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Abstract
We discuss the relations between alternative conceptualizations of the market process – neoclassical, Austrian and radical subjectivist/evolutionary – and alternative approaches to economic organization, for example, nexus of contract theory, Williamsonian transaction cost economics and the dynamic transaction cost approach of Langlois and Robertson. We argue that there is a distinct need for more firmly grounding theories of economic organization in theories of the market process, and that key ideas of the more dynamic conceptualizations of the market are likely to substantially enrichen the theory of economic organization.

Keywords
The market process, the theory of the firm

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I. Introduction

We would like to introduce this paper in the unusual way of spending some time on discussing a specific publication. The one we have in mind is *Economics as a Process: Essays in the New Institutional Economics*, a volume that was edited by Richard Langlois and published in 1986 by Cambridge University Press. It has now acquired the status of a standard reference in the new institutional economics, alongside, for example, Schotter (1981), Williamson (1985) or North (1990). At first glance, this may strike one as odd, for the book is far from coherent, as more than one reviewer pointed out (e.g., Mäki 1987). Thus, it contains diverse contributions from perspectives such as evolutionary economics, transaction cost economics, post-Marshallian economics, evolutionary game-theory and Austrian economics, in addition to splendid introductory and concluding essays by the author.

Moreover, as indicated by its title, the book pointed towards an extremely ambitious research program in economics, one that still has not materialized.[1] Specifically, it suggested – explicitly in Langlois' introductory and concluding chapters and implicitly in the rest of the chapters – that the new institutional economics was characterized by a strong *processual* dimension. Even today this must strike the casual reader as quite odd – for a dynamic conceptualization of the competitive process is certainly not the first impression one gets from reading the work of many prominent representatives of the new institutional economics, such as Coase or Williamson. It seems to be characterized by standard comparative static method. Nevertheless, Langlois valiantly argued that a number of, largely heterodox, research programs in economics (those mentioned above) should be seen as united in the attempt to extend the notion of *rationality*, to incorporate *processual* notions of economic activity and to get in the process a better grasp of *institutions* – three explanatory tasks that in his reading were closely intertwined.

Langlois was primarily interested in trying to clarify the more explanatory and methodological aspects of fitting these various theories together, and we shall follow him to some extent in this task. However, our focus is more narrow, and we also adopt a theoretical, rather than a purely methodological, focus. Specifically, we shall follow up on Langlois' *oeuvre* in trying to

[1] However, Douglass North's recent work (North 1990), as well as Langlois' own work, alone and with Paul Robertson (Langlois 1992; Langlois and Robertson 1995), may be seen as instances of such an emerging research program.

ascertain how various theories of the market process and what is ordinarily taken to be new institutionalist theories – namely the work of such writers as Coase (1937, 1960), Williamson (1985, 1996), Barzel (1997), Alchian and Demsetz (1972) – fit together. We will not try to provide a full synoptic discussion, but merely briefly indicate how assumptions about rationality and information on the agent level are intimately tied to conceptualizations of more aggregate phenomena, such as the market process *and* institutions, notably the firm.

In constructing this nexus, we draw on Littlechild (1986), a brief but extremely suggestive contribution to Langlois (1986) (section II, "*Classsifying Theories of the Market Process*"). Specifically, we argue that while it is possible to say something about economic organization (notably, the firm-market choice) within all the explanatory universes described by *neoclassical*, *Austrian*, and *radical subjectivist* perspectives, these different perspectives provide alternative explanations, typically highlighting different aspects of the firm and identifying different explanatory mechanisms. They are not mutually exclusive, but complementary. (Section III, "*Economic Organization and the Market Process: Preliminary*").

In addition to this more taxonomic exercise, we also provide a new perspective on the firm, inspired by what may *prima facie* look as strange theoretical bedfellows, namely property rights theory (Alchian 1965; Alchian and Demsetz 1972; Cheung 1983; Barzel 1997) and market process theory that stresses endogenous change, ignorance and Shacklian surprise (hence, the sub-title to this paper). However, the combination of these perspectives was also suggested (but not developed) by Littlechild (1986: 34-36). For example, 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 (p.35).

We show that this overall idea allows one to re-interpret the seminal contribution of Ronald Coase on "The Nature of the Firm", a contribution in which the notion of "unexpected events" (and the consequent need for flexibility) is quite central. Moreover, we also address issues in the theory of economic organization by looking more closely into those mechanisms inside firms that endogenously produce change, such as learning, experimenting, and increasing

division of labor,[2] and tie this to issue of coordination by managerial allocation of property rights inside the firm. We argue that the (Coasian) firm arises as an institution that coordinates a complex technological system, characterized by such endogenous change. (Section IV, *"Towards a Dynamic Property Rights Theory of the Firm").*

II. Classifying Theories of the Market Process

Talking about the market *process* easily leads to drowning accidents in a particularly dangerous terminological soup, namely that involved with the distinction between "static" and "dynamic". Thus, Fritz Machlup (1959) identified no fewer than 39 different distinctions between these terms that social scientists from Auguste Comte and onward had put forward. We are all familiar with the extreme conceptual quagmire that this distinction easily gets one into. The problem, of course, is that there is no agreement on exactly what constitutes a dynamic or static theory. The positive aspect of this is that we are basically free to invent our standards – which we here don't hesitate to do.

Specifically, we argue that the "dynamic'ness" of various theories of the market process may be pinned down by focusing on the questions they are designed to answer (Machlup 1959; Littlechild 1986; High 1990; Ikeda 1990). Since aggregate level behavior is dependent on what is assumed about individual agents, we accordingly focus on this level, imagining questions such as

1. *The adjustment question:* How do agents react, when *known data* are changed?
2. *The surprise question:* How do agents react when *new data* are introduced unexpectedly?
3. *The entrepreneurship question*: How do agents *change data*?

In terms of this scheme, a theory is more dynamic the more questions in ascending order it can address. Thus, a theory that can address both "the adjustment question" and "the surprise question" is more dynamic than a theory that can just address "the adjustment question". This gives some basis for arguing, for example, that Austrian market process theory (which can

[2] Actually, this suggestion is also present in *Economics as a Process*, namely in Axel Leijonhufvud's contribution "Capitalism and the Factory System".

address both the first and the second question) is more "dynamic" than mainstream theory (which can only address the first question[3]). This leads us to consider Littlechild (1986).

What Littlechild (1986) essentially does is to link what we have called agent-level questions to higher-level theories of the market process. Specifically, he suggests that we make a distinction, between "ideal type" models of the market process, distinguished by

> ... 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(Littlechild 1986: 27).

Based on these criteria, Littlechild identifies the following three ideal typical models, namely

1. *the neoclassical model* (e.g., Frydman 1982);
2. *the Austrian model* (e.g., Kirzner 1973) and
3. *the radical subjectivist model* (e.g., Shackle 1972; Lachmann 1986, O'Driscoll and Rizzo 1985).

As Littlechild explains, what is primarily characteristic of *the neoclassical model* is that "... the form the future can take is known in advance" (p.8). Specifically, agents can fully characterize the vector of variables that is relevant for his actions and can fully characterize the probability distributions of these variables. Thus, the neoclassical agent lives in world characterized by Knightian risk. As Littlechild explains: "He is unsure what the price of honey will be tomorrow, but he knows that honey will be traded. Conversely, he never finds honey in the shops if he had not previously expected it to be there" (p.28). Understood as a model of learning, the neoclassical model thus primarily deals with the question of how agents react when known data are changed. Bayesian updating of priors into posteriors is one mode of learning that is consistent with the neoclassical model, but not the only one; one can also have agents that use various forecasting techniques (Frydman and Phelps 1984).

In contrast to this, *the Austrian model*, particularly as developed in Israel Kirzner's work, posits that "... a consumer may discover honey for the first time" (Littlechild, 1986); discovery of hitherto unnoticed opportunities is centerstage in this model. Epistemically, we say that "'Tomorrow' is a vector of which the agent knows some components but not others; he or she

[3] A partial exception to this claim is recent formal work on incomplete contracts (Grossman and Hart 1986; Hart 1995). However, as we argue later, the exception is only partial, because these theories operate with a narrowly circumscribed conception of unforeseen contingencies.

knows that there will be other components, but not what they will be" (p.29). An implication of this is that the agent cannot construct probability measures over these "other components". How do agents act, given such ignorance?

The answer given by Kirzner (1973) is that agents spontaneously discover hitherto unnoticed opportunities (introduced by unexpected changes in data) and that pure profit incentives play a key role here. Inspired by the work of Ludwig von Mises and Friedrich von Hayek, Kirzner (1973) has constructed a closely reasoned theory of the market process as a process of the entrepreneurial discovery of new possibilities for trade. Central to this argument is the point that, what he calls "Robbinsian maximizing" (after Lionel Robbins), is inadequate to form the individualistic basis for a theory of the market as a dynamic process. This is because in the conventional conceptualization of the problem confronting the individual decision-maker, the whole decision structure is given. What should be included in the behavioral make-up of agents is what Kirzner calls "alertness", that is, the ability to recognize and act on new opportunities for profit. It is this behavioral quality that

Finally, in *the radical subjectivist model*, "... the future is not so much unknown as it is non-existent or indeterminate at the time of decision. The agents task is not to estimate or discover, but to create" (idem.). In a string of publications over several years, George Shackle (e.g., 1972) grappled with the issue of how agents change data based on their creative imagination and strongly criticized the maximizing model of rationality. However, his work has conventionally been seen as essentially negative; as critical rather than constructive. There is an element of truth to this, for Shackle never tells us much about what bounds choice (and its consequences). Apparently, anything goes.

However, in actuality, choice is often quite constrained; the producer in an almost perfectly competitive industry really only has a "single-exit" decision to make. Not only are there constraints on the individual level in the form of personal heuristics, rules-of-thumb, moral norms to which one adheres, etc., but there are (system) constraints that work on a more aggregate level, such as industry-level selection forces. While the former category of constraints are, as it were, *ex ante*, that is, works on the imagination and the consequent decisions themselves, the latter category of constraints are more of an *ex post* character. For example, the market selects among alternative imaginative entrepreneurial offerings.

This idea also establishes a link to *evolutionary* theorizing (Nelson and Winter 1982), a line of inquiry that was not included in Littlechild's scheme.[4] In general, there are numerous points of overlap and complementarity between Austrian, radical subjectivist and evolutionary market process theory. What unites these approaches is, on an overall level, that they highlight processes of qualitative change and that they conceptualize competition as a discovery procedure (in the sense of Hayek 1978); that is, competition is seen as a mechanism for social experimentation broadly conceived.

Consider the background to the canonical work of Nelson and Winter (1982). One of the main motives for this work was to formalize the kind of evolutionary reasoning that, they argue, has always been at the back of the economist's mind when he engages in informal discussion with colleagues or explains economic reasoning to the outsider. Such "appreciative" theory has traditionally been particularly prevalent in connection with problems relating to innovation and institutional and technological change. Many mainstream economists would argue that given enough time, this "appreciative" theory will become respectable, that is, it will be transformed to mainstream formal theory. However, in contrast to such economists, Nelson and Winter want economic theory to be fundamentally changed and the study of disequilibrium made the main business of economists. This is completely in line with the call in such Austrian treatises as Kirzner (1973) or Lachmann (1986) for a process approach to market activity.

In the view of Nelson and Winter, a process approach is required because of the nature of the phenomenon they address, namely technological change and innovation. They are themes that traditionally have been problematic for mainstream economics, and, accordingly, they have been suppressed. This is because they involve the essential open-endedness of the economy, that is, the fact that *novelties* emerge. There is a standard philosophical argument that, logically, new knowledge cannot be anticipated, for if it could, it would not be new in any meaningful sense. And innovation is usually defined as the production of new knowledge, that is, as novelty. In order to handle technological change we need a theory on market processes which will answer questions about how agents react to unexpected changes (question 2 above), or how and why some agents - innovative entrepreneurs - may introduce novelties (question 3).

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[4] In the context of *Economics as a Process*, evolutionary economics was treated by Richard Nelson's contribution, "The Tension between Process Stories and Equilibrium Models".

The basic aim of Nelson and Winter is to construct a fundamentally evolutionary approach that can handle (at least some of) the problematic aspects of the process of technological change. In an evolutionary conceptualization of market activity, there is 1) no presumption that agents continually maximize, and 2) no presumption that equilibrium is a necessary aspect of the model. Agents are presumed to act to the introduction of unexpected changes in a very limited fashion -they engage in limited stochastic search for ways of cooping with the new requirements. Profit opportunities is what motivate agents to search but search only starts when firms discover that their performance is below some threshold level. In the course of their search they may discover new and unexpected solutions to their problems and this re-introduces novelty in the economy. In a complex world, firms do not have automatic and costless access to best productive techniques. Such techniques have to be discovered, and discovered anew, as the Austrians emphasize.

The continuos introduction of novelty does not imply that we have opened up the way to analytical chaos. For selection in the market, operating on a population of firms with differential revealed performances, guarantees that the outcomes of market processes are not wholly random and unpredictable. However, for selection to produce ordered patterns of change it is necessary that the forces of selection (the criteria of competition) are constant and that the behavior of firms are relatively stable in comparison to the selection forces in the sense that firms do not change their behavior randomly . In such a setting, firms are portrayed as following "routines" which produce rather stable and to some extent predictable behavior. Routines are hierarchically arranged, with upper-level routines directing the search for more efficient lower-level routines (i.e., process innovation). Taken together with selection effects in the market, such innovative search determines profitability and, therefore, changes in the real capital of firms.

As we shall argue in the following two sections, discovery – and associated concepts, such as learning and flexibility – are crucial, not just for understanding the market process, but also for understanding the existence of the firm. In fact we argue that conducting experiments or searches (whether performed in a routine manner or not) is a means of reducing uncertainty and that the organization of transactions within firms is conductive to such experimentation. We begin by discussing the connection between economic organization and change in broad terms, and then narrow the focus to only consider the firm.

III. Economic Organization and the Market Process: Preliminary

A. The Role of Change: General Aspects

That (non-trivial, qualitative)) change and economic organization are somehow related is a theme that does not seem to emerge in economics until the debates of the 1920s and 1930s on the economic feasibility of socialism.[5] As the Austrians (Mises 1936; Hayek 1945) argued, it is only when change enters into consideration that economic organization makes a difference in terms of allocation and optimality; "It is ... worth stressing", Hayek pointed out, "... that economic problems arise always and only in consequence of change" (1945: 82). In a stationary state, economic organization is indeterminate, which implies that, for example, the choice between central planning or private property market organization is economically insubstantial. Basing their socialist schemes on the economics of the stationary state allowed the market socialists to suppress all relevant questions of economic organization, and portray market socialism in a much too positive light.

The other side of the coin is, of course, that non-trivial problems of economic organization derive from economies not being stationary. As the Austrians understood, the economic problem of society – or indeed of any kind of economic organization – does not relate to combining given inputs and outputs in an efficient way *per se*; rather, it relates to the problem of which institutions will most efficiently cope with the calculation, incentive and coordination problems introduced by economic change. Thus, in the complete absence of change there would be no costs of searching for contract partners, drafting contracts (Coase 1937), monitoring production (Alchian and Demsetz 1972), inspecting quality (Barzel 1997), making credible commitments (Williamson 1985), allocating residual rights of control (Hart 1995), etc. – in short, there would be no "... costs of discovering what the relevant prices are" (Coase 1937). The price mechanism, or indeed central planning, could achieve a perfect allocation of resources.

Hayek's solution to the problem of what guarantees a tolerable degree of consistency of plans in a changing economy was to point to "the telecommunications system of prices". Thus, he conceptualized institutions in informational terms: the institution of the price system economizes on information and bounded rationality and allows effective adjustments to unanticipated change. At approximately the time at which Hayek reached these insights,

[5] Lavoie (1985) provides a now classic overview and interpretation of the debate.

Ronald Coase (1937) presented an insight that, on the face of it, ran totally counter to Hayek's. The existence of the firm had to be rationalized in terms of failures of Hayek's telecommunications system. And Coase furthermore suggested that for some (essentially unspecified) activities, the firm was superior to the price system in terms of handling unanticipated change; sometimes the firm provided flexibility relative to the market.

However, these two arguments are not at all contradictory: It is precisely in the Hayekian picture of the changing economy that the existence of Coase's "costs of using the price system" may be rationalized. As Coase (1937) observed, 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. Both Hayek and Coase may be seen as identifying the kind of economic change that is crucial in the present context, that is, the kind of change that makes a difference to economic organization. Thus, Hayek is quite clear that the institution he focuses on derives its primary efficiency properties from its ability to handle *unanticipated* change, and Coase makes essentially the same point about the institution that concerns him. For one aspect of the efficiency of the firm has, as we shall argue, to do with its superior *flexibility* in adjusting to certain kinds of unanticipated change. As Coase observed, interesting contracts were not only long in duration but also open-ended because it is usually too costly or epistemically impossible to specify all future contingencies. This establishes a link between notions of contracts and notions of the market process, one that we pursue further in the next section.

B. Contractual Theories of the Firm and Theories of the Market Process

Contractual theories embrace a broad spectrum of theories about different sources of the costs of transacting and this is reflected in the many different explanations of firms as solutions to contractual problems. Foss (1994b) made an overall dichotomization between distinct traditions based on how dynamic they are. Thus, one may distinguish between the static nexus of contract and measurement cost approaches (Alchian and Demsetz, 1972; Jensen and Meckling, 1976; Fama, 1980; Jensen, 1983; Cheung, 1983; Barzel, 1982, 1985, 1989) on the one hand, and the somewhat more dynamic theorizing associated with particularly Williamson's work (Williamson, 1973, 1985) on the other hand. However, this distinction may now be seen as somewhat misleading. For example, the recent very influential work on incomplete contracts (Grossman and Hart, 1986; Hart 1995; Hart and Moore 1990) should

probably be placed in between the two other approaches, and the dynamic transaction cost theory developed by Langlois and Robertson (1995) probably belongs in the dynamic category.

However, although it probably make little sense to introduce dichotomous distinctions, it may nevertheless be possible to distinguish meaningfully between these theories based on some notion of underlying dynamics. For example, we can relate them to the framework suggested by Littlechild (1986) and discussed above. Thus, we see a correspondence between views of the market process and views of the contracting process.

In such an interpretation more static contractual theories resemble the neoclassic market process model in assuming "*... that the form the future can take is known in advance*" (Littlechild 1986, p.28; *emph. in original*). More static contractual theories here include the measurement cost (Barzel 1989; Cheung 1983), the agency (Jensen and Meckling 1976; Fama and Jensen 1983) and team production (Alchian and Demsetz 1972) theories of firms. Here, the future holds no surprises. This means that contracting is comprehensive and that all uses of assets are well known to economic agents. Not all relevant information is available to the economic agents, but by searching they may obtain more. Information may, for example, be lacking on valued attributes of assets or, in the case of humans, the effort they exert. Prices may therefore not perfectly reflect true value. This may create problems of excessive sorting, inefficient levels of performance and under-investment in durable production assets. Some of these problems may be reduced if the organization called a firm is created.

For example, in order to realize economies of scale many individuals may be needed to work on the same piece of equipment. However, high information costs make it difficult to determine in advance how much the operation of each individual contributes to the wear and tear of the equipment. This creates a situation where there will be insufficient incentives to invest in maintenance. According to Barzel (1997), one way of controlling such problems is to use a fixed wage contract in which workers are remunerated for their time rather than their output. But since a worker who receives a fixed wage for a fixed period of time has no incentives to identify the tasks needed for an effective operation of equipment, managers have to specify and monitor the task to be performed. A similar problem arises when team production is involved as in the well-known Alchian and Demsetz (1972) . In both of these two cases, the solution is to set up an organization in which a specialized monitor is given the rights to meter effort, receive the residual income from these activities, to alter membership of the team and to sell all the these right.

More dynamic transaction cost approaches – such as Williamson's – seem closer to what Littlechild (1986) call "the Austrian market process model". Here, recall, the problem is neither uncertainty nor risk, but ignorance. In such a world, "tomorrow" may bring about discoveries of improved materials or techniques, and contracting will necessarily be incomplete. Such discoveries may influence the value of rights over assets in ways which were not foreseen at the time of contracting. The allocation of rights to determine the use of the assets thus become important,[6] not just because some people may have natural ownership advantages (Casson 1997), but also because asset ownership is the best way of securing one-self against hold-up where transactions involve specific assets, as in the influential theorizing of Williamson (1975, 1985) and Hart (1995). According to this literature, unforeseen events may alter the relative value of assets or specific properties of valuable assets have to be discovered and therefore cannot be included in contracts. And in the presence of asset specificity, this may result in ex post transaction costs as contracts have to be renegotiated or even in lack of incentives to undertake transaction specific investment which otherwise would be efficient. Again firms arise as damage control under conditions of market failure.

For Williamson (1975, 1985) the choice between market or firm depends on the extent to which transactions are characterized by asset specificity, frequency and uncertainty. Given bounded rationality and uncertainty, these factors become decisive under incomplete contracts. These critical characteristics are well known to, understood and easily identified by optimizing agents and they will choose the optimal governance structure. However, here is a problem, for the notion of incomplete contracts involve the notion of unanticipated change. In spite of this, the theory (at least in its formal versions) portrays agents as so clever that they are able to choose those institutions that can most efficiently handle "unanticipated" future change, that is, those institutions that minimize the loss from incentive conflicts of various kinds.[7] Thus, agents at least "knows some components [of tomorrow's vector of events] but not others" or "he or she knows there will be other components, but not what they will be". For example, agents may vaguely anticipate the possibility of major changes in prices which could require renegotiations of contract terms.

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[6] As Littlechild points out: "It is now relevant to consider which party is best able to "predict" and respond to such unexpected change -or, perhaps, which party is most optimistic or apprehensive about the possibility of such a development" (1986: 35).

[7] Technically, agents can perform "dynamic programming". See Kreps (1996) for a discussion of this.

In the work of Hart (1995), the joint surplus from a contractual relation is assumed to be known (either precisely or probabilistically), and ignorance is only present as an assumed lack of ability to specify the exact nature of the object over which one contracts. The informational problems are even more circumscribed than in Williamson's work. Since contracts cannot be enforced, an agent will have greater incentives to undertake a transaction specific investment in his human capital if he also has residual user rights over complementary physical assets This is because he then avoids the threat of hold up by an owner of complementary physical asset for a share of the residual income his investment can produce.[8] Firms are thus defined by the physical assets over which an legitimate owner has formal residual user rights. Firms reduce uncertainty in only one dimension: they provide a guarantee for a certain share of the residual income of investments in human capital. Firms do not enable the discovery of the nature of the object over which one contract; such discoveries take place independently of whether or not firms exists.

The imagination needed to create new alternatives is stressed in the radical subjectivist model. The theory of the firm counterpart to this notion of the market process is, we argue, the dynamic transaction costs theory presented in Langlois and Robertson (1995). In their perspective, firms are seen primarily as responses to problems of coordinating interdependent tasks (primarily systemic innovations). Faced with fundamental uncertainty and asymmetric information, the firm "... can more cheaply redirect, coordinate, and where necessary create the capabilities necessary to make the innovation work" (idem.: 3). It is the capacity to coordinate activities rather than ownership that is at the center in this conception of firms, and coordination problems are seen as particularly severe in innovative environments characterized by fundamental uncertainty.

Langlois and Robertson (1995) argue that if firms were operating in an environment similar to that envisioned in the Austrian market model, transaction costs would gradually be reduced as individuals learn how to detect shirking and moral hazard and because they learn about the contingencies relevant to contracts. Therefore, in the long run, one should expect the boundaries of the firm to shrink. On the other hand, one should also expect a gradual improvement of firm capabilities as more activities become routinized, resulting in an

[8] If he enters into a team of other individual holding specific human capital the optimal ownership structure is one where the person best able to influence the income steam generated by all assets holds the rights over the physical assets, since this ownership structure ensures greatest gains from investments in human capital.

expansion of it's boundary. However, other firms also improve their capabilities and these are easily accessed through market contracts. This reduces the advantages from in-house production.

Therefore, as Langlois and Robertson point out "[o]ne of the principal determinants of the appropriate form of business institution is the nature of economic change that institution must confront" (p.3). This perspective is consonant with the radical subjectivist market model and also with the Austrian model: economic change arises as economic agents imagine or discover new profit opportunities. However, market contracting may not be an efficient means for taking advantage of a new profit opportunity and especially not if the entrepreneur who discovers the opportunities has to contract for adaptations of complementary capabilities to his needs. The entrepreneur may then find it too costly to inform owners of these capabilities of the idea and to persuade them to invest in such an endeavor - one for which not much is known about the vector of possible outcomes. Dynamic transaction costs thus create a need for control over assets.

C. Summing Up

One may argue that the role reserved for change and the unexpected in, for example, incomplete contracting theory is very limited indeed. It is merely manifest in the notion of an incomplete contracts. This is, of course, motivated by the desire to preserve analytical closure, and by the wish to work with very well-defined, and therefore also narrow, models. Thus, there is no overarching perspective on how change and economic organization is related, as there is, however loosely, in the work of, for example, Austrian school economists. The economic problem in most of the modern economics of organization involves combining existing inputs (allowance being made for "the fundamental transformation") and outputs in a transaction cost-minimizing/incentive-compatible way. Entrepreneurship, market creation, and innovation are not explicitly factored in.

However, a consistent perspective on economic organization informed by market process theories surely cannot neglect the more general presence of the unexpected in the form of innovative activity. It is definitely one economics' oldest empirical truths that the menu of inputs and outputs and corresponding markets have continuously expanded, through the growing "extent of the market", through the division of labor, and the process and product

innovations this dynamic process brings with it. Basically, Adam Smith and the Austrians give us the same answer here, that the market society because of dispersed property ownership is best equipped to deal with these problems. However, none of them allows us to go further and examine which of "the economic institutions of capitalism" will best handle the problems introduced by economic change. This is what we try to do, focusing on the firm, and addressing it in terms of arguments from property rights theory (e.g., Barzel 1997). Specifically, we focus on coordination problems in technologically complex systems as a major cause of the existence of firms.

IV. Toward a Dynamic Property Rights Theory of the Firm

A. Back to Coase

In a sense, we here go "back to Coase", since we – like Coase (1937) – do not seek a rationale for the firm in its presumed ability to reduce the severity of incentive conflicts, but rather focus on coordination problems that do not turn on such conflicts. Discovery, ignorance, genuine uncertainty and complexity, all concepts associated with Austrian and radical subjectivist theories of the market process, are central to the argument. Moreover, we interpret Coase's analysis of the nature of the firm in terms of the property rights theory pioneered by himself (Coase 1960), and carried further by Alchian (1965), Cheung (1983) and Barzel (1989).

B. Property Rights

Property rights are the rights agents hold over assets. Assets may be physical assets, such as tools, buildings and other equipment, or they may be human assets, such as the effort and work time provided by an agent. It is customary to distinguish between three different categories of property rights, namely

1. *user rights*, which define the potential uses of an asset;
2. *income rights*, or the right to consume an asset, and
3. *rights to transfer* permanently to another party ownership rights over an asset – that is to alienate or sell an assets (Alchian 1965).

Often physical and human assets have different properties which each can be specified and be subject to negotiations between parties to a transaction. Moreover, user rights over different attributes over assets may be shared between individuals. For example a copying machine can be used in different time periods and for many different types of copy works; different individuals may have different rights to use a computer in different time periods and for different purposes; etc.

There is a connection between learning (by doing) and the allocation of user rights. This connection is a consequence of the fact that learning by doing requires the exercise of user rights over assets. Now, clearly the patterns of leaning by doing in production depends on allocation of user rights between different individuals over time and specialization in production may be one reason for reallocation of user rights. Thus, specialization in production can be tied to the possession of user rights if its interpreted as a subdivision of user rights over assets, 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.[9]

As Adam Smith pointed in *The wealth of Nations, as* specialization in production is a main a sources 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.

Many of the labour saving innovations envisaged by Adam Smith is the result of experimentation and thus depends on the allocation of user rights over assets. However, the extent of experimentation depends on how well-specified and easily monitored user 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 learning and experimentation be. 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 keyboard. If he has greater discretion in deciding how to operate

[9] It should be noted that the kind of assets over which one holds rights need not be the same with specialization as without specialization, since in many instances specialization is accompanied by a shift from all purpose tools to more specialized equipment. However, the introduction of more specific equipment and tools limits rights, since these have fewer different uses.

the program, he might have a greater opportunity for learning by experimenting.[10] Discretion thus, enable individuals to learn a broader set of skills and to conduct experiments which may result in innovations.

However, discretionary behavior need not always result in productivity gains. This may, for example, be the case if there is strong technological interdependencies, so that the functional performance of a technology is greatly influenced by the fit between parts and between activities. In such a case, discretionary behavior may result in bottlenecks or in uneven development of components.[11]

From a property rights perspective, these problems can 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 use of assets. Even if important dimensions can be specified, it may be difficult to allocate these rights in ways which 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 results in excess stocks of intermediate products or in idle assets. In fact, with 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 which are needed in the production.

This kind of uncertainty creates costs of specialization due to unsolved coordination problems. Such coordination problems emerge as, for example, problems of bottlenecks where complexity and interdependent activities makes it difficult to specify how best to sequence various activities, where the introduction of more specialized tools and equipment creates capacity utilization problems due to technical indivisibilities, or where innovativeness of individual result in an uneven development of tools, equipment and

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[10] High information costs and ignorance often imply that transacting parties voluntarily leave rights over certain properties of an asset unspecified. For example, to completely specify all rights to use a computer requires full knowledge of all possible uses and all the different ways in which the computer may be operated, as well as a detailed listing of these uses. In addition, one would need to perform a tight surveillance of the users of the computer in order to enforce one's rights. Many rights over a computer are therefore left unspecified, and these rights may be captured by the user of the computer who then is capable of exercising some discretion in his decisions on how to use or operate the computer.

[11] With higher degrees of discretion individuals also have more room for shirking or otherwise appropriate a greater part of the value from the use of an asset. The allocation of residual income rights from the use of an asset can be a powerful mean of reducing such rent-seeking behavior.

components. Basically these problems arise when those who deliver parts or carry out activities are not aware of the need for mutual adjustment.

Solving problems that arise from technological interdependencies is an important souse of innovative improvements[12] (as pointed out by Rosenberg, 1976 and Sahal, 1981). However, such innovations do not emerge because of increased specialization, but because of learning in coordination. The question then arises: what institutional set-up best provides for experimentation and accumulation of experience in coordination?

In this context, and along basic Coasian lines (Coase, 1937, 1991), 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.

C. Coase on the Nature of the Firm

Coase (1937) appeals to coordination costs in order to explain why in an economy of specialized production markets and firms co-exists as alternative modes of coordination. The reason for the existence of firms, he explains is that there are costs of using the price mechanism and "[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; *our emph.*). With high market cost (later termed transaction costs), the market mode of coordination is substituted by a firm mode of co-ordination based on managerial decisions. But as pointed out by Coase the advantages of the firm mode over the market mode diminish as marginal costs of coordination increase with more tasks being coordinated within the boundaries of a firm. This leaves room for competition between firms for the coordination of specialized tasks.

While Coase (1937) does not explicitly suggest that uncertainty is a reason why there may costs of discovering the relevant prices, uncertainty seem to play an important role in explaining the need of open-ended contracts such as employment contracts. According to Coase such an employment contract is preferred

[12] Problems of bottlenecks and uneven development of components exist even with self-sufficiency, since individuals producing for their own needs may be unaware of how best to carry out an activity or to develop the technologies they use. Specialization in production, however, is likely to magnify the problems.

> ... 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 (Coase, 1937: 21).

Stated in the terminology of property rights theory, there are *high costs of specifying the valued attributes of assets in all future states*. These costs result in rights over valued attributes of assets being left unspecified. When the coordination between factors is subject to changes in external factors (contingencies) which cannot be specified *ex ante*, continuous redirection of resources and re-planning taking advantage of the dimensions of time and place of assets will be necessary in order to avoid bottlenecks.

High costs of discovering the relevant prices is a necessary, but not a sufficient, factor in explaining why firms emerge, since "... this cost may be reduced but it will not be eliminated by the emergence of specialists who will sell this information" (Coase 1937: 21). Firms exist only if there is also "... costs of negotiating and concluding a separate contract for each exchange transaction which takes place on a market (ibid, p.21).

An arbitrageur holding stocks of assets makes his money from superior knowledge about the value of the unspecified attributes of time and place and the employment contract could be interpreted as a providing stock of labor services which within limits could be allocated to different uses by the direction of a arbitrageur in response to unforeseen contingencies.

Now, arbitrageurs only need to bear the cost of stocks if they cannot appropriate the benefits of their knowledge of time and place by selling this information. Two factors may explain why it is not always feasible to sell information about time and place dimensions of assets. First, there is the well-known problem of information as a public good which, if revealed before the transaction, cannot be protected from capture (Arrow 1962). Secondly, negotiations may take longer time than direction by orders, and because of this opportunities for profitable action may be bygone.

In "The Nature of the Firm", Coase uses the employer-employee relationship as the archetype of the firms where managers' rights to direct resources within certain limits fills in the holes in the open-ended employment contracts. Later on Coase (1991) has remarked that already at the time when he wrote "The Nature of the Firm", he was aware that the analogy

between the employment contract and the firm could give an incomplete picture of the nature of the firm. Coase (1991) points to an amendment to the original article when he draws attention to a lecture note from 1934 in which he states that "..a full firm relationship will not come about unless several such contracts are made with people and for things which cooperate with one another" (Coase, 1991, p.64). This amendment can be interpreted to mean that managerial decisions fill the holes of open-ended contracts in cases where coordination of large number of factors which cooperate with each other is required. This is exactly the situation with technological interdependencies between many tasks.

To sum up, firms exists only if there is both high costs of discovering the relevant prices *and* if these costs cannot be reduced by contracting for this information. The latter may be the case where interdependencies between many resource owners make it costly to rearrange tasks to take advantage of new information on states of the world. Firms then save transaction costs by substituting *many* independently determined contingent contracts for managed directions.

D. Specialization in Production, Technological Uncertainty, and the Role of Firms

Like virtually all other contributions to the theory of the firm (Langlois and Robertson (1995) being the exception), Coase takes the costs of coordinating various tasks as well as the extent of specialization in the economy as *given,* and proceeds to analyze why not all transactions among specialized agents are coordinated in either firms or in open markets. However, the cost of coordination between tasks may crucially depend on the degree of specialization. Self-management of more tasks may be an alternative to specialization which 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 interdependence between tasks that we find the rationale of the firm. Specifically, firms can be viewed as solutions to *problems of coordination in situations where user rights over assets cannot be perfectly specified and allocated in manners which ensures the functionality of complex*

technologies. Such situations may occur because individuals have only limited computational capacity, making it to difficult for them to specify user rights in ways that solve problems of interdependencies or because they face uncertainty in the sense that they lack ability to imagine "... the alternatives between which decisions are made" (Littlechild, 1986, p.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. Such experimentation, of course 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 of bottlenecks and uneven development of components relative to pure market transactions. Thus, the firm arises not only in response to problems of adapting to unforeseen contingencies, but also as a response to technological uncertainty. In fact managed coordination is important even if there are *no* unforeseen contingencies which require adjustments in tasks.

For managed direction of resources to be efficient, it is required that managers are at least as qualified in discovering the relevant prices (that is, finding the highest valued uses of assets) as independent contractors would be.[13] Otherwise, costs of transacting may be saved at the expense of efficiency in the use of resources. If managers are better able to determine the valuable uses of resources compared to other agents, managers have a natural ownership advantage over resources. Such an advantage explains the single person firm, but not

[13] 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.

necessarily why managers hire employees who are prepared to take orders within certain limits in order to take advantage of this knowledge. "Managers" could as well rent the labor time of an agents in return for the exercise of a certain well specified task.

However, in actuality, managers stand a good chance of acquiring superior knowledge about the relevant prices of rights over assets which make up a complex technology. From the literature on incremental innovations, 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 managers who hold residual rights over assets, including rights to re-define and reallocate specific rights, are able to conduct experiments without continuously having to re-negotiate contracts which have more or less unforeseen outcomes -this saves time and ink-costs.[14]

Managers 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 boundaries of firms and in particular if interdependencies exists between many different firms and if due to high information costs it is difficult to specify all the tasks which must not be changed. Coordinating interdependent tasks within the boundaries of a firm may provide managers with a more complete picture of the nature of interdependencies – information which 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

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

coordination by order contracts would substitute for coordination by management.[15] 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 processes* of specialization in tasks, learning in coordination and specialization between firms and new ways of coordination will continuously be imagined by managers/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.

V. Conclusion

In *Economics as a Process* Richard Langlois suggested that an ambitious research program in economics was slowly beginning to emerge, one in which extended notions of rationality were coupled to dynamic conceptualizations of the market process and in which institutions were factored into the analysis, both as constraints and as endogenous outcomes of interaction among agents. However, he did not provide much detail on what such a research program may look like in the concrete.

In this paper, we have borrowed ideas on rationality and knowledge from Austrian and radical subjectivist perspectives, and have told a story about why there should be firms in a market economics based on these non-conventional. In order to structure the discussion, we focused these ideas in terms of insights from property rights economics and various types of work on specialization and innovation. Our theory of the firm involved the idea that firms exist because they provide superior mechanisms for experimenting with complex production technologies.

We emphasize that what we have tried to accomplish in this paper is just one out of a multitude of ways in which the research program that Langlois suggested may be focused. Many other avenues of similar types of research are open.

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

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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?

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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:

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