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THE EVOLUTIONARY THEORY OF THE FIRM: ROUTINES, COMPLEXITY AND CHANGE

by

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The evolutionary theory of the firm: Routines, complexity and change

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1 Introduction

The theory of the firm is a central element in modern economics and the firm is one of the central economic institutions of capitalism. An economic explanation of why firms exist - first suggested by Coase (1937) - is because they are efficient. The costs of organizing a transaction within the firm must be less than the costs of using the market for firms to exist. The modern theory of the firm explains the boundaries of the firm based on three major costs of organizing firms: communication and coordination costs (Coase 1937, Williamson 1975, Radner 1992) agency costs (Alchian and Demsetz 1972) and the hold up problem (Klein et al. 1978, Williamson 1985). These costs can be lumped together and viewed as different kinds of transaction costs. Common to this literature is the view that the size of the firm is largely independent of technological considerations which dominate the literature on plant size. The neglect of technology in this literature was noted by a number of commentators (e.g.

Antonelli 1999, Lindbeck and Snower 2003). However, most modern developments in the falling in the rubric economic theory of the firm have looked at the firm as bundle of bilateral contracts. This implies a major neglect of the technological and organizational aspects of production. This view is epitomized by Alchian and Demsetz (1972), who do not see any relevant difference between the relation which occurs between employer and employee and the one between a grocer and his customers.

The evolutionary theory of the firm provides an alternative explanation of the firm based on routines. In a world where agents differ in their perceptions of the environment, and where communication, acquisition of information and computation are limited and costly, coordination can only be achieved by means of the definition of a common set of rules and codes which are understood and shared by the members of the organization involved in economic interaction. While it is true that the evolutionary theory focuses especially on the technological aspects of production, it also stresses the cognitive nature of the organizational structure of the firm.

The evolutionary theory of the firm in its original form as proposed by Nelson and Winter (1982) is similar to the 'black-box' view of neoclassical economics a device to study evolutionary dynamics. This view of the firm does not consider the organization of the firm in an explicit way. However, the firm is described as entity processing, storing and producing knowledge. The evolutionary theory of the firm can be more than a device to study industrial dynamics. Notions like 'corporate coherence' (Teece et al. 1994) or 'routines as truce' (Nelson and Winter 1982) point in this direction.

2 Evolutionary economics

Evolutionary economics sees the economy as a scientific domain characterized by disequilibrium processes in which economic agents create and adapt to novelty through learning rather than a system in equilibrium or resting in a steady state (Witt 1991, Nelson 1995, Saviotti 1997, Foster and Metcalfe 2001, Fagerberg 2003, Cantner and Hanusch 2002). The influence of Schumpeter on evolutionary economics can not be overstated. The reasons for Schumpeter's appeal to many economists stems from the fact that he stressed the

qualitative nature of economic change which revolves around the introduction of new goods with different characteristics, new methods of production, and new methods of organization. Schumpeter was a major influence on the work of Nelson and Winter, whose seminal contribution *An Evolutionary Theory of Economic Change* provided the point of origin for the modern study of the evolutionary behavior in economic systems. The starting point of Nelson and Winter's contribution is a critique of the standard theory of production. Their emphasis is on learning (mainly technological) and selection among heterogeneous firms. The basic tenets are outlined Nelson and Winter as follows,

[t]he firms in our evolutionary theory will be treated as motivated by profit and engaged in search for ways to improve their profits, but their actions will not be assumed to be profit maximizing over well-defined and exogenously given choice sets [...] Our theory emphasizes the tendency for the most profitable firms out of business; however, we do not focus our analysis on hypothetical states of 'industry equilibrium' in which all the unprofitable firms no longer are in the industry and the profitable ones are at their desired size.

(Nelson and Winter 1992, p. 4)

Since Nelson and Winter's contribution it became more and more customary to equate changes in economic structure, the changing relative frequencies of different actions, behaviors and institutions with evolutionary change and to attribute the ultimate source of change to the co-existence of rival and different forms of behavior. Evolution in the context of evolutionary economics means that economic development over time is an open ended dynamic process over an open state space. This shows that evolutionary economics is not a one to one transfer of evolutionary theory or metaphors from biology into economics. Far from that, evolutionary economics takes into account the specificity of the economic sphere. The framework outlined in Nelson and Winter's contribution has work has proved to be fruitful, especially in the area of economics of technology and growth theory. Three distinguishing and interrelated traits of evolutionary economics can be identified:

1. While there is disagreement on the specific definitions, there is agreement on the fact that *knowledge and information* are central ingredients of the approach of evolutionary economics. Economic systems are knowledge-based. Economic knowledge is conceived as set of routines that are reproduced through practice. The processes of knowledge creation and destruction underpin and drive economic growth and qualitative change. The growth of knowledge cannot be meaningfully captured as a

constellation of equilibrating forces (Nelson and Winter 1982, Metcalfe 1998, Witt 1997, Foster and Metcalfe 2001).

2. Evolutionary economics takes a *population approach* instead of a typological approach based on representative agents. The heterogeneity of economic behavior is based on the distribution of knowledge and information within the economy (Hayek 1945). Heterogeneity drives economic change, which can cast in terms of observable changes in the compositions of population of firms, technologies, and industries. The decentralized nature of the economic system implies that there is massive parallelism of computation and behavior within the economic systems. Together with spillovers the decentralized organization creates not only the problem solving capability of the economic system but also the capability to formulate new problems and new behavior (Dosi 1997, Metcalfe 1998).

3. The *interdependence between selection and development* is a first characteristic of evolutionary economics. Competition as selection process provides a process structuring economic activity (Metcalfe 1998) and imposing a requirement of procedural rationality on participants. Selection changes the frequencies of entities (measures as numbers or market shares) in the population according to rewards. From a perspective of variety generation, markets are institutions which not only coordinate economic behavior but facilitate change, entrepreneurship and challenges to established behaviors. Selection processes operate on variety, they destroy variety. The generation of variety and the selection of variety interact in the process of development. In order to have economic development, variety needs to be re-created.

The outcome of the operation of an evolutionary process is adaptation, the fit of entities in consideration with the properties of the selection environment. In this respect, it has to be noted that evolutionary processes are not compatible with completely random behavior. Every notion of evolution which postulates that behavior is random ignores the requirement of *inertia* of any evolutionary argument. In other words, there must be some degree of heredity of behavioral routines, technologies, and attributes in the economic system. The inertia argument implies that the behavioral characteristics of the agents and units of selection must be correlated over time. This suggests that constructed 'random' worlds may change over time but not evolve in an evolutionary sense. This means, in order to construct an evolutionary argument for the economic sphere, it must be assured that the behavior of agents and organizations changes more slowly than the rate at which the selection process takes place.

3 The evolutionary theory of the firm

Nelson and Winter begin with a critique of the standard production theory. Standard production theory starts from the set of all technologically feasible technologies and assumes that each firm can operate these technologies if it wishes. Each of the different production techniques available is parameterized by a vector of inputs and outputs corresponding to the productive transformation a firm can accomplish. The set of all optimal techniques which provide the maximum output with given inputs define the production function. Nelson and Winter criticize this conception of production as not depicting the reality of the economic problem of production, where the idea that all technological knowledge is available in an articulate way in a book of blueprints is not met. Especially the implicit assumption that technological knowledge can be written down at a negligible cost is target of their critique. The existence of universally available technological knowledge implies that technological change is exogenous and the activities of research and development are separated from actual production. They contrast this theory with their own theory of production based on differential capabilities, embedded in the personal and organizational structure of firms. Skills on the personal level, and routines at the organizational level form the repository of knowledge with in turn defines the production possibilities of firms. The important aspect for Nelson and Winter was that the theory emphasized 'firm differences'. Thereby Nelson and Winter (1982) proposed an interpretation of the production technology as 'production knowledge' including beside embodied knowledge in equipment and machinery also tacit knowledge, capabilities, skills and even heuristics for problem-solving. Even if this knowledge is non-excludable in nature, it is not easily transferable between firms. It is stored as routines in the firms. Routines define the technological knowledge of a firm. Following Nelson and Winter, evolutionary theorists based their theories of the firm on bounded rationality (rule-based behavior) and routines.

The behavior of firms is characterized in terms of technological capabilities, workers skills and decision rules. The connecting elements are called routines. Routines are the result of past learning efforts and constitute the organizational memory of a firm. As such they are embodied in and link activities with the aim of producing goods or processing information.

Routines can be considered to be repositories of knowledge because they connect in an quasi-formal way individual skills. A routine is a sequence of condition-action rules for different tasks which are executed in sequentially or in parallel. The evolutionary paradigm of the firm is deeply rooted in the idea of the firm as an information processor that facilitates the firm's capacity to adapt and process new information. Organizational routines are all organizational regularities and standardized processes of production and information processing which describe the behavioral patterns and production techniques of firms. Nelson (1994) stresses that 'a firm can be understood in terms of a hierarchy of practiced organizational routines, which define lower order bureaucratization skills and higher order decision procedures for choosing what is to be done at the lover level'. Nelson and Winter describe with the term routine two different aspects, the cognitive aspects of learning and knowledge on the one hand and the organizational aspects of incentives, monitoring and control on the other hand. From this stems the conceptual difficulty or confusion on the exact definition what routines are in the literature (Cohen et al. 1996). Routines have the double character as problem-solving skills and as mechanisms of governance.

Organizational traits are closely related to the function of a 'truce' of routines. March and Simon (1993, p.2) state "organization is the transformation of conflict into cooperation". In the terminology of game theory this may be expressed as how a prisoner dilemma can be transformed into a coordination game. Basically, three different mechanisms can be used to achieve this goal: reciprocal altruism, the exclusion of free riding behavior and most importantly the repeated nature of the game within an organization. The folk theorem states that trigger strategies can support any set of payoffs feasible in the underlying game. The selection of equilibria is essentially a coordination problem. No longer are preferences central, the beliefs about how will the other players play the game become central. Put in this context a routine is a specific way to play the organizational coordination game. Routines provide organization-specific conventions. There will be routines within groups, but in organizational context of firms highly important are the rules of the game and the way how this game is played between different subgroups (different divisions or departments) of a firm. Inconsistent conventions lead to frictions in coordination and to losses in performance.

The specific feature of the evolutionary approach is that it explains the adaptive behaviors of firms through the tension between innovation and various selection mechanisms. Coriat and Weinstein (1995) argue that an evolutionary theory of the firm has the advantage, compared

to other theories of the firm, to provide an explanation for three issues of importance to understand the nature of firms:

1. It explains how a firm can be defined: through the set of routines and competencies that the firm encompasses.

2. It explains why firms differ: because they rely on a different set of routines which are firm-specific and cannot be transferred at low cost.

3. It explains the dynamics of firms: through the combined mechanisms of searching and selection and the possibility of transforming a set of secondary routines into the core activity.

The evolutionary theory thus provides a theory of firm differences and dynamic change based on learning and adaptation. Thereby it is a device to study industrial dynamics. However, even if the evolutionary theory is not primarily focused on the boundaries of the firm, it suggests an alternative approach to this issue - namely that the boundaries of the firm lie where information is most easily codified and a shared context is created which allows to minimize transaction costs associated with problems of limited (or missing) competence. In this respect it is true that routines may help saving transaction costs associated with information processing. But there are distinctive differences between transaction cost theory and the evolutionary approach. The transaction costs approach views the firm as an efficient outcome of market selection processes, which are usually treated as black box. The evolutionary paradigm, in contrast, is based on cumulative processes which do not necessarily ensure the 'survival of the fittest' but advocates a 'weak selection process' that is based on existing structures.

However, there are still a number of open questions which needs to be answered for the evolutionary theory to provide a true theory of the firm:

1. The theory how routines change is not well developed. The internal selection process within the firm needs more empirical and theoretical content.
2. Routines as a truce: The evolutionary firm has little to say regarding the conflicts within firms, e.g. capital - labor conflict or corporate governance. The role of routines as truce is largely unexplored.

3. The evolutionary theory of the firm is largely silent on the issue of entrepreneurship (Witt 1998).

Among these unsettled questions the issue of how routines change is a very important one. Therefore let us concentrate on this issue, in order to do this we need first to look in more detail at the foundations of the basic concept of the evolutionary theory of the firm: routines and rule-based behavior.

4 Routines and rule-based behavior

Routines are specific instances of rule-based behavior on the level of an organization. They are decision processes that require low levels of creative information processing (rules of thumb), but can be complex automatic behaviors which involve high levels of repetitive information processing. Cohen et al. (1996) define a routine as "an executable capability for repeated performance in some context that has been learned by an organization in response to selection pressures" (p. 683).

However, as a general theory of decision making the concept of routine is not precise enough. A consensus has emerged that routines relate to organizations whereas rule-based behavior relate to individuals. Rule-based individual behavior has been argued, may provide the core for an alternative behavioral theory of decision making (Cohen et al. 1996, Heiner 1988). As modern rational choice theory modern theorizing on rule-based behavior is based on firm individualistic foundations. Thereby the concept of rule-based behavior may form a theoretical basis to explain organizational routines.

Most economic models which involve learning argue that only some well specified dynamics on the learning on the content of the rules are needed, as it is assumed that,

1. That the representations of the agent are strict partitions of the states of the world.
2. That the set of possible actions is known and relatively trivial, that implies that the known actions do not differ from the possible actions.

3. That the interpretations are always true, there is no need for an interpretation. The representation is redundant as there is transparency of the form the agent knows what really happened.

However, as Dosi et al. (2004) argue, it might well be that another model might well be useful as a first descriptive approximation, where it is assumed that:

1. The action repertoire is fixed.
2. Learning is basically about the development of representations and models which map the invariant action repertoire on the payoff.

Behavioral adaptation is learning about the representations of the environment, the appropriateness of rules and the pay-off function attached to these rule given the environment. This shows that rule-based behavior is essentially dynamic, based on behavioral adaptation. The prime difference to rational choice theory is that theories of rule-based behavior see the adaptiveness at the level of the rules of actions. The individuals are not presumed to be case by case maximizers, capable to understand all contingencies of the choice situation. What is ascribed to them is the capability to change their rules by learning from past experience. Rule-based theorizing leads attention toward the process of adaptive learning (Vanberg 1994, p. 29).

A rule is essentially a condition - action rule applied to choice situations, which allows individuals to trigger an action when a condition is realized. There is no finite set of alternative rules at the disposition among which is chosen. And it makes not much sense to speak of a 'given best' rule, as the very nature of rules implies that their appropriateness can only be judged by their performance on a longer sequence of applications.[1] This shows that in the context of rule-based behavior there is more to bounded rationality that costly decision making (Radner 1996). Costly decision making refers to to costly activities related to (i) observation, (ii) information processing that is computing, (iii) memory, and (iv) communication. The last category is especially important in the context of an organization

1 A question which is debated in the literature is whether rule-following behavior is a subset of rational choice theory. That is, can it be rationally chosen to follow a rule. This question seems to be innocent, however, it boils down to the question: Can it be assumed that economic actors can chose to switch on and off their rational calculation? This would require some kind of 'meta-rationality', and a two step procedure of rational choice. In a first stage the decision maker decides rationally if he decides a rule or if he makes a choice. In the second stage he follows the rule or makes a rational choice. However, such a theory would be not much different from an adaptive learning process about rules, that is about evaluating rules ex-post and adjusting the rule.

when the decision making process is assigned to a team of individuals. If these costly processes refer to binding constraints they need to be taken in account in the decision makers optimization problem. If they relate to resource use in time, then extensive decision making causes delay, which may result in lower effectiveness of the decision.

The same is true for truly bounded rationality in the sense of Radner (1996), who does identify (i) inconsistency, (ii) ambiguity and vagueness, (iii) unawareness and (iv) the failure of logical omniscience as leading to true bounded rationality. Inconsistency may derive that the decision maker has inconsistent preferences, as he is forced to articulate preferences about which he is not sure. Ambiguity and vagueness relate to the interpretation of the world, the learning process about revisions of the model the agent holds. The problem is that the agent knows that he will revise the model in future, he has no ability whatsoever to predict what the revisions will be. Vagueness and ambiguity can refer to the uncertainty of consequences, that is, uncertainty about the payoff function or vagueness about the states of the world. While it may well be that a rational choice theory about learning of the model is feasible, the problem of 'failure of logical omniscience' is fundamental, as it refers to the fact that the agent "does not know all of the relevant logical implication of what he knows" (Radner 2000*, p. 653)*. Radner (2000) gives examples which illustrate the problem, one of these is: "Given all that is known, theoretically and empirically, about business organizations in general, and about telecommunications and AT&T in particular, should At&T reorganize itself internally, and if so, how?" (Radner 2000, p. 654).

As Radner remarks, the problem with the 'failure of logical omniscience' for any theory of rational choice including theories of bounded rationality is the meaning of 'rationality' in this specific case. Rule-based behavior in contrast replaces 'rationality' with adaptability. There are still problems with the formulation of a 'general' theory of behavioral adaptation. In this context the distinction between information and knowledge is extremely useful. Information can be defined as data relating to states of the world and the state-contingent consequences that follow from events. Knowledge in contrast is an information-produced belief (Fransman 1994), the cognitive frame to interpret information and to transform information into to new knowledge. And rules are essentially a specific form of (tacit or formal) knowledge.

Whenever one abandons the most restrictive assumption on information perfectness and symmetry among agents, organizational forms do matter because incentives, information

flows, and behavior differ according to the particular architecture of rules (corporate culture) of each firm. Routines are not behavior. They are stored behavioral capabilities. These capabilities involve knowledge and memory, and the firm by being the storage of routines is a coordination device for economic, especially productive, action.

5 The firm as a collection of organizational routines

Routines are not isolated. They are interdependent within firms. Business firms and other economic organizations are more or less complex networks of routines, where products (also information) of one activity are inputs of another. Some of the ties in this network can be very strong, while others may be weaker. The strength of the connection can result from strict technical complementarities, but also from dynamic complementarities, which capture learning spillovers, synergy effects and other mechanisms generating dynamic complementarities.

The same production activities e.g. manufacture of cars can be routinized in different ways, as emphasized by Dosi and Coriat (1998), who compare the different management styles, routines, incentives and control mechanisms in American and Japanese manufacturing. The differences show how knowledge and competence can be allocated in quite different ways. Aoki (1990) has emphasized this implies different internal architectures with respect to information-processing and incentive-governance. The fragmentation of task allocated to single workers requires a different control system and system of coordination than the Japanese system based on 'transferable work components' which can allocated to the workers in small group. This example shows that routines must fit with each other in order to provide a required performance.

Complementarity is an attribute of elements of a given system (network, production process or firm) and arises if single elements of the systems interact in such a way to influence the overall performance of the system. An good example is provided by the personal computer: The choice of best components (CPU, motherboard, graphic card, software) does not necessarily imply that this PC is better than all the others, indeed it might even not work if the 'best' CPU cannot be put on the 'best' motherboard. This shows also that complementarity is

deeply connected to the concept of linkages and interfaces, as with an adapter it might be possible to put the CPU on the motherboard. A useful metaphor for thinking about systems with complementarities is Stuart Kauffman's *NK* model (Kauffman 1993). The *NK*-model presents an intuitive mathematical metaphor to think about complementarity. The *NK* model is simple, it presents a system with *N* elements, each of which can take one of *x* possible states, and *K* dependence relations between these elements. The *NK* model can easily be thought to represent a firm with *N* routines. If a routine is not linked to any other activity then we have perfect separability. Under perfect separability each activity can be changed or even exchanged without compromising the working of the system, as the performance of other elements is not influenced. If an element is connected with other activities in the network, then its removal affects the performance of the other activities.

Some routines will mediate the interaction between other routines and in this way influence the performance characteristics. These may be viewed as forming the organizational 'core' of a firm. If no such activities would exist then the firm would just be a collection of unrelated organizational and technological processes not interacting with each other. The interdependencies and complementarities between routines form the core of a firm. That means that routines that affect the performance of many other routines are critical. A change in one of those core routines affects the overall performance of the firm to a much larger extent than routines that are peripherical. This implies, that complementarity lowers the possibility to control perfectly the performance of the firm, as small changes may have large effects. Separable routines, that are peripherical, are more likely to be changed, as even negative changes do not have a pervasive effect and can be identified and isolated without affecting many other functions within a firm. A firm consisting only of separable activities is perfectly modular. This would allow perfect control of the performance of the firm, but in the end, this system is devoid of a formal coordination mechanism relating them to each other. Hence, it would no longer be possible to talk about a firm.

The existence of highly interrelated activities has two implications on the process of organizational and technological search (Hölzl and Reinstaller 2003, Reinstaller and Hölzl 2004). First, for core activities there are more trade-offs between the performance values of different other elements of the organizational system. The risk that the improvements in performance of some routines are offset by reductions in performance of other routines is high. The more complex the organization is the higher will be the likelihood that a change in

one component may conflict with the overall performance. This implies that elements in the core are less likely to be changed. Improvements within the context of an existing organizational core take place by substituting, adding or changing routines that are peripheral. The second implication is that the core reduces uncertainty by representing a stable set-up. It represents a organizational design that works, and there is an incentive to keep the core elements of the operating procedures as they are. Together this implies that firms are slow and reluctant to change core routines. Firms are complex multi-dimensional bundle of routines, decision rules, incentive schemes whose interplay is largely unknown to those who manage the organization themselves, as with strong interdependencies the system can not be optimized by optimizing separately the elements it is made of.

If shocks punctuate the evolutionary development and induce radical transformations, the strong complementarities in the core may turn into binding constraints by causing imbalances between activities and hindering adaptation. Then firms have an incentive to break up the constraint posed by complementarities between the different routines forming the core. It is difficult for firms to re-invent themselves. Empirical research shows that changes that require the change of core routines increase organizational mortality (Carroll and Hannan 2000). This explains why new firms are the carriers of radically new innovations both in respect to technology and organization. Incumbents have an advantage with cumulative changes. Organizational routines, while being an effective way of storing and reproducing organizational knowledge, are by their very nature a source of organizational inertia.

The picture of the firm that emerges is one of a relative stability, which forms a focusing device to coordinate the actions of the people involved within the organization. Routines and rule-based behavior reduce the cognitive distance between the members of the organization (Nooteboom 1992). The focusing device helps to align perceptions, understandings, goals and motives.

6 How do routines change?

The firm a collection of organizational routines depicts the firm as rigid and inert. However, firms do change, and with them their routines. This raises questions about the usefulness of

this view on the firm - especially from the perspective of evolutionary economics, where competition does not take the form of pushing prices to marginal costs, but rather replacing products and processes by ones that are better, more efficient or satisfy preferences more closely (Nooteboom 2001). The question is, how do routines change and how do firms change. This question is far from settled, and related to the trade-off between exploration and exploitation in organizations (March 1991). The trade-off between efficiency of current production and the exploration of new products and new ways of doing things, related to the uncertainty of innovation, is one of the fundamental questions of the management of change.

Most evolutionary models are based on competitive selection. This model has also been applied to the selection of organizational traits. But in the context of the firm as a network of interdependent routines and activities this model has serious limitations, even if it cannot be denied that the competition between firms should lead to the selection of collections of routines that yield the highest profits (Massini et al. 2002). A strong selection argument is impossible to make as it is the totality of routines that are subject to the 'market screening', rather than individual routines. Increasing the internal efficiency of some routines does not imply that the overall efficiency of the firm needs to increase as well. Outputs are selected by the market, not individual routines or transactions. Therefore, it is generally very difficult to link the performance of single routines to firm's overall performance. Competitive selection between firms cannot explain the diffusion of routines.

The replication (copying) of organizational practices is a second mechanism (Hodgson and Knudsen 2004). For this reason, in organization science the idea of internal or managerial selection is dominant. Let us first consider the creation of a pool of variety for selection internal to the firm. This relates to the duplication of subsidiaries, divisions or departments. This redundancy is inefficient and difficult to manage (Nooteboom 2001). This possibility is open only to very large firm which have both the managerial and financial resources for the creation of internal variety of routines. Moreover, if we consider multinational firms, the subsidiaries are embedded in different economic and cultural environments, which may make it difficult to compare the efficiencies of routines or collection of routines. Even if it is difficult to obtain a clear picture of the contribution of each routine to the firm's overall performance, it is possible to consider of routine bundles related to identifiable and measurable activities such as total quality management or sales or logistic systems (Lazaric and Denis 2001). The internal selection of routines by management fiat is related to learning,

imitation and local adaptation. However, there is a fundamental problem related to the managerial selection and local adaptation. The link between internal selection processes and environmental pressures needs not to be strong. It might well be that internal selection environments become divorced from external pressures leading to maladaptation (Sorenson and Stuart 2000). The incremental nature of local learning processes increases the effectivity of operating routines and production processes. But these improvements are realized in the neighborhood of the firm's existing activities, thus increasing the possibility that the local adaptation becomes divorced from the selection environment, leading to an obsolescence of underlying routines.

As noted in the literature on the diffusion of organizational practices, examples of successful routine replication exist, as do examples of successful re-inventions of firms, such as the transformation of Preussag a diversified national mining company since 1923 into TUI (its new name adopted in 2002) now leader in the European tourism market. Critical in this respect is the capacity of the organization to absorb the new practices and to integrate them in the existing organizational context. This is an easier task for large firms with appropriate managerial and financial resources such as Preussag than for small firms, as re-focussing through acquisition is much easier than re-configuring an existing organizational structure. The interdependency of routines implies that the change of a routine not only alters the performance of other routines but more importantly it predetermines also the type of other routines. This implies that firms cannot easily be decomposed into its individual components. The structures and routines within firms share normally the fate of the firm itself. While individual skills and physical capital can be moved into alternative uses, the idiosyncratic structures and routines are usually specific to the firm itself (Winter 1998). Most of the firm's routines share the fate of the firm in which they were created (Hodgson and Knudsen 2004). This suggests that entrepreneurial action in response to firm exit may be an important element changing the pool of routines in an economy. The skills and physical resources released are released for alternative uses in existing and new firm, where they can be routinized in new and more efficient ways.

7 Concluding remarks

The specific feature of the evolutionary approach is that it explains the adaptive behaviors of firms through the tension between innovation and various selection mechanisms. It shows that rule-based behavior and routines can provide a useful basis for a theory of the firm which is concerned with change over time and development. However, the evolutionary theory of the firm is still basically a theory of why firms differ and provides a device for the study of industrial dynamics and evolutionary growth.

The discussion of the firm as a collection of organizational routines and the change of routines has shown that an evolutionary theory of the firm needs not be restricted to the definition of innovation possibilities frontiers. An evolutionary theory of the firm may be able to provide a theoretical framework for the analysis of organizational boundaries and change. The understanding of how routines are formed and change is central and needed as foundation for an evolutionary theory of the firm that integrates the views of the firm as repository of knowledge and of the firm as a network of incentives and power.

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