose that a farm production firm typically purchased seed from which to grow the product. The firm made all decisions necessary for the process, obtained and used all resources necessary, took all risks and accepted all benefits of the operation, and received all compensation for the firm's product. If, however, the farm production firm did not receive all rights to the seed and in fact never owned the product, that firm's range of functions become more limited, falling to the level of a contract producer supplying some resources but not engaging in all, perhaps not even the essential activities normally associated with a farm firm. (See Hamilton, 1994b). The firm's decision-making role is significantly different, as is its assumption of risks and opportunity to benefit from the production, and its compensation is based on completely different terms.

The "vertical" effect is felt when limited rights transfer affects the interaction of the firms in the production chain at the boundaries between the firms. For example, for a limited-rights transfer,

the full ownership of factors purchased and product sole and all claims associated with full ownership no longer exist. Instead, the firm receives the output of the preceding firm with only limited rights and, similarly, conveys (in a physical sense) the final product to the next firm in the chain passing on only limited rights. The responsibilities and benefits of ownership typically associated with a firm that purchases resources and inputs and sells output to the next firm in the chain no longer exist. Under some conditions the most important character of the product passing through and transformed by a given firm is such that most of the important aspects of the system of exchanges between firms disappear. The open, market-driven exchange mechanism is bypassed.

Theories of the Firm

As defined for our purposes, a theory of the firm gives definition and functionality to abstraction, provides the basis for analysis, and defines and provides focus for the source of actions with legal and economic significance. A theory of the firm should also provide the means by which to assess the consequences of the firm's behavior. Finally, a theory of the firm will help personify the motive forces that drive the firm to act and, in sum, drive all of economic behavior in legal and economic institutions of current interest.

Most theories of the firm are not exclusive. Thus, by accepting one theory of the firm one is not required to completely exclude other theories. Theories of the firm are overlapping. For exposition and analytical purposes, discussions of firm theories often point out the distinctions of the theory being discussed from all the rest. In most cases, that distinction is useful for the purpose of defining the theory under consideration rather than dismissing all other theories. Theories of the firm cannot be easily or accurately assigned to legal or economic principles and scholarship. In fact, the firm is one of the major topics upon which scholarship in law and economics converge and have added substantially to the Law and Economics field of scholarship. On a continuum, of course, some theories have a greater legal component than economic, and on the other end of the scale some are oriented entirely toward economics. However, a fuller view of the implications and interrelations of theories of the firm suggest that a completely separated list of theories from law and economics would be a disservice to the theories as well as to the totality of implications.

The Firm as a Set of Transactions

One of the most recognized views of the firm is that the firm itself is a set of transactions. The internal workings of the firm are treated as analogous to the observed transactions among firms. Commons introduced the transactions view of the firm, and the seminal work of Coase (1937) introduced the transactions costs concept that made the transactions analysis an economic framework. The value of the transactions theory of the firm is that the firm itself can be separated into observable and analyzable transactions.

The totality of transactions of every kind can be divided into intra-firm transactions and inter-firm transactions. Intra-firm transactions define the firm, and this is the approach taken with the introduction of the TGF. Accepting Coase's summarization, "the distinguishing mark of the firm is the supersession of the price mechanism." The price mechanism of the market is replaced by authoritarian, power-based decision-making within the firm. (Coase 1937). As developed primarily by Williamson (1975), the main distinction between transactions within and without the firm is the character of the driving force of decisions made. For transactions among firms, the market determines every element of supply, demand, and prices. On the other hand, within the firm decisions are made on an authoritarian basis that depends on the hierarchy internal to the firm.

This element of the transactions theory is evident in the TGF setting. The rigidity of the rights and responsibilities, concepts of biotechnology-based product ownership to capture its IPR value, the wide range of impacts on the rights of various actors, particularly in the restriction placed on their ability to enter the market-place freely and make independent choices, all suggest that the pricing mechanism that transactions theory would describe as market-based is more logically internalized into a TGF and is no longer suitable for inter-firm transaction analysis. The supersession of the price mechanism is evident and may be predicted to increase rapidly.

The fit between the TGF and transactions theory of the firm gives some guidance on the selection of transactions, contracts, and relationships that should be internalized in the TGF. This is, however, a difficult conceptual task. Coase himself observed that "it is not possible to draw a hard and fast line which determines whether there is a firm or not." (Coase 1988, p. 40, n.21). The difficulty increases with the widespread changes in the many ways firms not only organize through agreements and alliances, but surrender functions traditionally considered inherent to the firm. Although the TGF cannot be clearly defined by criteria for assigning transactions to the TGF as opposed to the inter-firm marketplace, the focus on transactions established by the transactions theory of the firm provides a clear mechanism by which to address the issue and make reasoned judgments.

Commentators often limit the value of the transactions concept of the firm to the application of the transactions cost theory of the firm. However, the theory's usefulness is not so limited. When the transaction is treated as the basic unit of analysis of the firm, analysis of governance and other human actions in the firm are brought under the transactions analysis. (Williamson 1988). The transactions formulation leads to useful considerations of asset specificity and incomplete contract analyses as well. (Williamson 1971). Others have attributed the firm's role in supplanting markets in terms of other reasons such as dealing effectively with a condition of technological non-separability. (Alchian and Demsetz). The TGF provides a framework with which to address each of these issues.

The Firm Defined by Transactions Costs

Transactions costs have come to dominate the transactions theory of the firm where the objective is to define the boundaries of the firm in terms of economic principles. Coase (1937) introduced the fundamental “tautology” that transactions will be internal to the firm so long as the transactions costs of the internal transactions do not exceed the transactions costs of those same transactions when they take place in the market rather than in the firm. Thus, treating the firm as a set of transactions led to the economic view of the firm in terms of transactions costs. The transactions cost theory of the firm has overshadowed other implications of the theory.

While the concept of transactions costs and the firm is easy to state, it is far more difficult to apply if one is interested in making specific determinations about each transaction’s costs and the relative costs of the transaction as an intra-firm or inter-firm transaction. This problematic is universal and probably no more difficult for the TGF than for any other firm of reasonable complexity.⁹ Transactions cost determination is problematic and confusion of defining costs and allocating them to the types of transactions included in the firm leads to difficulties in applying transaction costs analysis of the firm. (Demsetz). Part of the problem is that the transactions costs are of a different character within or without the firm for the very same transaction. “[I]t is difficult to use the magnitude of ‘transaction’ cost relative to ‘management’ cost to predict how changed circumstances affect economic organization.” (Demsetz, p. 149). Further, in the real world we deal with an immense variety of business forms. “The confusion that exists in the literature derives from a hidden presumption that we are still guided by the perfect decentralization model, and that, in some respects, information remains full and free.” (Demsetz, p. 148). The development of the principal-agent problem has further identified internal agency costs, noted below.

The TGF provides a mechanism to analyze transactions costs similar to that for other firms. Intra-firm transactions costs will include costs associated with management while inter-firm costs will include costs of market place transactions. Theoretically, the transactions included in the TGF will be identified on the basis of relative transactions costs, and the TGF will be defined along the same lines as suggested by Coase’s rule.

The role of transactions cost in current arrangements related to biotechnological products and the capture of IPR value is pronounced. The resort to limited-rights transfers of various kinds, the institution of new relationships necessary to protect the IPR value, and the new arrangements among participant firms in the production chain are all evidences of the new requirements for effective transactions. The introduction of the TGF as a focus for transactions is not only a reflection of the requirements for more non-market transactions but a source of abstraction and analysis, an object for observation of behavior and transaction cost consequences of current and future transactions and firm structure.

Commentators have described the distinction between inter- and intra-firm arrangements in terms of the nature of the product. Market transactions are said to involve products or com-

modities while intra-firm transactions involve factors of production. (Cheung 1983). The introduction of the TGF is the replacement of the product or commodity market with a factor market, driven by savings in the transactions costs. As the nature of the product changes from an owned and transferred physical commodity to a set of limited rights with restrictions attached, more of the factors contributing to the movement of limited rights from the beginning of the production chain to the end will be intra-firm factors of production. In fact, the biotechnology-based product, when in the “possession” of one of the participants in the production chain, is more a factor of production than a product. The TGF intra-firm transactions will capture that change, and the division of rights transferred and retained among participants in the firm may change in response to costs. Thus, the TGF considered in the context of the transaction cost theory of the firm provides a mechanism to define the events taking place in agriculture as a result of biotechnology as well as a mechanism by which to measure the performance of arrangements now in a state of experimentation.

One of the more promising potentials of the TGF as an analytical tool is that of identifying and internalizing externalities that are created with the changes brought by business results of biotechnology in agriculture and capture of IPR values. We may extend the concept of externalities to include not only economic externalities but “legal externalities” and “social externalities” as well. Concerns with the status of the independent farmer, the growth in size of production facilities with associated impacts on neighbors and communities, the disruption of communities upon redistribution of resources, implications for policies regarding land use, implications for the legal system and the purposes of laws regarding agriculture, concerns about the impacts of the biotechnological products themselves, especially unidentified dangers, and other significant changes are externalities with respect to current firms in the production chain. Externalities, by definition, are not captured by the market system.¹⁰ This is particularly true of non-economic externalities which are more important for policy makers than economic externalities. The TGF forces these issues into a forum in which all can be addressed together, even if not “efficiently.”

The Modern Corporation: Nexus of Contracts

Needless to say, the corporation is not the same as the firm. However, theories of the corporation are a useful subset of the theories of the firm. Development of theories of the corporation have contributed significantly to the discussion of the transactions view of the firm, in particular the distinction between transactions that are “internal” to the firm and transactions among firms that are market driven rather than hierarchically driven.¹¹ In addition, corporation literature has added considerably to organizational, control, and representational issues. Generally, corporate theory in both law and economics is rich, discourse is lively, and new ideas abound alongside grand traditional theories.

The legal nature of the corporation has always been recognized in law to be a fiction. Recognizing the fiction, a theory of a corporate as a “nexus of contracts” holds that the corporation is no more than a fiction and that in reality the corporation is a nexus of contracts all of which

converge to solve the problems associated with economic activity. As stated by Jensen and Meckling, corporations “are simply legal fictions which serve as a nexus for a set of contracting relationships among individuals.” Although itself a fiction, the TGF cannot be accorded the full status of a corporation because the corporation is accorded the status of a legal entity – a legal person. From a theoretical standpoint, however, the disabilities of the TGF because it is not a legal entity are of minimal consequence. To the contrary, the fact that the collection of transactions, contracts, and relationships establishing the intricate production chain relies only partially on a contract network is of interest of itself.

One line of thought from the nexus-of-contracts theory is a criticism of the Coase distinction of internal and market transactions. Some proponents of the nexus-of-contracts theory propose that all contracts, whether intra- or inter-firm, are voluntary contracts among individuals and the fact that a corporation or a firm is involved is of no significance. (Jensen and Meckling, Alchian and Demsetz, Cheung 1983, Klein, Hart 1989, Schwab). Others, however, believe that the nexus-of-contracts does not eliminate the usefulness of the intra- inter-firm dichotomy. (Spence). Hart notes that although Coase’s distinction between market and authoritarian decisions is not well accepted by the nexus-of-contracts theory of the firm, nevertheless the distinction between intra- and inter-firm transactions is useful.¹²

The nexus-of-contracts theory of the corporation is not a complete solution to the problem of defining the bounds of the TGF. Those who focus on the nexus-of-contracts theory must, as in the transactions theories, define which contracts are inter-firm and which are intra-firm. (Easterbrook and Fishel). Indeed, Demsetz adopts a “firm-like” organization description to address contracts. Intra-firm contracts are defined in various ways. A number of suggestions have been offered to determine which contracts are internal to the firm and not based directly upon immediate market forces, and which are devised as part of the corporation’s hierarchy and authority. Specialization to some degree is adopted as a characteristic of firm-like contracts to maintain compatibility with the theory of price. The second characteristic of interest in the firm contract is the expected length of time of association between the same input owners. The third faced is the degree of conscious direction that is used to guide the uses to which resources are put. (Demsetz).¹³ Needless to say, other criteria can be developed to determine which contracts are intra-firm and which are inter-firm.

One of the motivations for introducing the TGF is that an increasing proportion of the transactions in the production chain are defined by contracts rather than simple transactions in goods and services or simply by “relationships.” Critically, contracts carry an increasingly important burden in capturing and assigning the IPR value of the biotechnological innovation. In addition, the increasing complexity of relationships among all participants in the production chain to bring all participants “in line” depends on enforceable contracts. Thus, it is natural to think of the TGF as contract based. The TGF, as a nexus of contracts, provides the abstraction upon which legal and economic analysis may be focused, the firm’s behavior and its consequences may be assessed, and the complement of motivations of a myriad of participants can be identified.

The nexus of contracts within the organization specifies the nature of residual claims and allocates the steps in the decision-making process. Contracts divide and allocate rights. The contracts are supplemented by implicit understanding, by custom, and by the common law of contracts. (Cheung 1983). The decision process is comprised of steps such as initiation of proposals for resource use, ratification of the choice of decisions, executing the decisions, and monitoring performance and allocating rewards. (Fama and Jensen). In a complex organization, the decision-making process is spread among various agents.

Private ownership cedes to firm participation when contracts are used to parcel out rights less than full ownership. When a resource's owner, including the owners of labor, becomes part of the TGF, the owner is not required to sell the resources. Rather, the owners retain some rights and the contract becomes a "structured document" between the owner and the other party. (Cheung 1970). The owner agrees to follow directions rather than determine an independent course of action based on market price observations. (Cheung 1983). Note also that payment is made on a different basis, a basis that may not depend at all upon the value of the biotechnology-based property sale. Commodity market prices do not directly guide the resource owners.

Contracting attempts to add certainty to transactions and relationships. To the extent that corporations are a nexus of contracts, the value of the arrangement will depend on the certainty brought to the firm. If uncertainty can be reduced by bringing the contract within the firm, costs of enforcement may be reduced. The role of shirking, cheating, and opportunistic behavior may suggest that contracting should be brought within the firm (Williamson 1975, Klein Crawford and Alchian, Demsetz), although the importance of such factors in firm creation is not universally accepted. (Cheung 1983). These very forces suggest the existence of a TGF, although not necessarily in corporate form. Costs of monitoring play a prominent role in the TGF and certainly plays an increasingly important role in TGF contracts. Beyond merely formalizing transactions, the nexus of contracts and subsequent incorporation of contracts among owners and agents in the TGF may be viewed as an allocation of decision management, decision control, and residual risk allocation. (Fama and Jensen). In addition, information needs may be internalized by contractual arrangements and the bounds on bounded rationality may be improved.

The Modern Corporation: Modifications and Other Theories

The view of the corporation as a nexus of contracts is not universally accepted without reservation. The role of contracts and of corporate law is the subject of considerable current debate. (Clark, Eisenberg, McChesney, Bebchuck, Coffee). A corporation is subject to the statutory laws of incorporation and judicially determined law. The nexus-of-contracts purists ("contractarians") would deem the incorporation laws not very significant in the theory of the firm because the essence of the corporation is determined by the private contracts that can, with the complete freedom to contract afforded under law, modify the relationships otherwise assigned by incorporation law. To the contrary, other commentators ("anti-contractarians") hold that the

essential statutory laws, that is, the rules laid down by the state, cannot be modified or abrogated at will, at least without bounds. Thus, the freedom to make contracts about the corporate form is limited. (Bebchuck, Eisenberg, McChusney).

The anti-contractarians' view of the corporation would distinguish the TGF as a firm with corporate characteristics from the view of the contractarians because the anti-contractarians hold that the corporate form is more restricted than is the case of a corporation that is merely a nexus of private and independent contracts. Because the TGF is not a corporation, any restrictions imposed by the fact of incorporation do not apply. The TGF, despite its lack of corporate form, fits well with the nexus of contracts theory but not so well with the anti-contractarians' view of corporations. All of this gives guidance to using the TGF as an analytical tool to assess the behavior of the TGF as a nexus of contracts in the production chain.

One set of internal firm costs is identified as agency costs. (Jensen and Meckling). The contracts in the nexus of contracts are not costless. Structuring, monitoring, and bonding a set of contracts among agents with conflicting interests is not costless. Agency costs also include the value lost from the costs of enforcing contracts. (Jensen and Meckling). The total agency problem includes decision management, decision control, and residual risk bearing (Fama and Jensen) and organizational efficiency must address the combination or the separation of the three. These characteristics are very evident in the TGF. A considerable value rests on the network of contracts including contracts dividing rights in the biotechnology-based product, contracts regulating the flow of product through the chain, and contracts relating to the allocation of risks and benefits, among many others.

The trust metaphor for the corporation, in which something is held in trust for another, is the subject of current debate among legal scholars. The corpus of the trust, the corporation's assets, are held in trust by management for the beneficiaries, that is, the owners. (Kornhauser). The appeal of the trust theory of the firm is that the fiduciary duties of loyalty and care imposed on corporate directors and officers can be explained by the fiduciary duty of a trustee to the trust. The drawback of the trust model is that it is not possible in the context of modern corporations to rigorously identify the parties involved. Because complete freedom to contract would defeat the trust structure if obligations and duties could simply be contracted away, supporters of the trust theory insist that certain corporate characteristics cannot be contracted away. Thus, a set of mandatory rules remain for corporate firms. (Kornhauser).

Formally, the TGF probably will not reflect the trust theory of the firm well. However, the difficulty itself is instructive. Does the TGF have no participants that hold a high duty to other participants? Is no duty of loyalty and care owed to anyone by anyone else? These are important issues in both law and economics. In larger terms, some commentators would argue that such obligations should exist. At present those who owe the duty are not well-defined. Introduction and analysis of the TGF may provide a framework upon which those values can be built in the context

of corporate theory and by which the concerns of those with reservations about how biotechnology innovations are affecting the agricultural industry, especially farmers.

While many writers in the law and economics of corporate theory ascribe to a “neutral” view of corporate contracting, accepting the fundamental belief that the multitude of independent contracts each of which is made with the intent to maximize some function, more focus has recently been given to the externalities of contracting in corporations. (Klausman). Even those who accept the contractarian corporate model nevertheless look beyond the corporation to seek consequences felt by non-parties to the contracts. (Klausman). As discussed in transactions theory, the TGF may serve to identify these externalities.

The corporation is also a structure that assigns and focuses residual claims. In a corporation, only the shareholders have residual claims while all other participants have only claims set by contract not directly and instantly bound to the ultimate market-based returns on the product. (Fama and Jensen, Jensen and Meckling). If the TGF were a corporate form, it might tend toward the internal organization suggested by the agency problem. For example, costly control devices to make sure that important agents act in the best interests of the organization may be solved by assigning them residual value in the firm. (Fama and Jensen). By so aligning motivations and duties, costs can be reduced. However, in the TGF, the methods typically used for residual allocation in corporations – the assignment of ownership interests that carry residual rights – is not directly possible. The TGF should be analyzed to see how and to what extent agents are identified as particularly important, including their capacity to increase costs by undesirable actions, and how and to what extent mechanisms are devised to reduce such costs.

The Firm as a Product of Its Environs

While the transaction- and control-based theories of the firm are narrowly focused on transactions and identifiable relationships, another view of the firm recognizes that the organizational structure of the firm and corporate strategies depend upon the market structure environs of the firm. (Caves). Strategic choices and particularly structural adaptation are of interest to the rationale of introducing the TGF view of the production chain which is, in totality, the market set in which firms exist and act.

The firm environs theory of structure and strategy also addresses the issue of firm boundaries and thus the definition of the firm. Caves, treating the issue as a normative one, asks, given the distribution of strategies and structures actually observed, “has the boundary between administration and the market” been optimally located? The “organizational production function” relates to control mechanisms within the firm, control and the optimal flow of information within the organization, and the multiplication of hierarchical levels as it relates to a firm’s efficient overall size. Technology and competition affect organizational structure as, for example, increased competition imposes tighter control mechanisms within the firm.

One of the major observations about firms and markets is how the firm is structured internally. Prototypical structures can be divided into functional and multi-divisional for complex firms, each with advantages under differing circumstances. (Chandler, Williamson 1970, Caves). The functionally specialized firm is divided into departments each with a specific function adding to the overall operation of the firm. The multidimensional firm is organized into divisions serving different markets, each of which incorporates functions needed to carry out its mandate. This dichotomy may be applied to the TGF and, as a consequence, the character of the TGF and its role in the market may be clarified. In broader terms, theories may relate the overall form of the business enterprise to economic efficiency generally. (Cotterill).

In addition to market influences on the TGF, the introduction of the TGF into the production chain modifies the size and organizational structure in the production chain. Because of this, the market environment (production chain) is changed dramatically. The latter change is expected, by Caves' observations, to have a significant impact on the TGF's own structures and strategies. Thus, the overall production chain, including the TGF, is the product of a two-way or circular exchange of influences.

A consequence of the TGF, with its internal organization extending over multiple stages of the production chain, is the introduction of transfer pricing as a substitute for direct market pricing. Much has been made in defining a firm of the removal of transactions, contracts and relationships from the market pricing system. Internally, these same transactions, contracts and relationships must be measured in some fashion to determine many of the same characteristics that the market would impose, such as adequate performance, costs, efficiencies, etc. Once incorporated into the firm, an internal system for imposing discipline may be assigned to transfer pricing. Organizational structure influences this internal pricing mechanism where incomplete contracts exist and when new agreements must be negotiated periodically. (Grossman and Hart, Holmstrom and Tirole). For example, if units within the organization are allowed to bargain for prices internally, or allowed to consider outside transactions to replace internal transactions, "management" may face discipline akin to market disciplines. (Holmstrom and Tirole).

Participants in the TGF bargain for their role in the firm, but not in an open market setting. Their bargaining position in the overall market may not be clear. To the extent that the TGF relates each bargaining process to all others, some organization can be brought to the process. Options, and the lack thereof, may be identified for each participant. In any case, the transactions, contracts and relationships among participants in the production chain are greatly complicated by the introduction of the IPR value aspects of biotechnologically innovative products and the usual disciplines of the market place are subverted. The TGF is a mechanism by which some of the issues of market replacement may be collected and addressed.

Separation of Ownership and Control

Investigations into the theory of the firm began to diverge from the simple transaction cost format during the decade of the 1970s. (Demsetz). Attention began turning toward the issue raised by Berle and Means – the separation between ownership and control – with the important difference that, unlike Berle and Means, the task became one of understanding how firms organize to resolve the problem. Commentators began to raise issues such as moral hazard analysis, shirking, and opportunism not easy to explain using only transaction cost considerations and increasing attention was given to the problem of achieving incentive alignment of participants within the firm. (Demsetz).

Ownership and control issues have directly and indirectly raised a number of issues in law and economics that have been developed into firm theories. The most well known is the principle-agent model of the corporation in both law (Easterbrook and Fishel, Brudney) and economics (Fama 1980, Fama and Jensen, Jensen and Meckling), not separately addressed in this paper. Generally the principle-agent model has led to two themes in the literature. One theme is that the central issue in corporate law and economics is to reduce agency costs by devising methods to keep those controlling the corporation to the task of managing the firm for the benefit of the owners, the shareholders. A second theme is that the primary goal of the public corporation should be to maximize shareholders' wealth, leading to the question of relative positions of firm owners and resource owners. (See, *e.g.*, Greenwood).

Private ownership means that each input owner can produce and market the goods, sell the input outright, or enter into contractual arrangements and surrender the use of the input to an agent in exchange for an income. (Cheung 1983). The firm is a third option to this choice set. The entrepreneur or agent with a limited set of rights can, by contract, direct production without a direct reference to the price of each activity as if it were a market. (Cheung 1983). The reason that a private factor owner would surrender the rights over the allocation and use of the factors of production is, under transaction cost theory, to reduce transactions costs.

Another implication of the separation of ownership and control, also related to the problem of contracts and the uncertainty of nonperformance, is the problem of appropriation from owners. When an asset is owned by one entity and rented to another, the owner wishes to obtain quasi rent, that is, the value in its next best use to another renter. (Klein Crawford Alchian). If conditions in the market are such, however, that no alternative exists, the renter can appropriate the owner's quasi rent because the owner's alternative is nil. Restricted use assets are particularly subject to this behavior. If the quasi rent on one asset is closely tied to some other particular asset, both assets will tend to be owned by the same party. (Klein Crawford Alchian). Opportunistic behavior by renters presents a similar problem.

Separation of ownership and control is a recurring TGF theme. Separation of ownership and control occurs in the product itself when ownership rights are unbundled in limited-rights

transfers. Control over the use of a product has become common for many biotechnological products, and is a central issue in the capture of IPR value. In a somewhat more traditional assessment of separation of ownership and control, many observers and participants are concerned with the separation of ownership of factors of production from their control by non-owners. (See Hamilton 1994a). Introduction of the TGF provides a focal point for these issues and an example of solutions to the problems. How TGF solutions compare with those suggested by current theory is unknown at present.

Reactions to the principal-agent formulation of the firm and the agency cost and shareholder primacy principals associate with it have lead to proposals for modification, primarily in legal scholarship. Commentators in the “communitarian” or “progressive” school of corporate scholarship advocate the position that corporate directors, those in the control category, should be required to serve not only narrow shareholder wealth maximization goals but also those of other stakeholders such as employees, the corporation’s customers, creditors, and others. (Coffee, Greenwood, O’Connor, and Spoerl).

Another alternative to the principal-agent and the progressive formulations has recently been suggested by Blair and Stout. A “team production” view of the firm, more specifically the corporate firm, posits that all participants in a production process are team members. The team members are required to give up substantial rights, including property rights over the team’s joint output and team inputs such as financial capital and firm-specific human capital. The rights are surrendered to a legal entity created by the act of corporation. The distinguishing concept is that the assets formerly belonging to team members now belong to the corporation. The board of directors is in complete control of the use of the assets and allocation of results of production. The corporation is, importantly, a “mediating hierarchy” that mediates disputes among team members about allocation of results of production. Blair and Stout propose the team production theory as an alternative to the principal-agent analysis that focuses on the difficulties of drafting explicit contracts that keep agents faithful and the property rights analysis that proposes that contracting problems may be overcome by giving ultimate control rights to one party to the contract through ownership.

The TGF is amenable to analysis under the progressive or communitarian theories of the firm because one of its purposes is to identify what is happening in the production chain and how each participant’s interest is treated. The normative and pragmatic bases for the progressive theory apply to the TGF. In fact, a considerable part of the debate about biotechnological innovations in agriculture and the way participants are treated by the system used to capture IPR value is founded on the very issues giving rise to new corporate theories. While the team production theory addresses the important surrender of rights issues incorporated in the TGF, its dependence on complete surrender of property to a legal entity does not fit well with the TGF as formulated under present circumstances.

Institutional Contributions

While theories based on the rationality of economic actors with maximizing objectives dominate much of the literature on firm theory, economics and legal scholars take other views of the firm that provide a framework for analysis. The broader view of the firm includes factors that are not incorporated into many theories, factors based more on human behavior and its consequences as driving and shaping forces than on the calculus of maximization.

The history of institutional economics is rich and changing and only a note on more recent formulations of behavior-based views of the firm is appropriate. In his review of Chandler's 1990 overview of business enterprise growth and development, Teece notes that Chandler's work is shaped by the commanding thesis that the business firm and its managers are not merely reacting to broader technological and market forces. Rather, they are shaping technological development and market outcomes. Firms are not simply agents of the market. Markets are also agents of the firm. Generally, institutional economics places weight on factors of human behavior, particularly habit, and avoids characterizing all human economic behavior as nothing more than rational calculation. (Hodgson).

A variant of institutionalism is the view that the process by which a firm is created and designed may in itself affect the final formulation. (Williamson 1988). Although economic and legal analysis may dictate that a firm of a specific kind will exist in a defined set of environs, the process by which the firm arrives at its final form may yield a different result. While the proposition that process matters is widely resisted, Williamson deems it important. The issues surrounding the changes in agriculture brought about by biotechnological innovation suggest that the process of business, economic and legal innovation is tied to process more directly than de novo conversion to the most efficient final arrangement.

Both institutionalism and process theories of the firm are important with the introduction of the TGF. Our view that the human element in the firm supplies the elemental but extremely complex motivations that, in concert and in conflict, drive the firm to do what it does is a prime candidate for institutional economic analysis. If, for example, the entire industry were to be structured anew without antecedents, a much more efficient structure for a TGF may be instituted. It may take a form that is unacceptable to current participants or, for that matter, to the public at large if "farming" becomes unrecognizable and "farmers" as presently imagined are no longer an integral part of the food and fiber producing industry. The process must take into account tradition, particularly that of the farming tradition. Even more basic, however, is the institution of private ownership of resources in agriculture. As noted previously, this ownership of not only the product and its IPR value, but of the factors of production, shape the TGF. Full appreciation for all applications of theories will provide a richer and more understanding observation of the profound changes occurring in agriculture.

Further Research

It is clear that the TGF as hypothesized in this paper needs definition. Productive results to that end may be obtained by selecting a TGF candidate in a production chain now subject to new business and contractual arrangements occasioned by the introduction of a biotechnology-based product and strategies to capture the IPR's value. With that construct, it will then be possible to identify the participants, transactions, contracts, relationships, ownership, hierarchies, and other characteristics that define a TGF. With a particular TGF introduced and defined, analysis may proceed using the powerful tools and theories founded in the concepts and theories of the firm.

TGF theory itself requires further development, whether in close association with chosen existing theories of the firm or by formulating a new theory. Analysis will show which existing theories are most useful when applied to the TGF. Legal and economic analyses of the TGF may apply and extend current analytical methodology. Some of the major legal and economic issues to be addressed are evident from debates surrounding the introduction of biotechnology-based products and associated business arrangements that are changing agricultural production and distribution. Others will most certainly be discovered in the course of further research. TGF research can range in scope from macro-issues to the specific transactions, contracts and relationships within the TGF and transactions, contracts and relationships associated with the TGF's position in the reconstructed production chain. Organization theories at the boundary of law, economics and sociology will provide fruitful sources of ideas and methodologies.

The TGF lends itself to policy analysis by defining issues that are of concern to policy-makers and others, issues such as industry concentration, price discovery problems, the growth of integration and contract farming, diminution in the traditional roles of farmer producers, substitution of markets and market-determined pricing with internal and hierarchical decisions, and many others. In general, the public and policy-makers tend to view an industry as a simplified personification. For example, "biotechnology," despite the variety of methods, results, productions and introductions, may be thought of as a single phenomenon, as evidenced by general opposition to genetically modified products regardless of the product or its characteristics. A carefully conceived TGF, as a "personification of the industry," can provide a research tool with which to isolate issues, examine firm and participant behavior and the consequences surrounding biotechnology-based production, and identify specific conditions or arrangements causing the most concern.

Finally, participants in the production chain can benefit from a clear exposition of the character of the production chain and the participants' roles. The relative positions of participants can be compared and the forces adjusting positions in the production chain may be clarified. Those who are not satisfied with the role to which they have been relegated may use the TGF analysis to devise ways to improve their position or change the structure of the TGF to their advantage. The TGF may be used as a strategic planning device by individual participants or by the collection of participants making up the whole of the TGF.

The TGF, although introduced as a hypothetical firm with somewhat undefined characteristics, can, with care and imagination, be used to advance our understanding of the profound changes occurring in agriculture and address issues that will define agriculture well into the next millennium.

Endnotes

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²Krebs, David, and Michael Spence. 1985. Modelling the Role of History in Industrial Organization and Competition. p. 274. In George Feiwel (ed.) *Issues in Contemporary Microeconomics and Welfare*. London: Macmillan.

³Much productive literature about the firm has had, implicitly in earlier years and explicitly in recent years, an objective of combining law and economics disciplines. Part of this grew as a natural consequence of the Law and Economics movement in the last 30 years or so. In addition, however, several direct thrusts on the issues of the firm have occurred in the Law and Economics movement.

⁴Even undisturbed and unused resources may move from the line to the first level of enterprise by the mere fact that it is “owned” when some entity asserts dominion over it.

⁵This, too, shows the complexity of the chain. Final consumption does not completely end with consumption. Rather, the products resulting from final consumption such as disposal of packaging, sewage, and the modification of the economics of the final consumer by the consumption are also part of what has become an endless chain.

⁶Needless to say, the connecting lines as drawn only between serial firms in the chain do not represent all interactions. However, for purposes of exposition the only necessary interaction in the chain is with adjoining firms.

⁷The definition is formulated in terms of transactions, contracts, and relationships. In so doing, I am implicitly asserting that the three concepts collectively are necessary and sufficient to completely define any firm. The term “transaction” has the broad meanings usually prescribed in firm theory and the economic and legal literature on the subject. “Contract” includes explicit contracts, implicit and quasi-contracts, incomplete contracts, and contracts with terms assigned by contract law. “Relationship” includes issues of control, management organization, hierarchies, motivations, continuity, and other characteristics of a firm not easily captured in transactions and contracts.

⁸This is the primary reason that “relationships” is added to transactions and contracts as defining features.

⁹Williamson (1988) asserts that the delay in operationalizing the transactions costs theory because the burdens of “microanalysis” of transactions was one reason Coase’s firm theory languished for three decades. The “microanalysis” of every possible transaction to determine its costs is formidable.

¹⁰In theory, of course, they may be part of a bargaining and marketing system. (Coase (1960) and the plethora of offshoots, *e.g.*, Hovenkamp (1990), Regan, and Eastman). The TGF provides a forum for identification and discussion by bringing the issues into the locus of a firm analysis and the transactions, contracts and relations within the firm, and clarifying those between the TGF and others.

¹¹In significant ways, legal corporation theory has advance far beyond economic theories of the firm and represents the frontier of creative firm theory development.

¹²It may also be noted that the Coase theorem suggests further problems defining the distinction between inter- and intra-firm transactions in law and economics. (Eastman, Coase 1960, Coase 1988, Hovenkamp 1990).

¹³According to some commentators, investigation of the economics of contractual arrangements leads to the conclusion that Coase’s firm concept relates to the choice of contracts to include in the corporation.

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