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Learning in firms: Knowledge-based and property rights perspectives

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Abstract. – Proponents of the knowledge-based approach to the firm argue that organizational economics put all the burden on the allocation of incentives and property rights in the explanation of organizational phenomena, and neglects firm-specific knowledge and processes of learning. We argue that there is no inherent reason why organizational economics should be cut off from treating learning and exploring its organizational implications. More specifically, we demonstrate that it is possible to adopt an approach to learning that is consistent with rational choice methodology and stresses economizing, puts the emphasis on learning as a means of realizing efficiencies, is micro-analytic, and contains implications for economic organization. We concentrate on the role of experimentation as a means of finding solutions to coordination problems in complex production systems (*e.g.*, finding the optimal sequence of activities) and the transaction costs learning-by-experimenting may create. Such transaction costs help determine the existence, boundaries and internal organization of the firm, and have implications for the understanding of competitive advantage.

1. Introduction

Ever since its take-off period at the beginning of the nineteen-seventies (Williamson, 1971; Alchian and Demsetz, 1972), organizational economics (henceforth, "OE") has never been without vocal critics. Much of the contemporary critique is represented by the knowledge-based approach to the firm (henceforth, the "KBA"). Proponents of this approach argue that they offer explanations of organizational phenomena that rival those offered in organizational economics (*e.g.*, Conner, 1991; Kogut and Zander, 1992, 1996; Grant, 1996; Madhok, 1996; Spender, 1996; Nahapiet and Ghoshal, 1999). As Kogut and Zander (1992, p. 384) note, the KBA view "... differs radically from that of the firm as a bundle of contracts that serves to allocate efficiently property rights". And Madhok (1996, p. 578) argues that because OE "...basically ignores the essential notion of the

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firm as a bundle of knowledge, and the underlying processes therein" it is fundamentally "... is fundamentally incapable of being a complete theory of economic organization". Moreover, KBA writers claim that it is possible to address the existence, boundaries, and internal organization of the firm – that is, the *explananda* of OE – in terms of processes of accumulating, utilizing, and storing knowledge (Grant, 1996), a focus that also has strong implications for the understanding of competitive advantage. In essence, KBA writers claim that theirs is a perspective that is inherently more dynamic, and that OE is cut off from such a dynamic perspective because of its neglect of learning.

In this paper, we offer a discussion and an assessment of, first, how much the KBA itself really has to say about learning in firms, and, second, of the potential of OE to address this issue. We shall provocatively argue that, in actuality, the KBA has relatively little to offer with respect to such learning ("*Learning, and the Knowledge-Based Approach"*). Although it is correct that thus far OE has had little to say about learning [1], it is in no way cut off from addressing this issue and how it connects to economic organization. From an OE perspective, these issues should be addressed using a *micro-analytic* focus; an *economizing* approach which directs attention to efficiency issues; and *comparative institutionalism* which requires arguments of why one institution may more efficiently organize learning processes than another one. Thus, OE is a superior starting point for building an explanation of what exactly it is that may make firms more efficient institutions for organizing learning processes – something which is assumed rather than demonstrated in the KBA (*e.g.*, Kogut and Zander, 1996; Madhok, 1996).

In fact, we shall argue along such lines by developing the idea – mentioned by Coase (1937) but noted by only a few of his followers – that firms may exist because of the flexibility afforded by a structure of incomplete contracts and the discretion provided by managerial authority. Specifically, we develop this idea into an argument that firms may have learning advantages because the use of incomplete contracts and the discretion provided by authority are low-cost ways of conducting controlled experiments with, for example, production technology (K. Foss, 2000) or marketing efforts (Cyert and Kumar, 1996). In other words, firms may more efficiently set up and conduct sequential optimal designs of experiments in order to discover relevant information (*cf*. Blackwell, 1951).

In our view, understanding why this is so requires a micro-analytic focus that directs attention to the rights of and constraints on agents with respect to carrying out actions that may provide new information. Such a focus is supplied by the property rights perspective (Alchian, 1965; Demsetz, 1964; Barzel, 1997; Hart, 1995) ("*Learning, Economic Organization, and Property Rights*"). As we shall argue, there is a highly complex link between the distribution of rights in a firm and firm-level learning ("*Learning and Economic Organization: AProperty Rights Perspective"*). To our knowledge, this is the first attempt in the literature to tease out implications for learning in firms from such a

[1] While bounded rationality is fully acknowledged by many contributors to OE (*e.g.*, Williamson, 1985, 1996, 1998; Jensen and Meckling, 1992), the broader ramifications of bounded rationality (as represented by, *e.g.*, March, 1999) are never inquired into. For example, satisficing search is absent in most OE treatments. Bounded rationality mostly partakes of the limited role of rationalizing the incompleteness of complex contracts (Williamson, 1985, 1996).

perspective. We show how a combined learning-property rights perspective has implications for the existence and boundaries of the firm and also relate to issues of internal organization and competitive advantage. In particular, we argue that firms may be cost-efficient institutions for what we call "learning-by-experimenting", an argument that we support by drawing on organizational economics, particularly the property rights perspective.

We also treat various implications and ramifications of the approach, such as the general applicability of an experimental approach to firms and the distinction between individual and organization learning ("*Discussion*").

2. Learning and the Knowledge-Based Approach

The KBA very much reflects a number of diverse influences, and arguably exists in somewhat different versions (*e.g.*, competence-based and resource-based approaches, the capabilities approach, etc.). In this section, we shall briefly restate some of the main insights of the KBP with respect to competitive advantage, the boundaries of firms, the existence of firms and the internal organization [2]. According to KBA writers, these issues should be addressed by means of a theoretical "language" that places such concepts as resources, routines, capabilities, learning, and bounded rationality center-stage rather than opportunism, incentives and property rights (notably Kogut and Zander, 1992).

2.1. *The Knowledge-Based Approach*

As already stated, the relation between the KBA and OE is often seen as one of rivalry. To quote two proponents of the KBA:

> ''Our view differs radically from that of the firm as a bundle of contracts that serves to allocate efficiently property rights [*i.e.*, OE]... Rather, we suggest that organizations are social communities in which individual and social expertise is transformed into economically useful products and services ... Firms exist because they provide a social community of voluntaristic action structured by organizing principles that are not reducible to individuals'' (Kogut and Zander, 1992, p. 384).

To get an idea of the differences between the OE and the KBA, we here summarize the KBA analysis as it relates to the central issues of competitive advantage, and the boundaries, existence and internal organization of the firm. The latter three of these four issues are, of course, the key issues that OE has traditionally tried to address. We place particular emphasis on these issues as they relate to learning.

2.2. *Competitive advantage and learning*

The KBA begins from the notion of the firm as a bundle of heterogeneous resources. Because resources mesh with each other in a team-like manner, they are worth more to the firm than to the market (meaning other firms). They therefore yield rents. Arguably,

[2] For a more methodological discussion of the KBA, see Foss and Foss (2000a).

much of the KBA analysis of the ability of resources to yield rents has been cast in a equilibrium mold where interest centers on whether it is possible to sustain an equilibrium with firms characterized by resources of different efficiencies (Lippman and Rumelt, 1982; Barney, 1991; Peteraf, 1993). However, in itself this analysis hardly comes to grips with the sources of heterogeneity. Thus, firms are seen as facing a distribution of *given*, heterogeneous resources; rents from acquiring superior resources then stems from either luck (Lippman and Rumelt, 1982) or superior insight into the resource's true value (Barney, 1986). To the extent that the KBA aspires to being a normative theory, this is obviously unsatisfactory: The analysis only advises managers to be lucky or better informed than suppliers of inputs!

Not surprisingly, therefore, interest has increasingly focused on how firms themselves can create and improve resources (arguably at some cost in terms of analytical precision). Thus, resources such as routines, capabilities, competencies, etc. (in the following, we use the word "capabilities" to capture all these) are now seen as central to the explanation of competitive advantage, rather than those resources that can be purchased on factor markets (Dierickx and Cool, 1989; Teece *et al.*, 1997). A distinction is made in the literature between two types of capabilities. The first type of capability is the ability to organize (coordinate, integrate) existing resources; for example, they allow "multiple individuals [to] integrate their specialist knowledge" (Grant, 1996, p. 112). The other type of capability refers to the firm's ability to engage in learning (*i.e.*, "dynamic capabilities", Teece *et al.*, 1997). Because both types of capabilities may be tacit and firm-specific, they may be costly to imitate for would-be imitators. In fact, according to KBA writers, capabilities are particularly likely to meet the KBA conditions for sustained competitive advantage [3].

Considered as a normative theory, KBA has now changed from advising managers to be lucky or better informed in their capacity as purchasers of resources, to advising them to develop superior (dynamic) capabilities. However, it is characteristic of the literature that little is actually said about the means of fostering superior capabilities. In our view, this is due to the facts that, first, very little is said in the KBA about the nature of learning, and, second, very little is said about how the firm as an institution may promote (certain types of) learning relative to market organization.

2.3. *The boundaries of the firm and learning*

Capabilities are also placed centerstage in the KBA approach to the issue of the boundaries of the firm. This may be most clearly seen in the KBA analysis of diversification. In this analysis, the development of capabilities is seen as steered by strong inertial forces that narrowly circumscribe learning domains (Teece *et al.*, 1997). For example, excess management capabilities may be created as a natural by-product of the firm's activities (Penrose, 1959), but may only be deployed in closely related industries. This may be

[3] According to this analysis, only heterogeneous, rare and hard-to-imitate resources that are, moreover, acquired in imperfect factor markets can be rent-yielding strategic assets to firms (Barney 1991; Peteraf 1993). See Foss and Knudsen (2000) for a critique of this analysis.

seen as an instance of a general KBA proposition, namely that firms avoid undertaking activities that require dissimilar capabilities. Instead, the services from such capabilities are acquired through markets or inter-firm relations, depending on the degree of complementarity of activities (Richardson, 1972). Very specific and strategically important capabilities have to be deployed internally, due to the absence of markets for these assets (Dierickx and Cool, 1989). To sum up, in the KBA the boundaries of the firm are determined by capabilities that are argued to be the result of a time-consuming and path-dependent process of learning.

While there are many challenging and useful insights in the KBA analysis of the boundaries of the firm, the analysis suffers from the use of intuitive, yet essentially undefined concepts that are nevertheless claimed to be important determinants of the boundaries of the firm. Notably, it is not clear what is meant by capabilities being "similar" or "dissimilar" (as recognized by Richardson, 1972, himself), or by the learning domain being "narrow," although these concepts are seen as central to an understanding of where firms will place their boundaries [4]. Therefore, in its present stage of development the analysis does not allow for an identification of the firm's efficient boundaries. Moreover, for an approach that places so much emphasis on knowledge building, there is a surprisingly static quality to the analysis of the boundaries of the firm. Thus, there is little analysis of how the boundaries of the firm change under the impact of learning [5].

2.4. *The existence of the firm and learning*

According to KBA writers, the issue of why firms exist can be addressed in terms of capabilities and learning rather than in terms of incentives and property rights. Thus, according to Kogut and Zander (1992), firms can – because of an asserted and somewhat mystical function as "moral communities" and bodies of what they call "higher-order organizing principles" – create learning processes and achieve coordination that are inaccessible under market relations. In other words, firms exist because they more efficiently than markets produce, store and utilize capabilities. The obvious problem with this explanation is that exactly the same argument has been made on behalf of markets (Foss, 1996a, b). Thus, Hayek (1945) famously argued that the market's superiority must ultimately be traced to its superior learning capabilities. KBA analysis does not offer clear criteria that tells us why firms as institutions should be superior with respect to learning than markets are, that is, when we should expect to see firms arise from market relations because rational agents choose this institutional structure to govern their joint learning processes. This is not to say that criteria cannot be constructed from KBA analysis; in fact, one may argue that such criteria can be found in what KBA writers have said about internal organization. We turn to this next.

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[4] We do believe, however, that with respect to the analysis of the boundaries of the firm, the KBA points to important determinants that are neglected in OE (*cf.* Langlois and Robertson, 1995; Langlois and Foss, 1999).

[5] The work of Langlois and Robertson (1995) is a partial exception to this claim. Even in this work, however, firm-specific learning processes are not spelled out in any detail.

2.5. *Internal organization and learning*

Some KBA writers claim that the approach has implications for understanding internal organization that are completely different from OE (Ghoshal and Moran, 1996; Ghoshal *et al.*, 1995). Implicitly, these implications may be used for rationalizing of the existence of the firm in terms of its superior abilitity to foster and organize learning processes, that is, accumulate capabilities. The argument goes roughly as follows. Empirical evidence from big companies suggest that these firms do not fundamentally use the kind of control and incentive mechanisms in their internal organization that an OE perspective would lead one to believe (Ghoshal *et al.*, 1995) [6]. Rather, these companies try hard to construct a "shared context", that is, an internal institutional context that not only acts as a coordinating device but more fundamentally influences the values and ambitions of employees. This assists "… the development and utilization of local knowledge for local initiatives" (Ghoshal *et al.*, 1995, p. 752). In other words, the rationale of internal organization is to stimulate an ongoing learning process. In contrast, OE is claimed to be "bad for practice" (Ghoshal and Moran, 1996), because it operates with an overly cynical view of human nature. Thus, to follow the prescriptions flowing from OE will result in perverse psychological responses and impede the development and utilization of local knowledge for local initiatives.

The main problem with this analysis is not that it is incorrect (although the polemics against OE are), but that it doesn't go sufficiently far. Thus, it is correct that firms rely more on "low-powered" incentives than markets do, and that there is some sort of connection between such incentives and learning. However, this connection is not very strongly developed in the KBA.

2.6. *Discussion*

The KBA is often marketed as an approach that, compared to other approaches to economic organization, places learning centerstage in the explanation of issues such as the competitive advantage, existence, boundaries, and internal organization of the firm (Grant, 1996; Spender, 1996). For example, different path-dependent learning processes lead to differential capabilities that in turn help to explain competitive advantage and the boundaries of the firm. The existence and internal organization of firms are explained in a functionalist fashion by pointing to a purported superior capability of firms relative to markets to build capabilities, that is, engage in organizational learning. Moreover, KBA writers usually stress that it is possible to somehow construct theoretical links between learning processes and these phenomena that does not make use of OE reasoning relating to incentives and property rights in the explanation (Kogut and Zander, 1992, 1996; Grant, 1996). For example, the approach is claimed to offer an explanation of the existence of firms that is "opportunism-independent" (Conner and Prahalad, 1996).

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[6] It is not completely clear what is meant by arguing that OE prescribes "blunt control" and high-powered incentives as characteristics of firm organization. On the contrary, OE writers have long recognized that firms do *not* in general use high-powered incentives (Williamson, 1985; Holmström and Milgrom, 1991).

Although the KBA deserves much credit for stressing firm-level learning, we have argued that the approach does not successfully establish links between learning and capabilities (*i.e.*, the asserted outcomes of firm-specific learning processes) on the one hand, and between learning, capabilities and economic organization (*i.e.*, the existence, boundaries and internal organization of firms) on the other hand. Because the links between individual learning processes, firm-level learning and capabilities as the outcomes of learning processes are only vaguely described, capabilities are essentially a black box in the KBA. Although the notion of firm capability may turn out to be a useful meta-concept, it is at present without clear theoretical foundations in theories of individual behavior (Foss and Foss, 2000a). To the extent that arguments about economic organization, not to mention normative arguments (*e.g.*, about firm strategy), involve the notion of capabilities, some healthy skepticism is therefore advisable.

One possible reason for the confusion that we discern in the KBA is the lack of a more rigorous theoretical understanding of the problems that require firm organization rather than market organization. For example, Williamson's brand of transaction cost economics started out with a very well defined problem, namely that of the efficiency implications of vertical integration (Williamson, 1971). In his attempt to provide answers to this problem, Williamson inquired into the characteristics of mainstream economics which made an efficiency-oriented explanation of vertical integration difficult, which – in turn – made it possible for him to substitute these with concepts that were appropriate to his aim (*e.g.*, opportunism and incomplete contracts). This allowed Williamson and other contributors to OE to arrive at an exemplary instance of solving a well-defined problem from which OE could build in a cumulative fashion.

In contrast, KBA arguments rather loosely turn on the development of learning and innovation capabilities that purportedly markets cannot develop (Kogut and Zander, 1992, 1996; Grant, 1996; Spender, 1996). In a friendly reading, there is an underlying efficiency argument underneath the reasoning. Although one may thus argue that KBA writers also try to provide answers to problems of economic organization, these problems are not well-defined in the sense that problems in OE are well-defined. One reason for this is that is not clear what is the background knowledge against which KBA problems are indeed problems. To illustrate, in the early stages of the development of OE, this background knowledge was mainstream economics: Organizational phenomena (*e.g.*, vertical integration) could not be rendered intelligible in the context of mainstream economics – but at least it was possible to see where changes had to be made and how. Thus, one important reason for the progress of OE has been the relative ease with which problems could be defined and solved, because the relevant background knowledge and the associated problem-solving heuristics were so well defined.

In our view, much of the value of the KBA stems from its pointing to a host of interesting real-world phenomena that theorizing should take seriously and which have so far been largely neglected in the OE (Foss and Foss, 2000a). However, the KBA will benefit from more clearly defining what are the relevant real-world phenomena, explaining why these phenomena represent challenges for theorizing, clarifying the theoretical background knowledge against which these phenomena are challenges, and, finally, provide rigorous explanations of the relevant phenomena. This is not to say that the KBA should necessarily adopt the efficiency-equilibrium-optimization mode of explanation that characterizes OE. Other avenues may be possible. However, in our view, OE ideas are in fact very useful for focusing

and furthering KBA insights. In the following section, we sketch how ideas on the efficient allocation of property rights may be used for this purpose. More specifically, we argue that these ideas can be used for the establishing an understanding of learning in firms, and for connecting learning in firms with economic organization and competitive advantage.

3. Learning, economic organization, and property rights

3.1. *Learning and economic organization: Some heuristic suggestions*

The KBA is characterized by treating firm learning in a rather abstract and general manner. Thus, there is a plethora of references to firms learning (*e.g.*, Kogut and Zander, 1992, 1996; Madhok, 1996), without many discussions of the finer aspects of learning in firms (as contained in, *e.g.*, March, 1999). Thus, it is seldom made clear in a precise manner how individual and organizational learning relate, what is required for organizational learning to take place, how learning is influenced by the firm's organizational structure and by its reward systems, etc. Moreover, it is seldom made explicit how learning contributes to competitive advantage. More specifically, what are the problems that learning helps to solve? Thus, the notion of learning and the use made of the notion in the KBA is diffuse (*cf.* also Williamson, 1999). This, we submit, is why KBA attempts to link together learning and economic organization are so unconvincing.

Because of the inherent complexity of the notion of learning and its ramifications, discussions of learning in firms should begin from well-defined problems in well-defined settings, so that the complexity of the issues is manageable. Thus, what exactly is it that learning is supposed to do and how should learning processes be organized to accomplish this aim? Who are involved in the relevant learning processes, and how do individual learning activities connect (if at all)? In turn, these insights should as far as possible be phrased in a unified language. Our understanding of learning is, first, based on the premise that learning is a means to improve problem-solving abilities (Dosi and Marengo, 1994). However, this does not bring us much further in understanding learning and how it connects to economic organization, unless we define what sort of (organizational) problems that learning relates to. Typically, this is what KBA writers have not done. From an economic point of view, the relevant problems relate to increasing efficiency in the use of resources. The aim of learning, in this view, is to improve efficiency. Thus, a firm has learned if it has increased its potential for improving the efficiency with which it makes use of resources and this increase can be ascribed to a change in the stock of knowledge of one or more agents in the firm [7].

[7] It may be argued that such learning is "static" and does not relate to issues of innovation. This is incorrect. A (successful) innovation, whether relating to products or processes, is an efficiency improvement. Moreover, some may argue that our notion of learning is rational, incremental, centered on inference from experience, and only related to successful outcomes of trials. However, we believe that our notion is sufficiently broad to encompass many types of learning and it does not only relate to successful outcome of trials. With respect to the latter objection, even a failed experiment in a firm is likely to increase the *potential* for improving the efficiency with which the firm makes use of resources, since the failure provides additional information. With respect to the types of learning that our notion encompasses, we don't see any problems with including, for example, the development of cognitive categories (Denzau and North, 1994).

Although this does not mean that learning becomes reduced to solving maximization problems, it does bring learning within the scope of economic reasoning. Moreover, it also relates to issues of economic organization, because costs of learning will differ in a systematic way across different modes of economic organization, such as firms, markets and hybrids. (We shall later clarify some of the determinants of these costs.) Thus, our methodological stipulations amount to adopting, at least to some extent, the economist's working practice of addressing well-defined problems of efficient resource use in stylized settings. It does not necessarily mean that those who wish to address learning, competitive advantage and economic organization should rely on economics as the only relevant set of insights. Focus and clarity may perhaps also be obtained from a sociological starting point. However, in the following we shall argue that it is possible to use rather basic economic insights for the exploration of the links between learning, economic organization and competitive advantage. More specifically, these insights are derived from the property rights perspective. In accordance with our methodological stipulations above, we shall use such insights to examine particular types of learning in particular settings, namely with respect to the optimization of complex production systems.

3.2. *The property rights perspective*

OE is a collection of many theories [8]. To be sure, the theoretical languages of these theories differ. However, these differences reflect dialects of the same overall theoretical language - one with a vocabulary consisting of self-interested behavior, economic equilibrium, transaction costs, and property rights (Furubotn and Richter, 1998; Foss and Foss, 2000a). This overall language is the *property rights approach* (Alchian, 1965; Barzel, 1982, 1997; Coase, 1960; Demsetz, 1964; Eggertson, 1990; Jones, 1983; Libecap, 1989; North, 1990; Foss and Foss, 2000b). In fact, most OE approaches can be subsumed under the property rights approach, because these all look at different costs of specifying, exchanging and enforcing property rights. There are numerous characteristics of property rights that are salient to the present discussion. We present these in the following.

Types of rights

Property rights are the rights agents hold over assets, such as physical, human, financial, and intellectual assets [9]. More specifically, they include the following kinds of rights (Alchian, 1965; Eggertson, 1990):

1. *Use rights*, which define the potential uses of an asset.
2. *Income rights*, or the right to consume an asset.
3. *Rights to exclude* non-owners from access to assets.

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[8] Including the transaction cost (Coase, 1937; Williamson, 1985, 1996), the agency (Holmström, 1982; Holmström and Milgrom, 1991; Jensen and Meckling, 1992), the measurement cost (Barzel, 1989), the information cost (Casson, 1994), the team (Marschak and Radner, 1972), and the incomplete contracts (Hart, 1995) perspectives.

[9] In this paper, we use "assets" generically to refer to all these.

4. *Rights to transfer* permanently to another party all the above-mentioned rights over an asset – that is to alienate or sell an assets.

Preciseness

An important characteristic of property rights is the degree of preciseness with which they are delineated. For example, one may distinguish between *specific* and *residual* rights (Barzel, 1989; Hart, 1995). Specific rights are those rights that are specified in contracts and allocated between the transacting parties before any transaction takes place. Residual rights are those rights that are not constrained by stipulations in contracts or by the law. Both user and income rights can be either specific or residual. Residual income rights (or residual claims) are the non-specified income or pleasure a person can enjoy from using or alienating an asset (including his labor). In firms, rights and obligations may be more or less clearly defined. For example, if all rights are truly perfectly defined, according to the so-called "Coase theorem" (Coase, 1960), this literally means that:
– all possible uses of assets are fully known;
– all returns from all uses of all assets are perfectly known;
– all legitimate and illegitimate uses of assets are perfectly specified; and
– all this is perfectly enforceable.
If all rights are completely defined in this way, there cannot, by definition, arise any conflicts over the use of scarce resources or the returns from assets, because individuals do not have any discretion in the use of resources. In actuality, all rights are far from perfectly defined. Indeed, as the OE literature explains, it is exactly the imperfect delineation of rights that opens the door for organizational phenomena. For example, both the agency problem (Holmström, 1982; Holmström and Milgrom, 1991) and the hold-up problem (Hart, 1995; Williamson, 1996), with all the many implications with respect to ownership, organizational structure, performance, etc. that may be distilled from them, essentially arise because of imperfect delineation of rights. As we shall argue, the allocation and delineation of property rights are also crucial for understanding "softer" phenomena, such as corporate culture (Jones, 1983) and, our main concern here, learning in firms.

Property rights, transaction costs, and learning

In order to understand the link between property rights and learning, it is convenient to start with the world defined by the Coase theorem. As stated above, it is hard to think of learning in a regime of perfectly defined property rights, since in this world, all uses of resources are perfectly known and delineated (*cf.* Coase, 1988). In other words, there is nothing to discover in such a world [10]. The other side of the coin is that when there is room for learning in a social system, this means that rights are imperfectly delineated relative to the above idea.

[10] This may be criticized on the ground that the above stipulation of the implications of the Coasean zero transaction cost assumption are too restrictive, since this assumption does not necessarily imply the absence of discovery (*cf.* Kirzner, 1973). This may be debated; the zero cost transaction cost assumption is often taken to also imply zero information cost.

From a property rights perspective, imperfect delineation is caused by transaction costs. Conventionally, these include costs of measuring the attributes of assets, as well as negotiating and enforcing contracts on asset uses (Barzel, 1997). However, we should not forget that transaction costs also encompass costs of *discovering* asset uses, as Coase (1937) pointed out, and as Brian Loasby (1999, p. 74) has argued, transaction costs are to a large extent knowledge costs. This establishes one link between learning and transaction costs, in the sense that learning may reduce transaction costs. On the other hand, there is also a link from transaction costs to learning, because some kinds of learning involve the efforts of many agents, which may cause considerable transaction costs. These two different links are shown in Figure 1, as arrows A and B, respectively. Also shown in the figure are the links between transaction costs, imperfect delineation and attempts to improve delineation. The plusses over the arrows indicate that increasing transaction costs means that rights will be more imperfectly delineated, but that more imperfect delineation creates incentives to reduce transaction costs through learning.

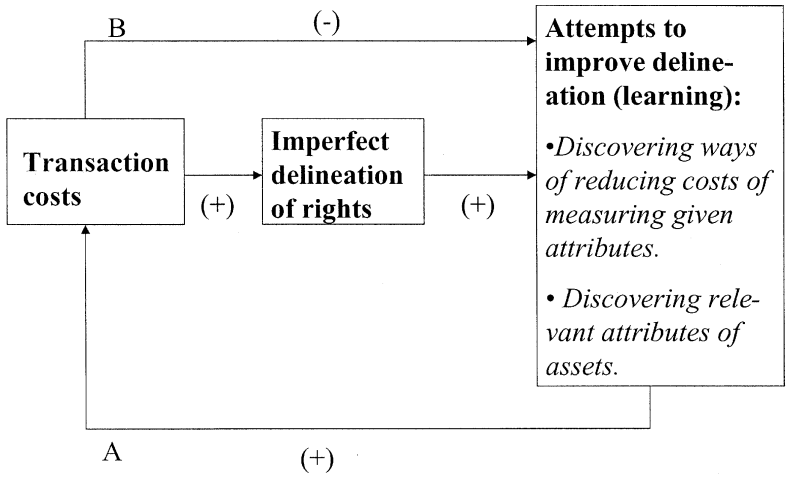

Fig. 1. *Learning and property rigts.*

Attributes and learning

An important aspect of the preciseness of property rights is the notion of attributes. Thus, in the property rights approach, assets are seen as having multiple attributes, where attributes are characteristics and possible uses of assets. For example, a copying machine is a multi-attribute asset in the sense that it can be used in different time periods, by many different persons, for many different types of copying work, can be purchased in different colours, sizes, etc. Because of human mental limitations (*i.e.*, bounded rationality), all such attributes are not likely to be known initially. This makes room for learning. Attributes relate to learning in (at least) two ways (*cf.* Fig. 1).

First, learning can be a matter of discovering ways of reducing costs of measuring given attributes [11]. For example, in the food and vegetable industry, much innovative activity has centered on developing techniques that will allow for more efficient measurement of the attributes of size, colour, durability, etc. of various kinds of fruit and vegetables (K. Foss, 1996). Second, learning can be a matter of discovering relevant attributes of assets that were hitherto unknown. In fact, most assets are likely to possess hitherto undiscovered attributes. Thus, as Penrose (1959) stressed, the services (*i.e.*, its attributes) of an asset – say, a machine – are not given to the operating personnel in the firm that acquires the machine but has to be discovered by them in a learning by doing manner.

Contracts and authority

Contracts, whether formal or informal, are used to define the terms of transfer of rights to attributes. To specify and to contract over the different attributes of assets are clearly costly actions – more precisely, they involve costs of delineating, transferring, capturing and protecting rights. When such costs exist, not everything can be specified in contracts. Notably, the employment contract is left partly open because of prohibitively high costs of specifying in detail all rights and obligations of the employee in all future conceivable situations (Coase, 1937; Williamson, 1985). However, because of the multi-attribute nature of most assets, virtually all contracts will be incomplete (Foss and Foss, 2000b). This may cause various types of problems related to conflicting resource uses, of which the hold-up situation of Williamson (1985) and Hart (1995) is only one example of a large set of costly bargaining problems. In OE, most attention has centered on these bargaining problems and on their institutional remedies. Less attention has been allocated to the problem of discovering productive uses and services (*i.e.*, new attributes) of assets and how this process is best organized, although this was arguably a major point in Coase's original paper (Loasby, 1999; K. Foss, 2000). As we argue in the following section, it is exactly this type of learning process that connects to issues of economic organization.

4. Learning and economic organization: A property rights perspective

In this section, we shall develop a property rights view of firms as institutions "... specializing in the speed and efficiency in the creation... of knowledge" (Kogut and Zander, 1996, p. 503). More specifically, we shall argue that relative to markets firms may have advantages in developing knowledge about how to coordinate what we shall call "complex production systems." In other words, we shall argue that OE perspectives,

[11] Relatedly, Alchian and Demsetz (1972, p. 94) argue that efficiency differences between firms arise as a consequence "... not of having *better* resources but in *knowing more accurately* the relative productive performances of those resources. Poorer resources can be paid less in accord with their inferiority; greater accuracy of knowledge of the potential and actual productive actions of inputs rather than having high productivity resources makes a firm (or an assignment of inputs) profitable".

as represented by property rights insights, are actually capable of handling issues of learning as these relate to economic organization.

4.1. *Costs of coordination and mode of coordination*

At least since Coase (1937), economists have known that the costs of coordinating transactions vary with the mode of coordination. However, they have arguably paid less attention to two central ideas in that paper. The first neglected idea is that the advantage of the firm mode over the market mode diminishes as the marginal costs of coordination increase with more tasks being coordinated within the boundaries of a firm (Coase, 1937) [12]. The second neglected idea is that firms may exist as low-cost coordination devices because of the flexibility afforded by a structure of incomplete contracts and the discretion provided by managerial authority. These two ideas are related, for the second idea make room for learning by firms, and such learning may in turn reduce the marginal costs of coordinating.

In contrast, most contributors to OE take the costs of coordinating transactions in the economy as given, in the sense that the costs of organizing a certain transaction with certain characteristics (*e.g.*, the degree of asset specificity) are the same, not only across firms but also over time. They proceed to analyze the allocation of transactions over alternative modes of economic organization with given costs. However, in actuality the costs of coordinating productive activities may change over time as a consequence of learning in coordination. Moreover, the costs of learning about coordinating may differ systematically across modes of economic organization.

Our main points in the following are, first, that learning in a firm may be understood as the discovery in that firm of a lower-cost way of coordinating production tasks, and, second, that some types of learning are more efficiently realized in firms than in markets, namely learning about how to coordinate a complex and interdependent system of production tasks.

4.2. *Coordinating complex production systems*

We begin from the notion of complex production system, by which we mean a system of productive tasks where there are many complementarities between tasks. A "task" is a set of activities that are carried out by one agent. The notion of "complementarity" is an important one in this context. First, it suggests that a complex production system will not normally encompass the whole economy, but will be an island of assets characterized by strong complementarities in a sea of competitive and complementary asset uses (Richardson, 1972). Second, it introduces a need for qualitative coordination, that is, the coordination of the uses of assets in terms of time and place. Now, it is well-known that qualitative coordination may be handled through including non-price information in contracts; for example, it has often been pointed out that the need for strong qualitative coordination in a steelworks does not logically imply firm organization. Rather, appeal to

[12] For example, transaction cost economics (Williamson 1985, 1996) or incomplete contract theory (Grossman and Hart, 1986) do not make this point.

asset specificity is required (Willamson, 1985). Thus, in the steelworks example, one may point to "site" or "temporal" specificity as the relevant type of specificity that may explain why steelworks-specific transactions are organized within firms, since these types of specificity will also introduce a hold-up possibility. The only coordination problem that is relevant to economic organization concerns the provision of the *ex ante* incentives that will secure the efficient (given the constraints of the problem) investments in assets (Hart, 1995).

4.3. *Learning-by-experimenting in complex production systems*

However, in our opinion, complex production systems influence economic organization in other, more subtle ways. For example, temporal and site specificity may not be *data* for the problem of determining efficient organization. Instead, relations of temporal and location specificity may be something that is *discovered* as a result of experimenting with a complex production system. The deeper, more subtle question then is how this process of experimenting is best organized. Arguably, in much of OE, there is an assumption that technological knowledge is a *datum*, and the choice is one between technologies characterized by different degrees of asset specificity (Langlois and Foss, 1999). The question of discovering optimal uses of assets in a complex production system is, in contrast, not inquired into. However, understanding how this process connects to economic organization is not outside the scope of OE, as we shall argue in the following.

In the context of a complex production system, bounded rationality implies that agents are not likely to have full knowledge *ex ante* about, for example, the optimal sequencing of tasks, even if they perfectly know the functionalities of (physical) assets. For example, the problem of defining an optimal sequence of tasks in a complex system of production may require more calculation capacity than is available in a supercomputer (Galloway, 1996) [13]. Given this, some sort of experimental process is necessary. What is the nature of this process? And what the necessary requirements for the process to be efficient?

First, one must identify the system boundaries, that is, where the relevant interdependencies are most likely to be located. Second, the experimental process must be in the nature of a controlled experiment (or a sequence of such experiments), so as to isolate the system from outside disturbances. Third, there should be some sort of guidance for the experiment. This may take many forms, ranging from centrally provided instructions, over agreement between the involved parties to the experiments, to shared understandings of where in the system to begin experimenting, how to avoid overlapping experiments, how to react to certain results from experimenting with respect to changing the experiment, etc.

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[13] Thus, in describing the problem of scheduling batches in a 5 stage production process, Galloway (1996) writes: "[t]he best schedule is the one which minimizes this idle time. Unfortunately, the only way to find the best schedule is by trial and error, and with 20 batches there are 1.8×10^{18} possible schedules. This problem is too large even for modern computers, so a simplifying assumption is frequently used" (p. 64).

Note this sort of experimental activity is not a flight of our fancy; it is what takes place in manufacturing departments on a regular basis in connection with error identification, installment of new equipment, fine-tuning of equipment, fine-tuning of routines, finding ways of adjusting to new inputs or input qualities, etc. In the present context, the problem is how this process is best organized. While the three characteristics of efficient experimenting that we listed above are necessary, they are not sufficient. This is because the experimental process may be organized in different ways, and the efficiency with which experimenting is carried out is dependent upon how it is organized. There are many dimensions to this issue. For example, one may ask what is the optimal organization structure for conducting a process of experimental learning. However, we are interested here in the more fundamental issue of how a process of experimental learning in a complex production system can provide a reason for the existence of the firm, that is, why, under certain circumstances, markets may be inefficient means of organizing the process.

4.4. *Learning-by-experimenting and the existence of the firm*

The problem of optimizing a complex production system may seem to be a purely technical one. However, it may be directly linked to property rights economics. In a world of complete knowledge and zero transaction cost, all rights to all uses of all assets could be specified in contracts. However, a complex production system may imply that agents are unable to specify on an *ex ante* basis rights over assets in such a way that each task fits optimally to all other tasks carried out in the system. Thus, complete contracts cannot be drafted, and contracting in a complex production system is thus unavoidably incomplete *ex ante*. The question is under which circumstances such incomplete contracting necessitates firm organization. By the latter term, we mean managed coordination by means of orders rather than by means of decentrally determined prices.

According to Coase (1937) the reason for the existence of firms is that there are costs of using the price mechanism and that "[t]he most obvious cost of 'organizing' production through the price mechanism is that of discovering what the relevant prices are" (Coase, 1937, p. 21). Suppose that the market, that is, a system of legally independent agents and no central direction, was to organize controlled experimentation with a complex production system. What would be the costs of organizing this, that is, why would there be "costs of discovering what the relevant prices are" in this situation?

Most notably, specific assets may be involved which may give rise to the well-known problems of hold-up (Williamson, 1985, 1996; Hart, 1995). Trivially, such a situation may arise if from the outset one or more assets are already specific. More interestingly, however, specificity may be an outcome of a process of experimenting. More specifically, as experimental activity leads to improved learning about how to optimize the system, assets will be increasingly specific in terms of time and location. Time and site specificity increase as the uses of assets become more efficiently coordinated [14]. This is

[14] To illustrate, just-in-time production systems often lead to an increase in asset specificity.

one force pulling in the direction of firm organization, though not the only one. Another force is the problems created by bounded rationality (independently of considerations of opportunism).

Recall that we argued that there is a set of necessary conditions for efficient experimenting, such as the ability to define system boundaries, isolating the experiment from outside disturbances, and "guiding" the experimental activity. There may be market failure in connection with all three conditions [15]. The main problem is that there is not likely to be shared conjectures with respect to these three conditions. With bounded rationality, agents may disagree about system boundaries and how to isolate the system from outside disturbances. Even abstracting from these problems, so that the system is well defined and isolated from outside disturbances, there may still be problems of coordination. This is because complex complementary systems are likely to exhibit multiple equilibria, so that it is not obvious how to coordinate on equilibria or even which equilibria are the most preferred ones.

In principle, one may imagine that an experimenting team hires an outside consultant that guides the experimental activity in the sense that he gives advice on the sequencing of actions and asset uses, initiate the experiments, draws the appropriate conclusions from each experiment, determine how these conclusions should influence further experimenting and so on. However, such an arrangement is likely to run into numerous bargaining costs, not the least because under market contracting, any team member may be able to veto the advice provided by the consultant. Succumbing to authority may be the cost effective way of organizing the experimental activity.

"Authority" here means that managers are given the rights to redefine and reallocate rights among team members, and the rights to sanction team members if these don't utilize their rights efficiently [16]. For example, managers decide on who is going to perform which tasks when. The possession of these rights means that managers are able to conduct experiments without continuously having to re-negotiate contracts; this saves bargaining and ink-costs. Moreover, the right to sanction team members also economizes on the agency costs from rights that are used inefficiently (Jensen and Meckling, 1992). Managers then are able to create "controlled" experiments in which they only change some aspects of tasks in order to trace the effects of some specific re-arrangements of rights. Arranging property rights in this way is tantamount to forming a firm. To sum up, we have argued that managed direction – that is, the firm – saves transaction costs when in complex production systems, sequential delineation and reallocation of rights over assets are required as a means of gradually improving the functional performance of such systems. As we argue next, this view also has implications for the understanding of the boundaries of the firm.

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[15] And it must be emphasized that because of the experimental nature of the process, we must be dealing with conjectures rather than proven knowledge.

[16] A complex production system is likely to be characterized by substantial information externalities, stemming from agents' private information (Holmström, 1982).

4.5. *Learning-by-experimenting, coordination knowledge, and the boundaries of the firm*

In his retrospective assessment of his own 1937 paper, Coase (1991, p. 73) pointed to the necessity of uncovering "... the reasons why the costs of organizing particular activities differ among firms" (p. 73). He criticized existing theories of the firm for paying too little attention to this problem. However, resolving the problem is important for a more precise understanding of the efficient boundaries of firms. In other words, if firms are not equally efficient at coordinating the same types of tasks, this should influence the boundaries of firms [17]. The arguments presented earlier suggest that learning-by-experimenting in complex production systems and the creation of coordination knowledge result in different abilities and thus different costs among firms with respect to organize different kinds of tasks [18]. The boundaries of firms reflect these endogenous changes in production and coordination costs as agents learn in production and coordination.

Based on the arguments presented earlier, we argue that the importance of learning in coordination depends on the nature of the technological interdependencies in a complex production system. A highly complex (in the sense of Simon, 1969) production system necessitates more learning-by-experimenting than a less complex system, primarily because the latter is more decomposable. As we have argued, there may be advantages from organizing learning-by-experimenting in the former type of systems inside the boundaries of the firm – at least until sufficient experimentation have resulted in precise knowledge about the nature of interdependencies. Possessing such coordination knowledge means that it becomes possible to precisely delineate and allocate rights to take specific actions in ways that ensure the coordination of the system. This also implies that well-defined tasks may be spun-off to outside suppliers, that is, market contracts substitute for managed direction.

However, if the production system is often perturbed in an unpredictable manner by outside disturbances, hierarchical coordination may still continue to hold sway (Coase, 1937; Langlois and Robertson, 1995). Furthermore, since an outcome of learning-by-experimenting may be increased asset specificity, the unpredictable nature of outside disturbances introduces problems of hold-up. Thus, even if a task is well-defined in most situations, it may still be kept within the boundaries of the because of the hold-up problem.

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[17] As suggested by Richardson's (1972) analysis.

[18] Socially developed norms, rules and routines also reduce costs of coordination. Norms and routines make the behavior of others more predictable thus reducing the need for information required to coordinate actions. In the terminology of property rights, norms and routines can be said to act as self-enforcing constraints on use rights. Such norms and routines certainly also play a great role in determining the costs of coordination in different firms and the decision to make rather than to buy may often be grounded on superior, non-imitable and non transferable routines which aids coordination in production. Norms and routines are not confined to firms; they may as well evolve as means of coordinating actions between independent individuals or individuals in different firms. In that case they also reduce costs of market transactions.

4.6. *Learning-by-experimenting and competitive advantage*

The process of learning-by-experimenting is likely to be path-dependent and complex. The precise outcome of the learning process is a result of the starting point of the process, the conjectures that participants in the process have formed and tried out, how they have reacted to falsified conjectures, etc. Thus, the resulting coordination knowledge is likely to be complex and contain many tacit elements. In line with the KBA analysis, such coordination knowledge may therefore be costly to transfer using market contracts (as in Kogut and Zander, 1992). This may explain the observed path-dependency in the kind of activities firms undertake (Teece *et al.*, 1997).

Since processes of learning-by-experimenting are path-dependent, firms are likely to end up with different stocks of coordination knowledge, even for the same underlying coordination problems. In turn, this implies that stocks of coordination knowledge across firms in an industry are associated with differential efficiencies. Therefore, these knowledge assets yield differential rents (Lippman and Rumelt, 1982). These rents may also be sustainable when the coordination knowledge that emerges from path-dependent processes of learning-by-experimenting is complex and contains tacit elements, making it costly to imitate.

5. Discussion

In this section, we briefly explore some issues that emerge from the above discussions, and which we have only treated superficially or not treated at all. We shall treat the scope of our experimental view of the firm, as well as the link between individual and social learning.

5.1. *Broadening the experimental view of the firm*

Arguably, our conceptualization of the link between learning-by-experimenting and economic organization is a very narrow one, only focusing on the optimizing of complex production systems. Now, we deliberately chose such a narrow focus in order to keep the discussion manageable (*cf.* Sect. 3). However, one may clearly argue that the experimental view of the firm is much broader in scope.

It is often impossible to find an optimum using analytical methods in systems that are characterized by many interdependencies and complementarities. Moreover, in complex systems, one may not even have identified the relevant interdepencies and complementarities. In both cases, learning-by-experimenting is required. Many firms are complex social systems, characterized by multiple interdependencies and complementarities that cut across departments and divisions, and are not just confined to production. It is an established truth in organization theory (*e.g.*, Thompson, 1967) that rational organizational structure should reflect such interdependencies and complementarities. From the

[19] This explanation is consistent with Demsetz (1988) who also argues that firms are not perfect substitutes in production of goods and services.

perspective of property rights economics, the purpose of organization structure is to handle externalities in a way that is conducive to organizational goals. Organization structure is essentially an allocation of property rights (Jones, 1983).

Moreover, as Loasby (1976, p. 133) perceptively noted, an organizational structure "... not only determines where an organization's problems are worked, but also helps to determine what problems they shall be, how they are defined, and what solutions will be attempted". Thus, "... each part of an organization is a kind of experimental design". We may add that such "experimental designs" are often nested, in the sense that the experiments that go on in different parts of an organization may influence other parts of that organization. In turn, this implies that the property rights structure represented by organization structure is *itself* an experimental design! Thus, our basic argument that experimentation, property rights, and economic organization are closely related is applicable to a much broader context than complex production systems.

5.2. *Organizational learning and learning-by-experimenting*

A key point in the KBA is that firms exist because they help structuring processes of organizational learning. Thus, Kogut and Zander (1992, p. 384) argue that "... organizations are social communities in which individual and social expertise is transformed into economically useful products and services", and exist for this reason (see also Spender, 1996 and Kogut and Zander, 1996 for similar arguments). Now, "organizational learning" is a term that is very seldom defined with much precision in the literature [20]. However, contributors to the literature seem to agree that organizational learning is a phenomenon that lies outside the orbit of rational choice, is stored in routines, and somehow emerges from the interaction of multiple actors in a history-dependent way (March, 1999). Much of the literature is therefore strongly descriptive (Weick and Westerly, 1995).

We agree that learning may be important to understanding the rationales of firms, and that it should be much more centrally placed in OE. However, we have problems with the existing literature on organizational learning. First, one searches in vain for precise criteria that distinguishes individual from organizational learning. Second, we fail to realize why it should not be possible to address at least important aspects of organizational learning by means of rational choice methodology. The learning-by-experimenting approach addresses both these two problems.

With respect to the distinction between individual and organizational learning, it may be argued that as an uncontroversial minimum organizational learning is learning that takes place within organizations. The problem then concerns why some learning processes are organized inside firms whereas other learning processes may take place across markets. In other words, do learning processes most efficiently take place between independent individual agents or between individual agents that interact within a hierarchical structure, such as a firm? In this paper, we have provided reasons why firms

[20] For example, Weick and Westerly's (1995) presumably authoritative discussion of organizational learning in the *Handbook of Organization Studies* does not offer a single clear definition of the concept.

(organizations) may in some circumstances organize processes of learning more efficiently than markets are capable of doing. We have relied on rational choice methodology throughout, arguing that rational agents will have to rely on learning-by-experimenting when they are faced with complex production systems [21]. Thus, our approach deals with both difficulties associated with the concept of organizational learning.

6. Conclusion

We began this paper by discussing the critique, launched by proponents of the KBA, that OE perspectives put all the emphasis on the allocation of incentives and property rights and neglects processes of learning. Although it is true that so far OE writers have had little to say about processes of learning and their consequences, we have suggested that there is no inherent reason why OE should be cut off from treating learning and exploring its organizational implications. More specifically, we demonstrated that it is possible to adopt an approach to learning that is consistent with rational choice methodology and stresses economizing, puts the emphasis on learning as a means to realizing efficiencies, is micro-analytic, and contains implications for economic organization. In order to focus these ideas, we concentrated on the role of experimentation as a means of finding solutions to coordination problems in complex production systems (*e.g.*, finding the optimal sequence of activities). and the transaction costs learning-by-experimenting may create. Such transaction costs help determine the existence, boundaries and internal organization of the firm, and has implications for the understanding of competitive advantage. This is one way in which OE may come better to grips with processes of learning and their implications for economic organization and competitive advantage. We have no doubt that there are many other such ways. Future work will explore these.

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[21] This is not to say that "non-rational" elements such as intuition, humour, routine-based decisions, etc. (Weick and Westerly, 1995; March, 1999) may not play a role, for example, in the formation of conjectures that are tried out in experimental learning and the interpretation of the evidence from experiments.

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