DANISH **R**ESEARCH **U**NIT FOR **I**NDUSTRIAL **D**YNAMICS

DRUID Working Paper No. 99-5

Organizing Economic Experiments: The Role of Firms

by
Kirsten Foss & Nicolai J. Foss
March 1999

Organizing Economic Experiments: The Role of Firms

Kirsten Foss and **Nicolai J. Foss**
RESPECT
Department of Industrial Economics and Strategy
Copenhagen Business School
Nansensgade 19,6
1366 Copenhagen K
Denmark
Phone +45 3815 2556/62
Fax +45 3815 2540
E-mail eskimp@cbs.dk, esnjf@cbs.dk

March 17, 1999

Abstract

Many economists, including Austrian economists, have argued that the market process is essentially an experimental process. We briefly try to clarify this conceptualization, and then argue that we may understand the firm in much the same light. A basic view of the firm as an experimental entity is derived, drawing on property rights insights.

JEL Code

D21, D23, D83

Key words

The theory of the firm, Austrian economics, property rights.

ISBN(87-7873-075-9)

Contents

Introduction

This paper aims at establishing links between the Austrian theory of the market process and the theory of economic organization. Others have also explored this link, focusing on, for example, the contribution of Mises' (1936, 1949) analysis of economic calculation to the understanding of the firm's boundaries (Klein 1996) or on how Hayek's insights in dispersed knowledge furthers our understanding of the large firm's internal organization (Jensen and Meckling 1992). However, our perspective is different from these contributions.

Specifically, we begin from the Austrian notion of the market process as not only a superior method of integrating dispersed knowledge, but also of producing new knowledge (novelties). One of the reasons for this superiority lies in the experimental nature of the market process: Experiments in products, processes, organization, etc. are continuously being conducted and evaluated. Alienable property rights allow local decision-makers to carry out such experiments, to a large extent without seeking anybody's approval. It is this overall experimental view that we wish to transfer to the firm; thus, we consider a new *locus* for experimental activity.

Firms play a central and even dominant role in the process of economic experimenting as inventing and innovating teams – a fact that is reflected in neither Austrian economics, nor in the mainstream economics of organization. However, our point is that a perspective on firms as experimenting teams not only furthers our understanding of the dynamics of the market process, it also allows us to develop a novel perspective on the firm.

Novelties are brought forward by firms, and are tested in the experimental procedure of the market process. For example, novelties may become embodied in new products and enter into the market process in the form of transactions with consumers or industrial users. However, prior to this injection into the market process, novelties have been produced inside the firm, or, perhaps, in cooperation with two or more firms. These processes also involve transactions, or, more precisely, the exchange of property rights, between various agents. As an enormous literature informs us of, the definition, exchange and enforcement of property rights is not costless, the relevant costs being transaction costs. Therefore, performing economic experiments is costly, not only in terms of direct outlays (R&D expenses, etc.), or in the form of possible parallel experimentation, but also in terms of transaction costs.

Focusing on these costs and on how they are influenced and influence economic experiments allows us to address issues of economic organization. Thus, we look more closely into the mechanisms inside firms that endogenously produce change, such as learning, experimenting, and increasing division of labor, and tie this to issue of coordination by managerial allocation of rights inside the firm. We argue that the firm arises as an institution that coordinates a complex division of labor in a technological system, characterized by ongoing, endogenous change. Our discussion contributes to at least two areas of research. First, we contribute to Austrian economics by arguing that the characteristically Austrian emphasis on catallactic activity as often experimental in nature may be extended to the firm. Second, we contribute to the economics of organization by incorporating issues of learning and experimentation into this body of theory.

Economic Experiments and the Market Process

Many scholars have, in different ways and from very different positions, suggested that the metaphor of experimentation is a useful way to characterize market activity.[1] Thus, Nelson and Winter (1982) base their evolutionary theory on the notion that "… the market system is (in part) a device for conducting and evaluating experiments in economic behavior and organization" (Nelson and Winter 1982: 277).[2] In a somewhat broader context, namely that of political philosophy, open'ness to experiments in rules, organization, lifestyles, etc. has been one of the traditional arguments in favor of the liberal ("great", "open") society at least since the writings of John Stuart Mill. And a number of economic historians (e.g., Rosenberg and Birdzell 1986) have argued that "… the freedom to undertake … experiments has been the essential element accounting for the fact that industrialization has been, uniquely, a historical product of capitalist societies" (Rosenberg 1992: 181). Finally, it has been argued the basic problem facing public policy is the "…design of institutional arrangements that provide incentives to encourage experimentation … without overly insulating these experiments from the ultimate test of survival" (Demsetz 1969: 19). The property rights system plays the key role here (North 1990).

---

[1] In spite of the connotations to closed-system conditions in natural science that the word carries with it (Bhaskar 1978).

[2] These include Schumpeter (1911, 1943), Mises (1936, 1949), Hayek (1946, 1978), Alchian (1950), O'Driscoll and Rizzo (1985), Pelikan (1988), Eliasson (1990), Loasby (1991), Rosenberg (1992) and Harper (1996).

However, it is somewhat unclear what is actually meant by saying that the market process is one of continuous experimental activity. To clear up this is important because, as a general matter, an experiment may be a completely unpredictable "voyage of exploration into the unknown" (Hayek 1946: 101) at the one extreme. Or, it may be of the completely controlled kind where the purpose of the experiment is merely to confirm once more an already well-established conjecture (Bhaskar 1978) at the other extreme. In fact, Bayesian sampling of information may in a generous interpretation be seen as experimenting.[3] Thus, some types of experimental acitivty may be completely consistent with mainstream economics while others are only consistent with Austrian or radical subjectivist approaches. And some types of experiments may require firm organization while others don't.

Experimental Activity in the Market Process

A step towards clarifying this is provided by Littlechild's (1986) discussion of "three types of market process". Specifically, he (1986: 27) suggests that we distinguish between "ideal type" models of the market process based on

> ... how the decision makers perceive of the world, how these perceptions change over time, how these additional information may be sought, and how the decision maker can limit his exposure to uncertainty.

This leads Littlechild to identify three ideal typical models, namely what he calls the "neoclassical model" (e.g., Frydman 1982), the "Austrian model" (e.g., Kirzner 1973, 1992, 1997; High 1986) and the "radical subjectivist model" (e.g., Shackle 1972; Lachmann 1986; Loasby 1976, 1991; O'Driscoll and Rizzo 1985). All three in principle make room for experimental activity, albeit of different varieties.

This may become clearer if we also consider Kirzner's (1997) distinction between two ways of portraying ignorance in economic analysis. First, mainstream models of the asymmetric information variety essentially posit that while agents are ignorant about certain things, they know precisely the extent of their ignorance and can take steps, for example, through search activities, to remedy this ignorance. For example, an agent may conjecture that search for a certain price of a certain good in a certain geographical area is warranted in the sense that the expected benefit is larger than the expected search costs, and that conjecture may be borne out

[3] See Cyert and Kumar (1996) for this interpretation.

by actual events. This might be thought of as in a limited sense experimental activity. Similarly, perhaps stretching the word too far, we might think of risk-bearing behavior as broadly experimental.[4]

Second, there is also the distinct possibility that agents are actually ignorant about what they are ignorant about. In Kirzner's work, this ignorance is seen as being remedied by spontaneous discovery. This would seem to leave experimental activity out of consideration because setting up and conducting an experiment is a purposeful testing of a conjecture with an uncertain outcome and not a spontaneous discovery. However, we may think of experimental activity as one way in which agents reduce the ignorance that they are initially unaware of, for example, through serendipitious discoveries. Moreover, introducing uncertainty into the activities of the Kirznerian entrepreneur remedies the problem: if the entrepreneur's activities may be seen as uncertain conjectures about arbitrage possibilities, then surely these activities too may be characterized as experimental.

While Kirzner's distinction clearly covers what Littlechild (1986) characterizes as the neoclassical and the Austrian model, it is less clear how it relates to the radical subjectivist model; in fact, it would seem to apply only to some extent. Clearly, in the radical subjectivist model, agents are exposed to surprises (Shackle 1972). This implies that they are ignorant about their own ignorance, otherwise genuine surprises could not take place. On the other hand, the radical subjectivist model stresses imagination, the ability to construct the choice set, and the subsequent testing of choices in the market process (O'Driscoll and Rizzo 1985). It is a view that is perhaps in greater conformity with the conventional understanding of experimentation than the two other views. However, all three captures some aspects of experimental activity. We may sum up these insights in the table below.[5]

[4] A relevant consideration in this connection is whether information about a risky event is generally shared or not. Thus, risk-taking behavior when there is substantial disagreement about the probability of the occurrence of a certain event (and it is therefore hard to insure against) is more deserving of being called experimental than when there is agreement on the probability (and the event is therefore easily insurable).

[5] The quotations in the table are from Littlechild (1986: 24).

TABLE 1

Models of the market process			
	Neoclassical	**Austrian**	**Radical subjectivist**
Characterization of the future	The agent can fully characterize the vector of variables that is relevant for his actions and can fully characterize the proba-bility distributions of these variables.	The future "… is a vector of which the agent knows some components but not others".	The future "… is not so much unknown as it is non-existent or indeter-minate at the time of decision. The agents task is not to estimate or discover, but to create"
Agents' know-ledge	Agents know what they don't know. Ignorance is reduced through search.	Agents don't know what they don't know. Ignorance is reduced through spontaneous discovery.	Same as in Austrian model. Knowledge is inherently conjectural.
Economic experimentation	Reduction of known ignorance; Bayesian updating of priors; risk-bearing.	A means to foster spontaneous disco-very.	A result of imagina-tion: a test of a bold conjecture.

As the table reveals, any sort of forward-looking and risky decision-making may be broadly characterized as experimental. However, in order to focus the discussion, we shall in the following associate experimental activity with choice situations characterized by a high degree of imperfection of knowledge about the future, and therefore a state of uncertainty that is deeper than what is normally assumed in mainstream economics. Thus, the conventional search model does not in this view portray experimental behavior. In our view, agents may still hold subjective probabilities about the outcomes of events. However, the key point is that when we are talking about experimental activity *proper*, what is involved are events about which disseminated knowledge is not present in the market.

Introducing a new product (rather than a product variation), a new process of production, or a new type of organization (e.g., Dupont's introduction of the M-form after First World War (Chandler 1962)) are instances of commercial experimental activity. In contrast, if what is involved are events that are well-understood (in terms of causal connections and possibly even probability distributions), we shall not – in our terminology -- be dealing with experimental activity proper.

Implications for Economic Organization

There are some – but not many – hints scattered in the economics of organization that experimentation and economic organization are related issues. Thus, Knight (1921) stressed the forward-looking, conjectural nature of entrepreneurial activity and tied this to both the existence of profit and the nature of the firm. In Knight's view, the entrepreneur's conjectures are so much clouded by uncertainty and so much inside the entrepreneur's own head that they cannot be communicated to other agents or insured. In order to capture profit from his commercial conjecture, the entrepreneur has to set up a firm with himself in the position of residual claimant. Thus, a combination of communication costs (Foss 1993) and moral hazard (Barzel 1987) explains both the firm and profit as a residual income category in Knight's view. This is one way of linking economic organization and commercial experimentation in the marketplace.

In his discussion of the "Nature of the Firm", Coase (1937) implicitly establishes a second link. As Coase (1937) observes, it is "... improbable that a firm would emerge without the existence of uncertainty", and it is clear from the context that he has Knightian uncertainty in mind. In an often quoted passage, Coase (1937: 21) notes that

> It may be desired to make a long-term contract for the supply of some article or service ... 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 desirable it is for the person purchasing to specify what the other contracting party is expected to do ... Therefore, the service which is being provided is expressed in general terms, the exact details being left until a later date ... When the direction of resources ... becomes dependent on the buyer in this way, that relationship which I term a "firm" may be obtained.

While there is nothing in Coase's discussion to suggest that he had experimentation in mind, we shall suggest that one benefit of the combination of hierarchical direction and the incomplete employment contract is that this eases the conducting of experiments inside the firm (e.g., with new technologies or organization structures) (see also Loasby 1991). More generally, the property rights structure that characterizes the firm may crucially reflect not only the desire to conduct commercial experiments but also a desire to safeguard against uncertainty

and its consequences.[6] In order to develop this view of the firm, we shall rely on property rights economics (e.g., Barzel 1997).

An Experimental View of the Firm

In this section we develop an experimental view of the firm. Our argument is based on a combination of insights about the economic implications of property rights and Austrian and radical subjectivist insights into imagination and entrepreneurial discovery. On this basis, we shall seek a rationale for firm organization in the superior ability to conduct commercial experiments that firms may have relative to markets.

Property Rights

At first glance, the property rights approach (Alchian, 1965; Barzel, 1989; Coase, 1960; Demsetz, 1964, 1969; Eggertson, 1990; Libecap, 1989; North, 1990) seems at variance with Austrian economics.[7] In fact, some parts of the approach, such as (certain interpretations of) the Coase theorem, have been criticized by Austrian economists (e.g., Kirzner 1973: 226-7). However, what may be objectionable in the property rights approach from an Austrian point of view are not the specific analytical categories developed within this approach *per se*. In fact, Austrians have for a long time devoted interest to the category of property and its economic implications (e.g., Böhm-Bawerk 1881; Mises 1936).[8]

Conventionally, property rights include *use rights*, which define the potential uses of an asset; i*ncome rights*, or the right to consume an asset; *rights to exclude* non-owners from access to assets, and *rights to transfer* permanently to another party all the above mentioned

---

[6] Littlechild (1986: 35) suggested something similar when he argued that "... ownership of a resource reduces exposure to unexpected events. Property rights are a means of reducing uncertainty without needing to know precisely what the source or nature of the future concern will be", and this overall insight can arguably be found in much of the modern theory of the firm (Grossman and Hart 1986; Hart 1995; Williamson 1996).

[7] Note that we primarily refer to the "older" property rights approach of Coase, Alchian, Demsetz, Barzel, etc. rather than to the more recent property rights approach that has been developed by Oliver Hart and various colleagues (e.g., Grossman and Hart 1986; Hart and Moore 1990). For an argument that these are two different approaches and that older approach is some important dimensions superior to the more recent one, see Foss and Foss (1999).

[8] The aspects that an Austrian may object to are rather the assumptions in the approach that agents always seek to maximize the value of the rights they control and that the process of exchanging rights can be represented in terms of equilibrium. Indeed, at least one writer (Eggertson 1990) characterizes the approach as "generalized neoclassical economics". But Austrians should not have problems with the basic notion that property rights are the rights people hold over assets.

rights over an asset – that is to alienate or sell an assets. Barzel (1994: 394) provides a convenient summing-up of the economic concept of property rights "... as an individual's net valuation, in expected terms, of the ability to directly consume the services of the asset, or to consume it indirectly through exhange. A key word is *ability*: The definition is concerned not with what people are legally entitled to do but with what they believe they can do".[9]

Because property rights define the relationships among individuals with respect to scarce assets, they are social institutions. However, it is important to observe that property rights systems may exist at several levels (among which there are hierarchical relations). Thus, the law, norms and mores of society define and delimit the range of privileges granted to individuals to assets. The combination of property rights and their institutional support is a "property rights system". However, property rights systems also exist on lower levels than the societal level, notably inside firms (Williamson, 1985; Grossman and Hart 1986; Barzel 1997). Thus, the system of property rights existing in a firm refers to the set of relations that define the position of each agent with respect to other agents and with respect to the assets with which the team works (Alchian 1984).

Historically, the property rights approach emerged from the insight that what is exchanged are not assets *per se*, but rather the rights to those assets (Coase, 1960; Alchian 1965). However, the exchange of rights is not costless. For example, often physical and human assets have different properties and may sometimes yield a number of different services depending on how the assets are used. In principle, each one of the properties and different uses of assets can be specified and be subject to negotiations between parties to a transaction. Moreover, use rights over different properties or uses of assets may be shared between individuals (Barzel, 1997). To specify and to contract over the different possible uses of assets are clearly costly actions – more precisely, they involve transaction costs. In the property rights framework, transaction costs are conceptualized as the costs due to the transfer, capture and protection of rights (Barzel 1997: 2). When such costs exist, not everything will be specified in contracts – they are left incomplete.

[9] This, we note in passing is completely consistent with Mises' point that ownership refers to "the power to use economic goods", that "… ownership is the *having* of the goods which the economic aims of men require", and that "… the economic significance of the legal *should have* lies only in the support it lends to the acquisition, the maintenance and the regaining of the natural *having"* (Mises 1936: 27).

Changing Property Rights

While property rights theorists have done much to clarify the meanings and ramifications of property they have done comparatively little to clarify *why* systems of property rights change over time, although some historical evidence has been brought to bear on this issue (Demsetz 1964; North 1990). *How* systems of property rights change have also been a neglected issue, because of the underlying comparative-static method in the property rights approach.[10]

Our response to these difficulties begins from the observation that the two issues of why and how property rights change are twin issues. Thus, from an Austrian perspective property rights change because of entrepreneurial alertness[11]; alert entrepreneurs may discover that some rearrangement of existing property rights or some capture of rights that are in the public domain increase their own utility. Clearly, this is an extension of the Kirznerian view of the entrepreneur (Kirzner 1973, 1992, 1997). Kirzner tends to take the property rights structure as given, and inquire into the arbitrage activities that alert entrepreneurs pursue inside this structure. However, in our view the concept of entrepreneurial discovery should be broadened to also encompass discoveries related to re-definitions and capture of property rights, and not just to the exchange of these.

It is this augmented entrepreneurial perspective that we apply to firms. In our view, firms are prime vehicles for entrepreneurial experimentation with products and processes because the property rights systems that characterize firms often allows this experimentation to be carried out at lower costs than in markets. Moreover, and what we shall focus on in the following, firms are also vehicles for experimentation with property rights structures *themselves*. Organizational changes -- such as outsourcing, changes in organizational structure, team-based management, etc. -- are thus experiments with the property rights structures of firms. But so are the more mundane trials and errors involved in setting up a smoothly running production system consisting of many interdependent specialized tasks,

[10] In Demsetz' (1967) famous example of how property rights changed among …. indians, the process of change itself is thus a black box.

[11] In the political realm, this process of entrepreneurs influencing the definition of property rights is of course known as "rent-seeking". The concept has also been applied to firms' internal organization (Milgrom 1988). But entrepreneurs grasping rights is a much wider concept than the concept of rent-seeking. Any attempts to capture rights that are in the public domain (Barzel 1997) may thus be seen as manifestations of entrepreneurial alertness.

possibly spanning several stages of production. In fact, to focus our discussion, we shall focus on exactly this kind of experimentation.

Experimenting with running a production system is only needed if there is uncertainty with respect to the best way of operating technically interdependent production systems. In the world portrayed by the neoclassical theory of production, this is not fundamentally a problem: Everything is laid out in the book of blueprints; thus, experimentation is not necessary (Nelson and Winter 1982). However, as the Austrians emphasize production technologies are not just given: They have to be discovered, and often discovered anew, for example, when unanticipated changes in preferences, technology and regulation make a change of the firm's capital strcuture necessary (Lachmann 1956). In this sort of experimenting with heterogeneous production technologies, we find a key function of the entrepreneur. As Lachmann (1956: 13, 16) stressed,

> … We are living in a world of unexpected change; hence capital combinations … will be ever changing, will be dis-solved and re-formed. In this activity, we find the real function of the entrepreneur.
>
> [T]he entrepreneur's function … is to *specify* and make decisions on the concrete form the capital resources shall have. He specifies and modifies the layout of his plant ... As long as we disregard the heterogeneity of capital, the true function of the entrepreneur must also remain hidden. In a homogenous world there is no scope for the activity of specifying.

We agree fully with Lachmann's points that interdependencies between assets are important for understanding the problem of organization, that unexpected contingencies upset existing combinations, that the entrepreneur task is to coordinate the uses of assets, and that most of the attendant problems would be trivialized in a homogeneous world.[12] In the terminology used here, a homogeneous world would be one in which the assignment of use rights to assets would be trivialized. Since all assets would be (perfect) substitutes, there would be no problem of managed coordination, although there might be problems of moral hazard related to the use of assets, requiring some monitoring. In this world, it would be hard to discriminate between firms and markets.

[12] By a "homogenous world", Lachmann means one where assets are only substitutes, not complements, and, furthermore, that all capital assets (save perhaps for human capital) are perfect substitutes.

Specialization and Property Rights

As Adam Smith pointed in *The Wealth of Nations,* specialization in production is a source of productivity improvements. Specifically, he ascribes productivity gains to improvements in a worker's ability to perform a task as it is repeated more often, the time that is saved from avoiding having to switch from one task to another, and an improved ability of workers to identity labor saving innovations. At least the first and third advantages of the division of labour are related to improvements in knowledge. Thus, the discovery of new knowledge is aided by the division of labor (Richardson 1975). In fact, as Brian Loasby (1995: 302) has argued:

> …the division of labour is to be thought of, not as a model of the efficient allocation of a given array of skills, but as a method of fostering the development of skills, and indeed generating other kinds of knowledge. It is a discovery process".

Many of the labor saving innovations envisaged by Adam Smith are results of workers' experiments with their own tasks in their own "circumstances of time and place" (Hayek 1945). In our perspective, the extent of this experimentation depends on the allocation of property rights – notably use rights – inside the firm. Thus, there is a connection between discovery and learning on the one hand and the allocation of use rights on the other hand. This connection is a consequence of the fact that learning and discovery will often require the exercise of use rights over assets. Patterns of learning depend on the allocation of use rights between different individuals over time and specialization in production may be one reason for reallocation of use rights. Thus, specialization in production can be tied to the possession of use rights to the extent that we interpret specialization as reflecting a subdivision of use rights over assets.[13]

This implies that the extent of experimentation depends on how well-specified and easily monitored use rights are, since the more well specified they are, the less able are those who use assets to experiment and the more constrained will their experimentation and discovery be.[14] Discretion may thus enable individuals to learn a broader set of skills and to conduct

[13] So that each individual holds rights over a more narrow set of assets or holds a more narrow set of rights over the same assets.

[14] If, for example, the manner in which a computer operator runs a program is pre-specified in a contract and easily monitored, his learning by doing may be limited to improving the speed with which he activates the

experiments which may result in innovations. In this sense, there is a direct link between property rights and possibilities of discovery.

Coordination and Property Rights

So far we have told a rosy story inspired by both Smith and Hayek in which the discretionary behavior of local agents result in productivity gains. However, discretionary behavior may not always result in such gains. First, if the discretionary behavior takes place inside a firm, shirking or other ways of appropriating a greater part of the value from the use of an asset are possible instances of discretionary behavior.[15] Thus, there is a clear trade-off here between local innovativeness and the provision of incentives (Jensen and Meckling 1992). The allocation of residual income rights from the use of an asset can be a powerful mean of reducing shirking.

Second, discretionary behavior may give rise to problems if strong technological interdependencies are involved.[16] In this case, discretionary behavior may result in bottlenecks or in uneven development of components. From our perspective, these seemingly technological problems can in actuality be ascribed to imperfectly specified rights over assets as production tasks are subdivided. This is because it is difficult to specify all valued dimensions of assets *prior to* specialization, since many of the valued dimensions of assets only become apparent from *experimenting* with the uses of assets and discovering the best uses of those assets.[17] However, given a great deal of interdependence in a complex system, the best time and place to use an asset depend on the specification of the uses of all other assets that are needed in production.

---

keyboard. If he has greater discretion in deciding how to operate the program, he might have a greater opportunity for learning by experimenting.

[15] In Leijonhufvud's (1986) story, the interdependencies that characterize the division of labour also introduce the possibility of hold-up (Klein, Crawford, and Alchian 1978; Williamson 1985). We neglect this possibility here.

[16] See Milgrom and Roberts (1992: chapter 4). The concept of "complementarities" in the modern economics of organization (idem.; Hart 1995) covers much of what we mean by interdependencies. (Complementarities/interdependencies were also much emphasized in Austrian capital theory, e.g., Lachmann 1956). However, in contrast to the modern economics of organization, we emphasize coordination rather than hold-up problems and the like.

[17] Even if important dimensions can in fact be specified, it may be difficult to allocate these rights in ways that ensure the best use of assets. This may, for example, be the case with the time and place dimension of assets where non-optimal allocations result in excess stocks of intermediate products or in idle assets.

This creates costs of specialization due to unsolved coordination problems, that is, problems of making agents' plans mesh (Hayek 1937; Malmgren 1961). In firms, such coordination problems emerge as, for example, problems of bottlenecks. These are problems where complexity and interdependent activities make it difficult to specify how best to sequence various activities, or where the introduction of more specialized tools and equipment creates capacity utilization problems due to technical indivisibilities, or where innovations in individual activities result in an uneven development of tools, equipment and components. Basically these problems arise when those who deliver parts or carry out activities are not aware of the need for mutual adjustment, or do not have the incentive to make their activities mesh with those of others.

Solving problems that arise from technological interdependencies is an important souse of innovative improvements (Rosenberg 1976; Sahal 1981). However, such innovations do not emerge because of increased specialization, but because of learning in coordination. The question then arises: what governance structure best provides for experimentation and accumulation of experience in coordination? We shall follow basic Coasian arguments (Coase 1937, 1991), and stress that one of the reasons why managed coordination may be advantageous relative to price coordination is because the former reduces costs of learning about the coordination of technological interdependent tasks. We try to explicate such a view in the following.

Experimenting and Learning: the Role of Management

Virtually all contributors to the theory of the firm (Langlois 1992) being one exception) take the costs of coordinating various tasks, as well as the extent of specialization in the economy, as given. However, the cost of coordination of tasks may crucially depend on the degree of specialization. Self-management of more tasks may be an alternative to specialization that reduces overall costs of production in cases where coordination between many specialized and interdependent tasks proves costly. The degree of specialization therefore depends on the marginal costs of coordinating increasingly specialized tasks and the marginal benefits from specialization.

It is in the handling of some of the coordination problems associated with interdependencies between tasks that we may find a rationale of the firm. Specifically, firms can be viewed as solutions to problems of coordination in situations where use rights over assets cannot be

perfectly specified and allocated in manners which ensures the functionality of complex technologies. Such situations may occur because agents have only limited computational capacity (Williamson 1985), making it to difficult for them to specify use rights in ways that solve problems of interdependencies. Or they may occur because agents face uncertainty in the sense that they lack ability to imagine "... the alternatives between which decisions are made" (Littlechild 1986: 29).

This kind of uncertainty (which characterizes the radical subjectivist market model) has typically been attributed to the possibility of inventions that change the set of alternatives between which economic agent can choose and thus also the structure of (shadow) prices. However, uncertainty in a non-probabilistic sense is also associated with much experimental activity. In the context of firm activity, experiments take place in the form of the many trials and errors involved with setting up a smoothly running production system which consist of many interdependent specialized tasks. Of course, such experimentation is only needed if there is uncertainty with respect to the best way of operating technically interdependent production systems. Due to such technological uncertainty, firms may start different kinds of experiments and follow different paths of learning.

The firm provides a low cost way of discovering solutions to coordination problems related to bottlenecks and uneven development of components. For managed direction of resources to be efficient, it is required that entrepreneurs are at least as qualified in discovering the relevant prices (that is, finding the highest valued uses of assets) as independent contractors would be.[18] Otherwise, costs of transacting may be saved at the expense of efficiency in the use of resources. If entrepreneurs are better able to determine the valuable uses of resources compared to other agents, entrepreneurs have a ownership advantage over resources. Such an advantage explains the single person firm, but not necessarily why entrepreneurs hire employees who are prepared to take orders within certain limits in order to take advantage of

[18] Coase (1937) mentions "..increasing opportunity costs due to the failure of entrepreneurs to make the best use of the factor of production" (p.23) as one of the factors which set a limit to the efficient size of a firm. He also assumes that "..the costs of losses through mistakes will increase with an increase in the spatial distribution of the transactions organized, in the dissimilarity of the transactions, and in the probability of changes in the relevant prices. As more transactions are organized by an entrepreneur, it would appear that the transactions would tend to be either different in kind or in different places" (p.25). Managers, in other words, have limited capacity to "discover the relevant prices" and this increases mistakes as more and more dissimilar transactions are organized in a firm.

this knowledge. Entrepreneurs could as well rent the labor time of an agent in return for the exercise of a certain well specified task.

However, in actuality, entrepreneurs stand a good chance of acquiring superior knowledge about the best uses of the assets that make up a complex technology. From the innovation literature, it is apparent that the solution to problems of bottlenecks and uneven development in components are based on learning by doing in production and development (Rosenberg 1976; Sahal 1981). The argument here is that this experience from learning by doing is probably more easily accumulated within the boundaries of firms. One of the reasons why one might expect this learning to be less costly within the boundaries of firms may be that entrepreneurs who hold residual rights over assets -- including rights to re-define and reallocate specific rights -- are able to conduct experiments. They can do this without continuously having to re-negotiate contracts (which will have more or less unforeseen outcomes because of the uncertain nature of the experimental process). This saves all sorts of costs related to time, bargaining and contract drafting.[19]

Entrepreneurs are then able to create "controlled" experiments in which they only change some aspects of the tasks in order to trace the effects of some specific re-arrangements of rights. Setting up a controlled experiment may be more difficult across the boundaries of firms, particularly when interdependencies exists between firms and if it is difficult to specify all the tasks which must and must not be changed. Coordinating interdependent tasks within the boundaries of a firm may provide entrepreneurs with a more complete picture of the nature of interdependencies. Such information is not only important in relation to eliminating bottlenecks, but also in relation to avoiding problems of uneven development of components by setting up interface standards and other more permanent solutions.

So far, the argument has been that relative to markets, firms may economize on the transaction costs of learning the best way of coordinating technological interdependent systems. Now, once a firm has discovered how to coordinate some specialized tasks, there would be little advantage from managed direction relative to market transacting, and coordination by order contracts would substitute for coordination by management.[20]

[19] In this connection wage contracts may be an efficient way of sharing risks from experimenting.

[20] Managed direction could still be advantageous in cases where adaptation of interdependent production systems to unforseen contingences were called for.

However, such specialization between firms would give way to economic gains from further specialization in tasks, and this *in turn* would create new uncertainty and new opportunities for reducing coordination costs by experimenting. In other words, there will be an *ongoing process* of specialization in tasks, learning in coordination and specialization between firms and new ways of coordination will continuously be imagined by entrepreneurs, much like the process of cumulative causation envisaged by Allyn Young (1928). Thus, firms contain many mechanisms that *endogenously* produce change, such as the (related) mechanisms of ongoing learning, experimenting, and changes in the division of labor. Therefore, while there may be optimal time paths of firm growth, our reasoning would indicate that it is doubtful whether there is an optimum size of the firm (cf. also Penrose 1959).

Conclusion

In this paper, we have brought Austrian ideas to bear on the theory of the firm. In particular, we have argued that it is possible to arrive at an experimental view of the firm from broadly Austrian principles. Thus, the experimental view of the firm developed here stresses the role of the firm as a repository for a broad range of experiments, mostly with production technology. It is a view that stresses the role of discovery and learning. However, experimental activities are in general costly, and are particularly to be so when experimentation with strongly interdependent technologies is involved. The costs of coordinating such technologies may be reduced by bringing them in-house. This explains the existence of the firm from an experimental point of view.

The story we have tried to tell in this paper is broadly consistent with much of the modern economics of organization. Thus, we have borrowed ideas from the property rights literature (e.g., Barzel 1997), and have applied these ideas to settings involving complementarities between assets and activities (Milgrom and Roberts 1992; Hart 1995). However, we have given these ideas distinctively Austrian and radical subjectivist interpretations, first, by stressing the experimental nature of economic activity, second, by arguing that a primary task of the entrepreneur/manager is to conduct controlled experiments with interdependent production technologies, and, third, by stressing that the goal of these experiments is to achieve internal plan consistency (i.e., make the production process run smoothly). Clearly, all this can be taken further. For example, entrepreneurs also initiate experiments in order to launch new products that in turn may be tested in the experimental procedure of the market

process. However, our main aim in this paper has been to suggest that Austrian and radical subjectivist ideas mesh with important insights in mainstream economics, and that new insights emerge from combining these bodies of theory.

References

Alchian, Armen A. 1950. “Uncertainty, Evolution, and Economic Theory,” in idem. 1977. *Economic Forces at Work*. Indianapolis: Liberty Press.

Alchian, Armen A. 1965. “Some Economics of Property Rights,” in idem. 1977. *Economic Forces at Work.* Indianapolis: Liberty Press.

Alchian, Armen A. 1984. “Specificity, Specialization, and Coalition,” *Journal of Institutional and Theoretical Economics* 140: 34-49.

Arrow, Kenneth J. 1962. “Economic Welfare and the Allocation of Resources for Invention, “ in *The Rate and Direction of Inventive Activity: Economic and Social factors*. Princeton: Princeton University Press.

Barzel, Yoram. 1982. “Measurement Costs and the Organization of Markets,” *Journal of Law and Economics* 25: 27-48.

Barzel, Yoram. 1987. “The Entrepreneur’s Reward for Self-Policing,” *Economic Inquiry* 25: 103-116.

Barzel, Yoram. 1994. “The Capture of Wealth by Monopolists and the Protection of Property Rights,” *International Review of Law and Economics* 14: 393-409.

Barzel, Yoram. 1997. *Economic Analysis of Property Rights*, 2nd ed., Cambridge: Cambridge University Press.

Bhaskar, Roy. 1978. *A Realist Theory of Science.* Brighton: Harvester-Wheatsheaf.

Boudreaux, Don and Randall G. Holcombe. 1989. “The Coasian and Knightian Theories of the Firm,” *Managerial and Decision Economics* 10: 147-154.

Böhm-Bawerk, Eugen von. 1881. “Whether Legal Rights and Relationships are Economic Goods,” in Hans Sennholz, ed. 1962. *Shorter Classics of Böhm-Bawerk*. South Holland: Libertarian Press.

Casson, Mark. 1997. *Information and Organisation*. Oxford: Oxford University Press.

Chandler, Alfred D. 1962. *Strategy and Structure*. Cambridge, MA: MIT Press.

Cheung, Stephen N.S. 1983. “The Contractual Nature of the Firm, “ *Journal of Law and Economics* **26**: 1-22.

Coase, Ronald H. 1937. “The Nature of the Firm,” *Economica* **4**: 386-405, in Oliver E. Williamson and Sidney G. Winter. 1991. *The Nature of the Firm*, Oxford: Oxford University Press.

Coase, Ronald H. 1960. “The Problem of Social Cost,” *Journal of Law and Economics* **3**: 1-44.

Coase, Ronald H. 1991. “The Nature of the Firm: Origin, Meaning, Influence,” in Oliver E. Williamson and Sidney G. Winter. 1991. *The Nature of the Firm*, Oxford: Oxford University Press.

Cyert, Richard M. and Praveen Kumar. 1996. “Economizing by Firms through Learning and Adaptation,” *Journal of Economic Behavior and Organization* 29: 211-31.

Demsetz, Harold. 1964. “The Exchange and Enforcement of Property Rights,” Journal of Law and Economics,7: 11-26.

Demsetz, Harold. 1967. “Toward a Theory of Property Rights,” in idem. 1988. *Ownership, Control, and the Firm*. Oxford: Basil Blackwell.

Demsetz, Harold. 1969. “Information and Efficiency: Another Viewpoint,” in idem. 1989. *Efficiency, Competition and Policy*. Oxford: Basil Blackwell.

Eggertson, Thráinn. 1990. *Economic Behavior and Institutions*. Cambridge: Cambridge University Press.

Eliasson, Gunnar. 1990. “The Firm as a Competent Team,” *Journal of Economic Behavior and Organization* 13: 275-298.

Foss, Nicolai J. 1993. “Theories of the Firm: Contractual and Competence Perspectives,” *Journal of Evolutionary Economics* 3: 127-144.

Kirsten Foss and Nicolai J. Foss. 1999. “Contracts and Ownership: Residual Rights of Control versus Appropriable Control Rights,” *mimeo*.

Frydman, Roman. 1982. “Towards an Understanding of Market Processes”, *American Economic Review* **72**: 652-668.

Grossman, Sanford and Oliver Hart. 1986. “The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration” *Jounal of Political Economy* **94**:691-719.

Harper, David. 1996. *Entrepreneurship and the Market Process: An Enquiry Into the Growth of Knowledge*. London: Routledge.

Hart, Oliver. 1991. “Incomplete Contracts and the Theory of the Firm,” in Oliver E. Williamson and Sidney G. Winter. 1991. *The Nature of the Firm*, Oxford: Oxford University Press.

Hart, Oliver. 1995. *Firms, Contracts, and Financial Structure*, Oxford: Clarendon Press.

Hart, Oliver and John Moore. 1990. “Property Rights and the Nature of the Firm” *Journal of Political Economy* **98**: 1119-1158.

Hayek, Friedrich A. von. 1937. “Economics and Knowledge,” in idem. 1948. *Individualism and Economic Order*. Chicago: University of Chicago Press.

Hayek, Friedrich A. von. 1945. “The Use of Knowledge in Society,” in idem. 1948. *Individualism and Economic Order*. Chicago: University of Chicago Press.

Hayek, Friedrich A. von. 1946. “The Meaning of Competition,” in idem. 1948. *Individualism and Economic Order*. Chicago: University of Chicago Press.

Hayek, Friedrich A. von. 1968. “Competition as a Discovery Procedure,” in idem. 1978. *New Studies in Philosophy, Politics, Economics, and the History of Ideas*. London: Routledge and Kegan Paul.

High, Jack. 1986. *Maximizing, Action, and Adjustment*. München: Philosophia Verlag.

Jensen, Michael C. and William H. Meckling. 1992. “Specific and General Knowledge and Organizational Structure,” in Lars Werin og Hans Wijkander, eds. 1992. *Contract Economics*. Oxford: Blackwell.

Kirzner, Israel M. 1973. *Competition and Entrepreneurship*, Chicago: University of Chicago Press.

Kirzner, Israel M. 1992. *The Meaning of the Market Process*. London: Routledge.

Kirzner, Israel M. 1997. “Entrepreneurial Discovery and the Competitive Market Process: An Austrian Approach,” *Journal of Economic Literature* 35: 60-85.

Klein, Peter. 1996. “Economic Calculation and the Limits of Organization,” *Review of Austrian Economics* 9: 3-28.

Klein, Benjamin, Robert G. Crawford, and Armen A. Alchian. 1978. “Vertical Integration, Appropriable Rents, and the Competitive Contracting Process,” *Journal of Law and Economics* **21**: 297-326.

Knight, Frank H. 1921. *Risk, Uncertainty, and Profit.* 1964 ed. New York: Augustus M. Kelley.

Kreps, David M. 1996. “Markets and Hierarchies and (Mathematical) Economic Theory,” *Industrial and Corporate Change* **5**: 561-595.

Lachmann, Ludwig M. 1956. *Capital and Its Nature*. 1978. Kansas City: Sheed Andrews and MvNeel.

Lachmann, Ludwig M. 1986. *The Market as an Economic Process*, Oxford: Blackwell.

Langlois, Richard N. 1992. “Transaction Cost Economics in Real Time”, *Industrial and Corporate Change* **1**: 99-127.

Lavoie, Don. 1985. *Rivalry and Central Planning.* Cambridge: Cambridge University Press.

Langlois, Richard N. and Paul L. Robertson. 1995. *Firms, Markets and Economic Change*, London: Routledge.

Leijonhufvud, Axel. 1986. “Capitalism and the Factory System,” in Richard N. Langlois. 1986. *Economics as a Process*, Cambridge: Cambridge University Press.

Littlechild, Stephen C. 1986 “Three Types of Market Process,” in Richard N. Langlois. 1986. *Economics as a Process*, Cambridge: Cambridge University Press.

Loasby, Brian J. 1976. *Choice, Complexity, and Ignorance*, Cambridge: Cambridge University Press.

Loasby, Brian J. 1991. *Equilibrium and Evolution*. Manchester: Manchester University Press.

Loasby, Brian J. 1995. “The Division of Labour,” *History of Economic Ideas* 4: 299-323.

Malmgren, Harald B. 1961. “Information, Expectations, and the Theory of the Firm,” *Quarterly Journal of Economics* 75: 399-421.

Mises, Ludwig von. 1936. *Socialism*. 1981 ed. Indianapolis: Liberty Press.

Mises, Ludwig von. 1949. *Human Action*. London: William Hodge.

Milgrom, Paul and John Roberts. 1992. *Economics, Organization, and Management.* Englewood Cliffs: Prentice-Hall International.

Nelson, Richard R. and Sidney G. Winter. 1982. *An Evolutionary Theory of Economic Change*, Cambridge, MA: Belknap Press.

North, Douglass C. 1990. *Institutions, Institutional Change, and Economic Performance*, Cambridge: Cambridge University Press.

O’Driscoll, Gerald P. and Mario Rizzo. 1985. *The Economics of Time and Ignorance*, Oxford: Basil Blackwell.

Pelikan, Pavel. 1988. “Why the Imperfect Innovation System of Capitalism Cannot be Outperformed,” in Giovanni Dosi et al., eds. 1988. *Technical Change and Economic Theory*. London: Pinter.

Penrose, Edith T. 1959. *The Theory of the Growth of the Firm*. Oxford: Oxford University Press.

Richardson, George B. 1975. “Adam Smith on Competition and Increasing Returns,” in idem. 1998. *The Economics of Imperfect Knowledge.* Aldershot: Edward Elgar.

Rosenberg, Nathan. 1976. *Perspectives on Technology*, Cambridge: Cambridge University Press.

Rosenberg, Nathan. 1992. “Economic Experiments,” *Industrial and Corporate Change* 1: 181-203.

Rosenberg, Nathan and Lawrence Birdzell. 1986. *How the West Grew Rich*. New York: Basic Books.

Sahal, Devendra. 1981. *Patterns of Technological Innovation*, Reading: Addison-Wesley.

Schumpeter, Joseph A. 1911. *The Theory of Economic Development*. 1983 ed. New Brunswick: Transaction Publishers.

Schumpeter, Joseph A. 1943. *Capitalism, Socialism and Democracy*.

Shackle, George L.S. 1972. *Epistemics and Economics*, Cambridge: Cambridge University Press.

Smith, Adam. 1776. *An Inquiry Into the Nature and Causes of the Wealth of Nations*. 1981 ed. Indianapolis: Liberty Press.

Williamson, Oliver E. 1985. *The Economic Institutions of Capitalism*. New York: Free Press.

Young, Allyn. 1928. “Increasing Returns and Economic Progress,” *EconomicJournal* **38**: 527-542.

Danish **R**esearch **U**nit for **I**ndustrial **D**ynamics

The Research Programme

The DRUID-research programme is organised in 3 different research themes:

- The firm as a learning organisation

- Competence building and inter-firm dynamics

- The learning economy and the competitiveness of systems of innovation

In each of the three areas there is one strategic theoretical and one central empirical and policy oriented orientation.

Theme A: The firm as a learning organisation

The theoretical perspective confronts and combines the ressource-based view (Penrose, 1959) with recent approaches where the focus is on learning and the dynamic capabilities of the firm (Dosi, Teece and Winter, 1992). The aim of this theoretical work is to develop an analytical understanding of the firm as a learning organisation.

The empirical and policy issues relate to the nexus technology, productivity, organisational change and human ressources. More insight in the dynamic interplay between these factors at the level of the firm is crucial to understand international differences in performance at the macro level in terms of economic growth and employment.

Theme B: Competence building and inter-firm dynamics

The theoretical perspective relates to the dynamics of the inter-firm division of labour and the formation of network relationships between firms. An attempt will be made to develop evolutionary models with Schumpeterian innovations as the motor driving a Marshallian evolution of the division of labour.

The empirical and policy issues relate the formation of knowledge-intensive regional and sectoral networks of firms to competitiveness and structural change. Data on the structure of production will be combined with indicators of knowledge and learning. IO-matrixes which include flows of knowledge and new technologies will be developed and supplemented by data from case-studies and questionnaires.

Theme C: The learning economy and the competitiveness of systems of innovation.

The third theme aims at a stronger conceptual and theoretical base for new concepts such as 'systems of innovation' and 'the learning economy' and to link these concepts to the ecological dimension. The focus is on the interaction between institutional and technical change in a specified geographical space. An attempt will be made to synthesise theories of economic development emphasising the role of science based-sectors with those emphasising learning-by-producing and the growing knowledge-intensity of all economic activities.

The main empirical and policy issues are related to changes in the local dimensions of innovation and learning. What remains of the relative autonomy of national systems of innovation? Is there a tendency towards convergence or divergence in the specialisation in trade, production, innovation and in the knowledge base itself when we compare regions and nations?

The Ph.D.-programme

There are at present more than 10 Ph.D.-students working in close connection to the DRUID research programme. DRUID organises regularly specific Ph.D-activities such as workshops, seminars and courses, often in a co-operation with other Danish or international institutes. Also important is the role of DRUID as an environment which stimulates the Ph.D.-students to become creative and effective. This involves several elements:

- access to the international network in the form of visiting fellows and visits at the sister institutions
- participation in research projects
- access to supervision of theses
- access to databases

Each year DRUID welcomes a limited number of foreign Ph.D.-students who wants to work on subjects and project close to the core of the DRUID-research programme.

External projects

DRUID-members are involved in projects with external support. One major project which covers several of the elements of the research programme is DISKO; a comparative analysis of the Danish Innovation System; and there are several projects involving international co-operation within EU's 4th Framework Programme. DRUID is open to host other projects as far as they fall within its research profile. Special attention is given to the communication of research results from such projects to a wide set of social actors and policy makers.

DRUID Working Papers

96-1 **Lundvall, Bengt-Åke:** The Social Dimension of the Learning Economy. (ISBN 87-7873-000-7)

96-2 **Foss, Nicolai J.:** Firms, Incomplete Contracts and Organizational Learning. (ISBN 87-7873-001-5)

96-3 **Dalum, Bent and Villumsen, Gert**: Are OECD Export Specialisation Patterns Sticky?= Relations to the Convergence-Divergence Debate. (ISBN 87-7873-002-3)

96-4 **Foss, Nicolai J:** Austrian and Post-Marshallian Economics: The Bridging Work of George Richardson. (ISBN 87-7873-003-1)

96-5 **Andersen, Esben S., Jensen, Anne K., Madsen, Lars and Jørgensen, Martin:** The Nelson and Winter Models Revisited: Prototypes for Computer-Based Reconstruction of Schumpeterian Competition. (ISBN 87-7873-005-8)

96-6 **Maskell, Peter:** Learning in the village economy of Denmark. The role of institutions and policy in sustaining competitiveness. (ISBN 87-7873-006-6)

96-7 **Foss, Nicolai J. & Christensen, Jens Frøslev:** A Process Approach to Corporate Coherence. (ISBN 87-7873-007-4)

96-8 **Foss, Nicolai J.:** Capabilities and the Theory of the Firm. (ISBN 87-7873-008-2)

96-9 **Foss, Kirsten:** A transaction cost perspective on the influence of standards on product development: Examples from the fruit and vegetable market. (ISBN 87-7873-009-0)

96-10 **Richardson, George B.:** Competition, Innovation and Increasing Returns. (ISBN 87-7873-010-4)

96-11 **Maskell, Peter:** Localised low-tech learning in the furniture industry. (ISBN 87-7873-011-2)

96-12 **Laursen, Keld:** The Impact of Technological Opportunity on the Dynamics of Trade Performance. (ISBN 87-7873-012-0)

96-13 **Andersen, Esben S.:** The Evolution of an Industrial Sector with a Varying Degree of Roundaboutness of Production. (ISBN 87-7873-013-9)

96-14 **Dalum, Bent, Laursen, Keld & Villumsen, Gert**: The Long Term Development of OECD Export Specialisation Patterns: De-specialisation and AStickiness@. (ISBN 87-7873-014-7)

96-15 **Foss, Nicolai J.:** Thorstein B. Veblen: Precursor of the Competence-Based Approach to the Firm. (ISBN 87-7873-015-5)

96-16 **Gjerding, Allan Næs:** Organisational innovation in the Danish private business sector. (ISBN 87-7873-016-3)

96-17 **Lund, Reinhard & Gjerding, Allan Næs:** The flexible company Innovation, work organisation and human ressource management. (ISBN 87-7873-017-1)

97-1 **Foss, Nicolai J.:** The Resource-Based Perspective: An Assessment and Diagnosis of Problems. (ISBN 87-7873-019-8)

97-2 **Langlois, Richard N. & Foss, Nicolai J.:** Capabilities and Governance: the Rebirth of Production in the Theory of Economic Organization. (ISBN 87-7873-020-1)

97-3 **Ernst, Dieter:** Partners for the China Circle? The Asian Production Networks of Japanese Electronics Firms. (ISBN 87-7873-022-8)

97-4 **Richardson, George B.:** Economic Analysis, Public Policy and the Software Industry. (ISBN 87-7873-023-6)

97-5 **Borrus, Michael & Zysman, John:** You Don=t Have to Be A Giant: How The Changing Terms of Competition in Global Markets are Creating New Possibilities For Danish Companies. (ISBN 87-7873-024-4)

97-6 **Teubal, Morris.:** Restructuring and Embeddeness of Business Enterprises-Towards an Innovation System Perspective on Diffusion Policy. (ISBN 87-7873-025-2)

97-7 **Ernst, Dieter & Guerrieri, Paolo:** International Production Networks and Changing Trade Patterns in East Asia: The case of the Electronics Industry. (ISBN 87-7873-026-0)

97-8 **Lazaric, Nathalie & Marengo, Luigi:** Towards a Characterisation of Assets and Knowledge Created in Technological Agreements: Some evidence from the automobile-robotics sector. (ISBN 87-7873-027-9)

97-9 **Ernst, Dieter.:** High-Tech Competition Puzzles. How Globalization Affects Firm Behavior and Market Structure in the Electronics Industry. (ISBN 87-7873-028-7)

97-10 **Foss, Nicolai J.:** Equilibrium vs Evolution in the Resource-Based Perspective: The Conflicting Legacies of Demsetz and Penrose. (ISBN 87-7873-029-5)

97-11 **Foss, Nicolai J.:** Incomplete Contracts and Economic Organisation: Brian Loasby and the Theory of the firm. (ISBN 87-7873-030-9)

97-12 **Ernst, Dieter & Lundvall, Bengt-Åke:** Information Technology in The Learning Economy B Challenges for Developing Countries. (ISBN 87-7873-031-7)

97-13 **Kristensen, Frank Skov.:** A study of four organisations in different competitive environments. (ISBN 87-7873-032-5)

97-14 **Drejer, Ina, Kristensen, Frank Skov & Laursen, Keld:** Studies of Clusters as a Basis for Industrial and Technology Policy in the Danish Economy. (ISBN 87-7873-033-3)

97-15 **Laursen, Keld & Drejer, Ina.:** Do Inter-sectoral Linkages Matter for International Export Specialisation? (ISBN 87-7873-034-1)

97-16 **Lundvall, Bengt-Åke & Kristensen, Frank Skov.:** Organisational change, innovation and human ressource Development as a response to increased competition. (ISBN 87-7873-036-8)

98-1 **Præst, Mette.:** An Empirical Model of Firm Behaviour: A dynamic Approach to Competence Accumulation and Strategic Behaviour. (ISBN 87-7873-037-6)

98-2 **Ducatel, Ken.:** Learning and skills in the Knowledge Economy. (ISBN 87-7873-038-4)

98-3 **Ernst, Dieter.:** What Permits Small Firms to Compete in High-Tech Industries? Inter-Organizational Knowledge Creation in the Taiwanese Computer Industry. (ISBN 87-7873-039-2)

98-4 **Christensen, Jens Frøslev.:** The Dynamics of the Diversified Corporation and the Role of Central Management of Technology. (ISBN 87-7873-040-6)

98-5 **Valente, Marco.:** Laboratory for Simulation Development. (ISBN 87-7873-041-4)

98-6 **Valente, Marco.:** Technological Competition: a Qualitative Product Life Cycle. (ISBN 87-7873-042-2)

98-7 **Lam, Alice.:** The Social Embeddedness of Knowledege: Problems of Knowledge Sharing and Organisational Learning in International High-Technology Ventures. (ISBN 87-7873-043-0)

98-8 **Jørgensen, Kenneth M.:** Information Technology and Change in Danish Organizations. (ISBN 87-7873-044-9)

98-9 **Andersen, Esben Sloth:** Escaping Satiation in an Evolutionary Model of Structural economic Dynamics. (ISBN 87-7873-045-7)

98-10 **Foss, Kirsten:** Technological Interdependencies, Specialization and Coordination: A Property Rights Perspective on The Nature of the Firm. (ISBN 87-7873-046-5)

98-11 **Andersen, Poul H.:** Organizing International Technological Collaboration in Subcontractor Relationships. An Investigation of the Knowledge-Stickyness Problem. (ISBN 87-7873-047-3)

98-12 **Nymark, Søren:** Billeder af strategi i forandringsrige organisatoriske omgivelser: 3 cases fra DISKO studierne. (ISBN 87-7873-048-1)

98-13 **Andersen, Esben Sloth:** The Evolution of the Organisation of Industry. (ISBN 87-7873-050-3)

98-14 **Foss, Kirsten & Foss, Nicolai J.:** The Market Process and The Firm: Toward a Dynamic Property Rights Perspective. (ISBN 87-7873-051-1)

98-15 **Lorenz, Edward.** Societal Effects and the Transfer of Business Practices to Britain and France. (ISBN 87-7873-053-8)

98-16 **Ernst, Dieter.** Catching-Up, Crisis and Industrial Upgrading. Evolutionary Aspects of Technological Learning in Korea's Electronics Industry. (ISBN 87-7873-054-6)

98-17 **Kaisla, Jukka.** The Market Process and the Emergence of the Firm: Some Indications of Entrepreneurship Under Genuine Uncertainty. (ISBN 87-7873-055-4)

98-18 **Laursen, Keld.** Do Export and Technological Specialisation Patterns Co-evolve in Terms of Convergence or Divergence?: Evidence from 19 OECD Countries, 1971-1991. (ISBN 87-7873-056-2)

98-19 **Foss, Nicolai J.:** Firms and the Coordination of Knowledge: Some Austrian Insights. (ISBN 87-7873-057-0)

98-20 **Mahnke, Volker & Aadne, John Harald:** Process of Strategic Renewal, Competencies, and the Management of Speed. (ISBN 87-7873-058-9)

98-21 **Lorenzen, Mark:** Information, cost learning, and trust. Lessons form co-operation and higher-order capabilities amongst geographically proximate firms. (ISBN 87-7873-059-7)

98-22 **Lam, Alice:** Tacit Knowledge, Organisational Learning and Innovation: A Societal Perspective. (ISBN 87-7873-060-0)

98-23 **Lund, Reinhard:** Organizational and innovative flexibility mechanisms and their impact upon organizational effectiveness. (ISBN 87-7873-061-9)

98-24 **Christensen, Jesper Lindgaard & Drejer, Ina:** Finance and Innovation System or Chaos. (ISBN 87-7873-062-7)

98-25 **Laursen, Keld:** How Structural Change Differs, and Why it Matters (for Economic Growth) (ISBN 87-7873-063-5)

98-26 **Holmén, Magnus & Jacobsson, Staffan:** A method for identifying actors in a knowledge based cluser. (ISBN 87-7873-064-3)

98-27 **Richardson, G. B.:** Production, Planning and Prices. (ISBN 87-7873-065-1)

98-28 **Foss, Nicolai J.:** Austrian Economics and Game Theory: a Preliminary Methodological Stocktaking. (ISBN 87-7873-067-8)

98-29 **Foss, Nicolai J. & Mahnke Volker:** Strategy Research and the Market Process Perspective. (ISBN 87-7873-068-6)

98-30 **Laursen, Keld:** Revealed Comparative Advantage and the Alternatives as Measures of International Specialisation. (ISBN 87-7873-069-4)

99-1 **Lorenz, Edward:** Organisational Innovation, Governance Structure and Innovative Capacity In British and French Industry. (ISBN 87-7873-070-8)

99-2 **Ernst, Dieter:** Responses to the Crisis: Constraints to a Rapid Trade Adjustment in East Asia's Electronics Industry. (ISBN 87-7873-071-6)

99-3 **Foss, Nicolai J.:** Understanding Leadership: A Coordination Theory. (ISBN 87-7873-072-4)

99-4 **Foss, Kirsten & Foss, Nicolai J.:** Understanding Ownership: Residual Rights of Control and Appropriable Control Rights. (ISBN 87-7873-073-2)

99-5 **Foss, Kirsten & Foss, Nicolai J.:** Organizing Economic Experiments: The Role of Firms. (ISBN 87-7873-075-9)

Information for subscribers.
Subscription price for 1997 is 600 DKR (about 20 papers). The rate for single issues is 40 DKR. It is possible to make a commitment to an exchange of papers from related departments or research teams. All correspondence concerning the DRUID Working Papers should be send to.

Pernille Wittrup
Fibigerstræde 4
DK-9220 Aalborg OE
Tel. 45 96 35 82 65
Fax. 45 98 15 60 13
E-mail: druid-wp@business.auc.dk