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Angaben zur Veröffentlichung / Publication details:

Rahmeyer, Fritz. 2006. "From a routine-based to a knowledge-based view: towards an evolutionary theory of the firm." Augsburg: Volkswirtschaftliches Institut, Universität Augsburg.

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Institut für Volkswirtschaftslehre

Universität Augsburg

Volkswirtschaftliche Diskussionsreihe

From a Routine-Based to a Knowledge-Based View:
Towards an Evolutionary Theory of the Firm

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Beitrag Nr. **283**, Mai **2006**

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Abstract

Evolutionary economics in the initial version of Nelson and Winter is concentrated on the analysis of the evolution of industries and markets and in that entrepreneurial innovation activities. But a theory of the firm beneath the level of the industry is not taken into account to a large extent. In order to widen its fundamental principles a resource-based, and as its extension, a knowledge-based view of the firm, both originated in the field of Business Strategy, are seen as promising candidates to close this gap within evolutionary economics. Industry dynamics as the evolution of a population of firms in this way is supplemented by a more detailed characterization of the internal structure of individual firms. It is the fundamental question with regard to the adequacy of an evolutionary interpretation of firm behaviour and development as to what extent a firm and its individual activities are considered to be capable of purposefully and actively influencing its environment, on the one hand, and are blindly selected by environmental pressure, on the other hand. In this way firms become intendedly heterogenous concerning market performance and organizational structure. Regarding the general topic of a theory of the firm, a unified approach will not be constructed, but more likely a hybrid one being composed of technological, institutional and efficiency-based elements.

Keywords: Economic evolution; resource-based view; knowledge-based view of the firm; theory of the firm.

JEL-Classification: B 52; D 21; D 83; L 23

To be published in:

H. Hanusch and A. Pyka (eds.) (2006), Elgar Companion to Neo-Schumpeterian Economics. Cheltenham, Northampton, Ma.: Edward Elgar.

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From a Routine-Based to a Knowledge-Based View: Towards an Evolutionary Theory of the Firm

Fritz Rahmeyer

1 Introduction

One of the central subjects of evolutionary economics especially in the line of thought of Nelson and Winter, for their part - among others - based on Marshall and Schumpeter, is the analysis of entrepreneurial innovation activities and the evolution of markets and industries. But a theory of the individual firm beneath the level of the industry as a population of firms shows only fragmentarily. It is the object of this paper to reduce this gap and to lay more emphasis on the firm compared to the industry. To this end at first some necessary comments concerning the idea of evolution and its adequacy for economic reasoning are made (chapt. 2). After that alternative theories of the firm in the fields of industrial and institutional economics will be under careful scrutiny (chapt. 3). As the building block of an enlarged evolutionary theory of the firm a resource-based view in dynamic form presents itself. Knowledge, both as an input to and an output of production, is the most important resource and gives reason for a knowledge-based view of the firm (chapt. 4). The broadening of the currently existing behavioural evolutionary approach, resulting from findings of the field of Business Strategy, opens up a more active role to enable the firm to gain a sustained competitive advantage. In addition to that it leads to an *intended* heterogeneity among firms concerning market performance and internal organizational structure.

2 Evolution in nature and society: fact, forms, theory

Evolution as an endogenously emerging historical process denotes a mainly gradual and irreversible change of an organic or a socio-economic system, when compared to its initial state. In economic thought there is still no agreement concerning the content and adequacy of this idea and especially its theoretical foundation. For obvious reasons this concept may first of all be put forward in loose analogy to the neo-Darwinian theory of biological evolution. Reasoning by analogy is a method of scientific cognition and means the transfer of theoretical ideas between scientific disciplines in order to solve problems (see Cohen, 1993, p.13). Hereby a close transferability need not exist (see Niman, 1994, p.364; also Dosi and Nelson, 1994, p.155). Building blocks of a neo-Darwinian theory of evolution¹ are the constrained emergence of variety among the individuals

¹ For the origin of the synthetic evolutionary biology, see Mayr, 1984, pp.454; Depew and Weber, 1995, pp.299.

of a species, occurring undirected and by chance, their advantage or disadvantage concerning the survival and replication rate of genes by means of natural selection of organisms as the physical characteristic of an individual and the retention of those characteristics that are best adapted to the environment. Each individual in a population is unique, and when compared to the average, it will either be favoured or at a disadvantage (population thinking; see Mayr, 1984, pp.38). The result of the selection process is a directed change inside a population. It does not go off purposefully but opportunistically as well as coincidentally and does not lead to a perfect adaptation. So on the one hand evolution requires the emergence of diversity and in this way change, while on the other hand it destroys variety and gives rise to a directed and structured course. It is the result of a two-stage process, characterized by chance (creation of variety) and necessity (adaptation of individuals), so constituting a dynamic equilibrium between adapted individuals and their given environment. Predominantly it takes place by a gradual but not an erratic change of a population. Besides the emergence and natural selection of diversity among the units of a population a genetic evolutionary explanation also comprises the more regular development of the individual organisms in the population, the latter unlike the former dependent on the environment. From a historical point of view Darwin took up basic elements of English Political Economy for the formation of his theory of evolution, such as the law of population as a natural force and the idea of the division of labour in growing markets (see Schweber, 1985, pp.85). For him Classical Political Economy was a branch of evolutionary biology (see Depew and Weber, 1995, p.2).

To put forward a socio-economic theory of evolution, functional counterparts for all elements of biological evolution in the economic sphere must be found. For that, information, knowledge, behavioural rules as units of variation are looked upon analogously to a pool of genes which novelty flows into and which are selected for application and diffusion in the form of technical artefacts, production engineering, entrepreneurial activities as phenotypes in firms and markets on a competitive basis. Selection takes place on various stages as a hierarchical process (see Mokyr, 1991, p.128). To generalize, it is the basic idea of a possible, albeit only weak, reasoning by analogy between biological and economic evolution, but going beyond merely speaking in images, that the origin, application and storage of scientific and technical knowledge, in this way giving rise to economic and organizational innovations and change, may be interpreted as a simultaneous endogenous process of the emergence and reduction of diversity, caused in the end by the need for the creation and combination of scarce productive resources. Economic evolution includes both change and regularity. So the explanation of the emergence,

selection and retention of human knowledge is in the forefront of evolutionary economics (see Hermann-Pillath, 2002, p.22). Economically usable knowledge has the properties of a public good. Its production is not given exogenously, but the result of invention and discovery as economic forces, whose returns must be appropriated as well as exploited (see Foray, 2004, p.14).

Now, there are a considerable number of important differences between the biological theory of evolution and an evolutionary approach to economic change regarding the emergence and selection of variety as evolutionary mechanisms. To mention the most important ones:

- Socio-economic novelties come into being not only by happenstance, but also to a high degree intentionally and for the purpose of altering the environment (see Winter, 1975, p.103; Ramstad, 1994, pp.84; McKelvey, 1996, p.23). But irrespective of purposeful human activities their result is mostly unknown.
- Selection of economic variety within a population of individuals is the consequence of human activities, too (artificial selection). The respective units of variation and the environment interact with each other. An evolutionary theory may comprise "...blind' and 'deliberate' processes..." (Nelson and Winter, 1982, p.11).
- Technical and economic evolution runs faster and frequently more progressively than biological evolution.
- Accumulated experience, knowledge, behavioural rules will be transmitted to the next generation.

So socio-economic evolution takes place also or even above all in accordance with the model of Lamarck (see Nelson and Winter, 1982, p.11; Saviotti and Metcalfe, 1991, p.36). According to that theory, evolution is an exclusively vertical phenomenon, the continuous internal development of an organism or a technical artifact or product in the direction of a higher complexity and perfection in adaptation to environmental demands. At the same time the retention of acquired features passes to the next generation through transmission. Variety is the result of adaptation to the external environment, but for Darwin both a precondition and the result of variation and selection. For the reasons mentioned above Witt (i.a. 2001, p.48) pleads for the elaboration of a more generalized and independent, instead of a Neo-Darwinian, theory of evolution but whose focus of interest also are useful, unforeseeable economic and technical knowledge and innovations and their origin, dissemination and consequences.

Despite these differences between biological and economic evolution concerning the dominant evolutionary modes of operation a comparable

causal structure for describing and explaining organic and socio-economic change is discernible. It exists in the theoretical conception of the emergence of variety in different forms, its reduction by competition and the retention of selected variety accompanied by the transmission of acquired characteristic features. A simultaneous result is the internal development of individual organisms (evolution and development). "Evolutionary theory is a manner of reasoning in its own right, quite independently of the use made of it by biologists...What matter are variety, selection and development - not the natural world" (Metcalfe, 2005, p.420). In addition, by self-organisation in the form of interactions between the units of analysis among themselves and with the environment new economic structures may emerge unpredictably, but without human design or government intervention. To summarize, economic evolution comprises both Darwinian and Lamarckian integral parts (see Fleck, 2000, p.265; Hodgson, 2001, p.114). For this view the term 'Universal Darwinism' (see Hodgson, 2002, pp.269) was coined,² in which Neo-Darwinism is the more detailed theory also with a higher element of explanation (see Hodgson, 2001, p.116; Knudsen, 2001, p.122).

3 Survey of theories of the firm

In an evolutionary, behaviourist view it is the purpose of a theory of the firm to describe and explain internal practices and activities in enterprises and on markets. Both are organized by rules and structures of business (see Schneider, 1997, p.55). Regarding the last ones, in addition to market structure, these contain all the capabilities, including the provision of resources, which offer an explanation for the heterogeneity between firms concerning their internal growth and their organization and strategy. (ibid., p.60; also Dosi and Marengo, 1994, pp.158). The courses of activities inside a firm concern its birth, existence and passing. Individual firms will affect these activities, relevant to scale and scope of production, carrying out of innovations, the internal restructuring of its organization, through their own unique efficiency. A theory of the firm in this way must explain the dissimilarities in the levels of success among enterprises ("why firms succeed or fail"; Porter, 1991, p.95). Simultaneously, the firm is a self-contained and developing entity in its own environment by means of deliberately utilizing and building resources, while also being a part of the evolution of its population within an industry. At the level of the firm and the industry it is subjected to the pressure of internal and external selection, in its entirety or its separate activities. Both manifestations of

² "... Darwinism includes not only specific theories that explain particular biological mechanisms, but also a general theory that applies to all open, complex and evolving systems, irrespective of the particular mechanisms of inheritance or replication" (Hodgson, 2002, p.273).

evolution, on different levels, happen at the same time (see Foss, 2001, pp.328; Rathe and Witt, 2001, p.337). From an evolutionary point of view there is no representative firm.

Currently there is no unified theory of the firm, either in economics or in management strategy (see Garrouste and Saussier, 2005, p.194). Economics mainly deals with market performance and its determining factors, strategic management looks into allocation and coordination within the firm. Structuring competing theories, which give priority to different aspects of firms, in broad agreement with the literature, technological, institutional and efficiency-oriented theories are distinguished (see Winter, 1988; Williamson, 1990b; Conner, 1991; Spulber, 1992; Chandler, 1992; Knudsen, 1995; Teece, Pisano and Shuen, 1997). They integrate characteristics of competitive markets, business strategies and organizational structures. The main dividing line exists between institutional and efficiency-oriented theories.

3.1 Technological theories

Among the technological theories there are the standard neoclassical theory and the one typical of industrial organization. In neoclassical theory the firm is characterized by its production and cost function. Subject to this restriction, it maximizes its profits in which it has complete information concerning supply and demand, resulting in the “optimal product-market price” (Kay, 1997, p.9). This expresses the optimum performance in decision making, exchange as its main field of activity, the market as the mode of coordination and prices as the only way of gaining competitive advantage. Firms exist to combine completely mobile and freely available factors of production and choose from among efficient production schemes. They all have access to the same knowledge of production. So the neoclassical theory of the firm represents a theory of market allocation, but not a detailed model of an individual firm (see Demsetz, 1988, p.143; Spulber, 1992, p.543).

According to industrial economics, besides their production and cost function, and in that industrial structure, firms are also characterized by their competitive strategies (see Spulber, 1992, p.569). Their internal structure is again unspecified. Business or corporate profits result from determinants of market structure (industry effects), but not from the firm level (positioning effect). Including Porter's idea of the ‘competitive forces’, that builds a bridge between industrial organization and strategic management, both elements of market structure and market conduct, in the end preferences and production techniques, as well as competitive advantages at the firm level, have an effect on firm and market

performance. “A general model of strategic choice must include both environmental analyses (of threats and opportunities) and organizational analyses (of strengths and weaknesses)” (Barney, 1997, p.53). As the main criticism of the technology-oriented theories of the firm, the argument is raised regarding their predominantly static orientation and the inadequate consideration and processing of information and knowledge (for the latter see O'Brien, 1984, p.53).

3.2 Institutional theories

In an organizational or institutional view the purpose of a theory of the firm is to explain the existence and the boundaries of firms, also their internal organizational structure (see Holmstrom and Tirole 1989, p.65; also Foss, 2005a, pp.24). Different approaches of these theories have the assumption in common that coordination of individual economic activities does not only take place on markets but also in enterprises as hierarchically structured organizations. In them the main subjects are contractual relations and incentive conflicts among the owners of productive factors and - as connecting link - property rights. In explanation, both asymmetric information, even uncertainty³ (Knightian view) just as bounded rationality, asset specificity and opportunism resulting in transaction costs (Coasian view) are taken for granted (see Rumelt, Schendel and Teece, 1991, pp.13; Foss 2000, pp.XXX). Knowledge about the manufacturing process is assumed to be the same for all firms, but not so regarding their internal organization. To this end, the shaping of institutional arrangements in organizations on a contractual basis for the efficient use of information and the protection of their overall performance is considered. Organizational problems are such of making a contract to manage internal relationships. In this connection economically relevant contracts are always incomplete. Especially the purchase of knowledge and entrepreneurial capabilities is not completely contractable (see Hodgson, 1988, p.183). Learning of individuals and organizations is neglected. The (ex ante) formation of incentive, control and information systems to guarantee the performance of the tasks of an agent in accordance with the principle, assuming asymmetric information before and after the making of a contract, is in the forefront. Technologically the firm is again looked upon as a production function. The competitive process is not taken into consideration.

³ Knight (1921, p.271) regards the existence of a firm as a result of “the reduction of the uncertainty in individual judgements and decisions” (p.293) that is shared between owners and employees.- Besides, a firm makes possible a greater flexibility in case of uncertainty than forming individual contracts between individuals on the market. In contrast to Knight, Coase (1937, p.407) is of the following opinion: “We can imagine a system where all advice or knowledge was bought as required.”

Transaction costs economics, as a part of institutional economics, works on the assumptions of bounded rationality, of opportunism of market competitors or contracting parties, and of asset specificity of exchange between the participants (see Williamson, 1990a, p.34). Contracts between competitors are necessarily incomplete because of limitations of knowledge and must be renegotiated continually. They must correspondingly allow for adaptation as new situations later arise (ex post consideration). To resist opportunistic behaviour after specific assets have been invested, the firm is organized as a governance structure (ibid., p.18), showing incentive and adaptation qualities. But it is not only a production or a cost function: "... governance is the means by which to infuse order, thereby to mitigate conflict and to realize...mutual gain from voluntary exchange" (Williamson, 2002, p.180). Firms and markets are alternative modes of the organisation of production and exchange. Consequently, they may be looked upon as adapting and reshaping organisations reacting to economize on transaction costs in a world of bounded rationality and incomplete information. The relative level of transaction costs determines the size and scope of a firm, thereby its boundaries. Compared with that the production process of a firm is not included in the consideration. Dynamic aspects such as learning and technical innovations are not taken into account concerning the decision in favour of markets or firms, too (see Hodgson, 1998, p.188). To summarize, in institutional theories nearly all problems of economic organization originate from conflicts resulting from individual incentives either in advance of drafting a contract or afterwards by organizing a governance structure (see Foss, 1999, p.732; 2005a, p.32). Neither theory comes with an answer regarding firm heterogeneity and a dynamic perspective on the boundaries of the firm, except for transaction costs.

3.3 Efficiency-based theories

Among this category of theories the static resource-based view of the firm and the advanced process-oriented "dynamic capability approach" are included (see Williamson, 1991, p.76; Teece, Pisano and Shuen 1997, p.510). The former is positioned by Barney (2001, p.644) against Porter's approach of explaining competitive advantage in the tradition of Industrial Economics as the result of market power on product markets. Both variants contend that firms are not merely organizations characterized by a bundle of contracts or transactions. They mainly exist because they are looked at as being able to employ and build a bundle of specific resources and capabilities for their own use, in order to cope with economic and technical change and with uncertainty and to generate and also appropriate value. These will increase in the passage of the industrial process by means of knowledge and innovation activities. So internal

managerial activities, unlike external factors, the former resulting as well from interactions between firms, are taken into account to explain competitive advantage.⁴ The firm with its internal structure is a goal-directed operating organization of common human activities, actively changing its environment, and also a social and historical unit. It is not only an entity capable of adapting to environmental influences (see Foss, 1996, p.471). With regard to its available specific resources and both competences for their employment, among others organizational routines as vehicles of internal coordination and practical knowledge, the firm by its own decree will be lastingly heterogeneous, in contrast to its competitors. In the tradition of Marshall and Schumpeter, gradual as well as major innovation activities are the promoters of economic evolution. Following mainly Foss (1993, p.132; but also Hodgson, 1998, p.180; Foss, Knudsen and Montgomery, 1995, p.4), in particular the dynamic-capability approach may be categorized as a hitherto missing element of evolutionary economics. The focus of interest of an evolutionary theory of the firm in an ontogenetic, developmental reflection is the process of manufacturing, but not pure exchange, contractual relations or transaction costs, but first of all learning of individuals and organizations as a problem-solving activity, resulting in new knowledge and capabilities. Its central question from a business strategy point of view is: Why do efficient, successful firms differ in their own discretion (see Nelson, 1991, p.61; Dosi and Marengo, 1994, p.158; Carroll, 1993, pp.242)? Efficiency does not mean optimality of market performance but best possible interaction with and adaptation to the environment.

New directions in alternative theories of the firm complement or even take the place of the "optimal product-market price" as the central category of the neoclassical theory. The following elements in various combinations are considered (see Kay, 1997, p.10):

- bounded rationality and satisficing as alternative behavioural assumptions to optimization (Simon);
- resources in factor markets instead of predominantly goods in product markets (Penrose);
- firms and hybrid institutions as complementary institutional arrangements to markets (Coase, Williamson);
- innovations instead of prices as the most important competitive activity (Schumpeter).

⁴ "...economizing is more fundamental than strategizing - or, put differently, that economy is the best strategy" (Williamson, 1991, p.76).

From this point of view, "...the firm...is a hierarchically organized collection of resources making imperfect decisions in which technological change is typically the critical strategic variable" (ibid., p. 29).

4 Evolutionary approach to a theory of the firm

4.1 Principles of a behavioural theory of the firm

The subject of an evolutionary perspective in economics may be defined as describing and explaining endogenously, but also exogenously emerging, undetermined and irreversible technical, economic and organizational change, especially the creation and diffusion of new knowledge and technical innovations, and thereby also both the blind and guided genesis of variety and its as well purposeful selection on the market. Forces of persistence retain continuity in respect to which features will survive in the selection process (see Nelson, 1995, p.56). Besides, evolutionary change is seen also as the result of the self-organization of complex systems, market coordination for instance (see Witt, 1996, p.709; Foster and Metcalfe, 2001, p.2, 14).

In contrast to the technological and institutional theories, evolutionary economics is directed to the real, observable behaviour of enterprises. In it the industrial process instead of exchange and contracting is at the center of attention. Firms, above all, are carriers of production techniques and productive knowledge. Knowledge about the manufacturing process is necessarily incomplete, unequally distributed and to be appropriated to a different degree. Concerning the behavioural rule of firms, the evolutionary approach refuses the assumption of optimality. Instead of conscious optimized decision making, Nelson and Winter (1982, p.15) on the basis of bounded rationality of the competitors work from the assumption of the rule-bound behaviour of routines to characterize the process "...of 'how things are done' in business firms and organizations more generally" (Winter, 1986, p.152; 1988, p.175). Inherently rigid "standard operating procedures" (Cyert and March, 1963, p.101), which are founded on past experience, serve as the basis for organizational routines (see Pierce, Boerner and Teece, 2002, pp.87). Their result is like that of intended rationality, long lasting and predictable. Besides, both authors use a non-reductionist method of analysis, conceding enterprises as purposefully behaving organizations an independent importance, separated from the basic individual actors ("...individual behavior as a *metaphor* for organizational behavior..."; Nelson and Winter, 1982, p.72)⁵. In addition,

⁵ For a critique of this scientific approach that conflicts with methodological individualism, see Foss, 2003, pp.196. As he sees it, too little attention is devoted to individual decision making (p.198).

learning and the creation of knowledge is regarded as a social not only an individual process.

The organizational routines of the firm for employing productive resources, comparable to skills of individuals, include its repetitive hierarchically structured behaviour in manufacturing, investment, search and innovation activities (see *ibid.*, p.16; 73). In this, its knowledge, experience and competence regarding both production and organization that to a high degree are of a local and specific nature are accumulated. Routines create continuity and reinforce the internal stability of the firm (see Winter, 1975, p.101). They do not have to result in optimal outcomes but they are adapted to the respective environment.⁶ In the view of Nelson and Winter (1982, p.14) organizational routines are comparable to genes as units of variation in nature, as much as firms to organisms as their phenotypes. The frequency of successful routines will increase as a result both of the (external) selection process within a population of firms and within the individual firm over the period of its development, the latter being of a more purposeful kind. Intended and problem-oriented processes of learning and searching, to be directed at seeking profits, that occur cumulatively and path-dependently, based on failures in the past, can change behavioural routines gradually and with some delay. The introduction of technical and organizational innovations into the market intend to improve the adaptability of firms in case of an unsatisfactory market performance and to open up new activities (for the latter, see Winter, 1975, p.105; Witt, 1996, p.712). In contrast to optimal adaptation in this way a variety of routines of firms will occur, driving evolutionary change (see Metcalfe, 1995, p.471). Corresponding to their specific routines, firms will differ for efficiency reasons in the level of unit costs and profits. A modification of routines impedes the transmission and retention of invariable rules, with that being in conflict with evolution in nature. Thereby the explanation of stability and persistence of firm behaviour will also be affected. In this evolutionary understanding firms in the end are regarded as knowledge-based organizations capable of learning and transformation, or even as “repositories of productive knowledge” (Winter, 1988, p.175). They are in their entirety or their individual essential parts such as routines, resources (see Aldrich, 1999, p.40) subject to selection on the market and also show an, although not regular, internal path of development. Undeniable, besides their routine and learning activities the persistent profitability of enterprises also depends on their internal organization, for instance the existing control and incentive mechanisms,

⁶ “...no such thing as a universal best practice can possibly exist. There can only be local ‘best’ solutions” (Becker, 2004, p.652).

in that way giving rise to transaction costs (see Vromen, 1995, p.109), as “the institutional structure of production” (so Coase, 1988, p.47).⁷

4.2 Resource-based view of the firm

In broadening the basic behavioural approach of evolutionary economics for information of management theories concerning business strategy, firms will be characterized through three relatively stable attributes (see Nelson, 1991, p.67; 1994, p.233). They may increasingly lead to intended, chosen permanent inter- and intra-industrial heterogeneity regarding their market performance and the provision of resources. These attributes are, first, their market strategy and internal organizational structure, and, second, their specific competences and capabilities, particularly for utilizing and for creating scarce productive resources and carrying out innovation activities as central parts of corporate and competitive strategy. Resources must be selected, capabilities be built (so Makadog, 2001, p.389).

Strategy comprises the long-term objects of an enterprise and its incurred commitments, based on its given internal resources.⁸ Structure includes the organization of a firm with regard to its environment to achieve its objects. Both elements decide what the core competences of a firm are referring mainly to technology and production in order to obtain sustained competitive advantage. They change only slowly as a consequence of bounded rationality and its given hierarchy of routines.

The capabilities of an enterprise for the formation and growth of resources and its competences for their deployment supplement and above all modify its operating routine activities. They are regarded as a “higher-level routine” (Winter, 2003, p.991). Thereby they serve as a basis for the deliberate development of successful that is value creating strategies. “...the capabilities discussion provides a bridge between the predominantly descriptive concerns of evolutionary theory and the prescriptive analysis of firm strategy” (Dosi, Nelson and Winter, 2000, p.12). Capabilities and competences, also the decision-making rules, determine the competitive strength of a firm (see Dosi and Teece, 1998, p.301). They arise from cumulative entrepreneurial search, learning and innovation processes, also of knowledge transmission. Like routines they are characterized by continuity and delayed change.

⁷ “The fact that incentives are not taken into account is a drawback shared by all the evolutionary theories of the firm” (Garrouste and Saussier, 2005, p.186).

⁸ Following Porter (1991, p.102), the firm is regarded as a bundle of activities, aiming at its adaptation to the environment and also their formation. The shaping of a market strategy will occur on the basis of the available provision of resources that is assumed to be equal for all firms (see also Spanos and Lioukas, 2001, pp.908).

In this broadening of the basic behavioural model, the firm, following Penrose (1959, pp. 24), is looked upon as a bundle of productive physical and human resources (stocks), capable of internal development, whose produced heterogeneous results (flows) are able to be used for manufacturing purposes in different ways. The unique bundles of resources and services, coordinated by means of administrative decision making, thus the resource company's management, create its capabilities. "The business firm...is both an administrative organization and a collection of productive resources" (ibid., p.31). These for their part induce the productive output of the resources (ibid., p.78). Learning in the course of the manufacturing process will result in persistent corporate growth, and, in this way, extends the capabilities of the firm concerning manufacturing and organization. Corporate growth will result in surplus firm-specific resources, for instance human capital as a result of its growing experience, for which no efficient market exists. They make possible an expansion of production in previous and in new business activities, which on their part again lead to innovations in knowledge and resources in enterprises. As a consequence of the indivisibility of productive factors, the different possible uses and the new development of resources and productive services, a firm will not be able to attain a state of long-term equilibrium. To sum up, resources may be defined as specific productive factors, obtained in markets, modified and refined through the ability of the company's management, employees or external specialists into characteristic features of the firm for the purpose of its competitiveness (see Schneider, 1997, pp.60).⁹

So firms, in the form of their provision of resources as input factors which are valuable and in short supply and the supply of services, show qualities of both coherence and heterogeneity. Their existence, also their horizontal and vertical boundaries, may be justified as an aggregation of such basic units (bundle of routines, pool of resources, nexus of contracts), for which an internal organization compared to market coordination produces a comparative advantage with regard to generating individual skills, organizational routines, valuable resources, thereby at last competitive advantages compared with rivals (see Williamson, 1999, p.1096; Granstrand, 1998, p.467; Madhok, 2002, p.536). As their individual types, tangible, physical and also intangible resources, such as human capital, technical knowledge as well organizational resources, for example corporate management, are distinguished (see Barney, 1991, p.101; Bamberger and Wrona, 1996, p.132). The former are subject to wear, the

⁹ But there is not yet a unified definition of what resources, also capabilities, exactly are. See for that critique Duschek, 2002, p.50; Bromiley and Fleming, 2002, p.329. - Teece, Pisano and Shuen (1997, p.516) prefer the term "firm specific assets" instead of resources.

latter as a result of indivisibilities show a partly unlimited usage, via appropriation and exploitation through individuals and organizations, perhaps. Increasing returns in use again result in path-dependency. In contrast to tradable productive input factors, resources are not completely movable and so show less value in any different use. They are difficult to imitate and substitute or not at all. Due to incomplete information their expected value for a firm exceeds their market price. In addition, they can be protected against rivals by creating limits to competition (also called “isolating mechanisms”; Rumelt, 1984, p.567) comparable to barriers to entry (for characteristics of resources see Barney, 1991, pp.105; Peteraf, 1993, pp.180). The sort of resources to be employed arises out of their competitive environment in product markets. In this functional definition firms are interpreted as “integrated clusters of core competencies” for the coherent employment of resources (see Teece et al., 1994, p.23; Dosi and Teece, 1998, p.296). They exist beyond market structure and competitive strategies.

A qualitatively different and scarce supply of valuable resources gives reason for a permanent (Ricardian) efficiency rent. Firms at the same time have to absorb the generated rent and to convert it by investment activities into internal growth (fitness). The effect may be an increase in size and market share possessed by successful firms. Not all firms of a population need to behave uniformly concerning their fitness in the form of internal growth and financing of innovations, if they are not able to realize and use their available opportunities equally. The relative position of a firm inside its industry (firm characteristics) gains in importance in explaining the relative corporate success compared with the attractiveness of the industry as a whole or its environment (industry characteristics). So the resource- or efficiency-based approach must more likely be categorized as a complement than exclusively a substitute for the firm of industrial economics (see Conner, 1991, p.143; Bamberger and Wrona, 1996, p.141; Henderson and Mitchell, 1997, pp.11). That is why in its static version it disregards the environment as well as the internal organization of an enterprise. Both the internal strengths and weaknesses of a firm and its external threats and opportunities of the product and factor markets simultaneously determine corporate success, and not only the supply of resources or the environment. Altogether, the resource- or efficiency-based view assigns a more active role to firms than only the adaptation to a given environment or its change. In this way it broadens the original behavioural theory of the firm.

The resource-based view starts at a given different provision of heterogeneous and imperfectly mobile resources of firms. It comparatively neglects to explain how new resources are created and already existing ones integrated, with that how the resource base is broadened (so called

“dynamic capabilities”; see Teece, Pisano and Shuen 1997, p.510; Eisenhardt and Martin, 2000, p.1107; Spanos and Lioukas, 2001, p.924). It also remains open, as to which way the intra-industrial heterogeneity among firms with regard to the initial accumulation of valuable resources will happen (see Noda and Collis 2001, p.899). If the personal knowledge of individuals and the collective knowledge of organizations, the latter being stored in their technologies and management as their carrier (“...organizations know more than what their contracts can say.” Kogut and Zander, 1992, p.383) is looked at as the central resource to improve decision making and also the internal control of enterprises, then its creation, application and dissemination is the most important task of the firm and its management resources (see Mahoney, 1995, p.97). Technical and organizational knowledge is especially applied in transforming tangible input into the production of goods. Equally it leads to competence- and capability-building and therefore is a prerequisite for generating, extending and using a bundle of resources. Merely insignificant differences among firms concerning their adopted strategy and their market conditions may increase as the result of diverging, self-reinforcing interactions, for instance increasing returns in production and use, or of local learning and experience, not only differently efficient resources. Converging forces of imitating corporate success and management decisions may influence the pursued path of a firm and reduce differences in its development. The emergence of knowledge, techniques, rules set off both by external factors like new scientific discoveries and by internal learning, the valuation of technical artefacts, products, organizations and their activities by external as well as internal selection, together with retention and diffusion of confirmed new knowledge and more effective routines and capabilities, describe an evolutionary process of knowledge creation and transmission (for that see Zollo and Winter, 2002, pp.343). The newly created knowledge contributes to the necessary diversity for the continuation of the evolutionary process.¹⁰ In terms of March (1991, p.71), the growth of knowledge and thereby technical innovations are the result of a balance “...between the exploration of new possibilities and the exploitation of old certainties.” Both activities compete for resources so that a balance between them must be found according to the intention of a firm. Penrose’s theory of firm growth may be looked at as an attempt to show regularities in the internal development of a firm. Unlike the static resource-based approach, following the dynamic capability view, the persistent success of firms also depends on their interrelation with the environment, for instance their technological opportunities and appropriability requirements, not exclusively internal conditions. But

¹⁰ “...the growth of our knowledge is the result of a process closely resembling what Darwin called ‘natural selection’; that is, the *natural selection of hypotheses*...” (Popper, 1972, p.261).

transaction costs resulting from activities concerning the formation and employment of resources, also the appropriation and protection of their created rent, are not included in the analysis (see Foss 2005a, pp.103; 2005b, p.549). At the end, economic, technological and organizational evolution is both the result of an unintentionally occurring market selection by environmental pressure and of voluntary, purposeful entrepreneurial activities, which are founded on acquired knowledge (see Vanberg, 1996, p.693). To speak with Winter (1995, p.151): "It is in addressing the dynamics of resource exploitation that one finds the strongest complementarities between the resource-based view and evolutionary economics..."

4.3 Knowledge-based view of the firm

In this interpretation as a knowledge-generating, -integrating and -using organisation the activities of a firm aside from coordination, are characterized also by learning, innovation and organizational change as a dynamic process (see Eliasson, 1994, p.179). These reproduce and raise its knowledge level, intentionally and deliberately, accompanied by mistakes and costs, and replace in evolutionary reasoning the optimization of resource allocation in the technology-oriented theories of the firm. Learning and production of knowledge happen in different organizational ways. Firstly, internal to the firm through scientific research and development and the following innovation of new products and manufacturing processes (R&D competition), but also through gaining experience on the part of employees in manufacturing (doing, using). Secondly, through the purchase and commercial use of external knowledge from the science and technology sectors, i.e. universities or research laboratories, or from rivals or customers and suppliers, for instance by means of reverse engineering, fluctuation of R&D personnel, or from R&D cooperation with competing firms in different forms (see Malerba, 1992, pp.847; Antonelli, 1999, p.247). The common pool of knowledge will increase in this way and serve as a basis for positive externalities for further creating and exploiting knowledge.

Internal and external sources of knowledge are complementary to each other. Internally created knowledge and its dissemination inside the firm will not cause transaction costs to the same extent than purchasing external knowledge. Knowledge transfer between firms is an especially important reason for incomplete contracts. Furthermore, the acquisition and use of the mostly product- and firm-specific knowledge from learning and experience is made available to a greater extent, than in the case of technical knowledge acquired through formal R&D activities. This is of a more public nature, and to an even greater degree, more difficult to

appropriate. Positive externalities of this latter kind of knowledge are abundant, acting in this way as an incentive to cooperate with rivals. In consequence patent protection to acquire property rights may decrease in importance, compared to gaining lead time and secrecy (see Lewin et al., 1987, pp.793). In case of an at least partial exclusion of the proceeds of knowledge production temporary (Schumpeterian) monopoly quasi-rents will arise (see Peteraf, 1993, pp.180) and render possible the financing of R&D expenditures. Knowledge and innovations emerge as a result both of market incentives and technological opportunities. Against that, the huge amounts of costs of R&D investments and the uncertainty regarding their technical and economic results, will bring disadvantages as well. From a management point of view this gives reason for a participation in different forms of research cooperation to get access to external resources. But the acquisition and utilization of external knowledge requires an 'absorptive capacity' of the recipient firms, based on accumulated knowledge in the past and resulting from their own learning and research activities (see Cohen and Levinthal, 1990, p.128). As a result, the production of knowledge and innovations are not an individual entrepreneurial activity, but more and more often has become a collective and specialized process, in that a multitude of private and public contributors are involved, who interact positively by means of both creation and exploitation of spillover effects (see Pyka, 1999, pp.71).

In addition, knowledge consists both in a more tacit, implicit and a more codified, explicit form. The former is stored in individuals and organizations and is especially the result of experience, not formalized and hardly transferable in and among enterprises. Its proceeds are able to be privately appropriated to a high degree, so that enterprises have a common knowledge base. Explicit knowledge is stored in codebooks, patents, and computer software and is more easily divisible and exchangeable (see Grant, 1996, pp.111; Antonelli, 1999, pp.244; Argote, 1999, pp.71). The codification of knowledge is the result of an economic decision concerning its costs and benefits, but not of inherent characteristic features of the different forms of knowledge (see Cowan, David and Foray, 2000, pp.240). The possibility of appropriating implicit, often also localized knowledge will diminish in the course of the life cycle of a technology. At the same time its chances of codification and its more even distribution among firms will increase (see Saviotti, 1998, p.850).

By combining the different sources and forms of learning and knowledge, the following possibilities of differentiating knowledge in firms will arise (see Antonelli, 1999, p.245):

- internal implicit knowledge, obtained especially through realization of practical experience (learning, using);

- external implicit knowledge, through appropriation from the collective innovation system;
- internal explicit knowledge, as a result of in-house research and development activities;
- external explicit knowledge, required from formal R&D cooperation.

These individual kinds of knowledge complement one another, too. Enterprises, according to industries and the attained phase of the life cycle of their products, are integrated into a network of internal and external knowledge with resulting spillover-effects. Nonaka and Takeuchi (1997, p.74) give priority to the creation and extension of knowledge by articulating implicit knowledge in an explicit form, what they call 'externalization'. Different forms of scattered productive knowledge can be integrated and utilized inside a firm more efficiently than by contracting between individuals on the market, especially in the case of tacit knowledge. So a reason for its existence is provided (see Demsetz 1988, p.157; Grant, 2003, p.208; Foss, 2005 a, pp.37). "...we proposed that a firm be understood as a social community specializing in the speed and efficiency in the creation and transfer of knowledge" (Kogut and Zander, 1996, p.503). An increasing specialization and distribution of knowledge supports the emergence of cooperation between them. Because of this, the horizontal and vertical boundaries of a firm will be increasingly blurred. But as a consequence of opportunistic behaviour concerning the necessary disclosure of its own research activities, cooperation may not be stable.

Firms with their individual activities differ from each other with regard to their sources and processing of information and productive knowledge. Also for this reason they show a technical and organizational diversity, according to their technological path taken, their level of unit production costs, the different capabilities in converting new knowledge into new organizational routines, innovations and internal growth. They develop internally, as regards their resources and capabilities, on the basis of their business strategy,¹¹ and they or their individual activities are subject to selection in the competitive market place. As a result both market and organizational structure will permanently alter.

Following the dynamic capability, knowledge-based view, the firm, aside from being a pure 'exchange structure' to impose incentives and control on individuals internally, is a social, knowledge-creating and knowledge-applying 'productive unit' (for this distinction see Knudsen, 1995, p.214;

¹¹ For a life cycle model of business organization emphasizing the role of the entrepreneur who is constrained by his/her flexible 'business conception', see Witt, 2000, pp. 736.

also Spulber, 1992, p.566; Langlois and Foss, 1999, p.213). It coordinates and integrates dispersed and specialized knowledge regarding the employment of resources of different participants and in different forms (see Hayek, 1945, pp.519) and on this basis can simultaneously create new knowledge. This applies to all activities of the firm. Knowledge is stored and accumulated in individual persons and with that in organizations with their hierarchically structured routines and capabilities. Together with its stock of knowledge and its capabilities also the organizational structure of the firm must evolve. So the evolutionary dynamic capability approach of developing and using knowledge and resources in an integrated way includes the production process and the organizational structure of an enterprise, requiring an integration of theories of Organizational Economics and Strategy Research like the resource- and the knowledge-based view of the firm (see Foss, 2005a, pp.50). In that way it may contribute to both the explanation of internal firm organization and its strategy to resist competitive pressure and to attain sustained competitive advantage.

5 Concluding Remarks

The relation between evolutionary economics and Business Strategy in the version of a resource-based and a dynamic-capability view of the firm may be looked at from two different starting points. On the one hand evolutionary economics is intended for the broadening of the static resource-based approach towards a behavioural, process-oriented variant, in this way to explain the creation of new resources and capabilities for their use. On the other hand the resource-based and especially its extension in form of the knowledge-based view are a promising candidate in order to close a gap within the framework of evolutionary economics. In this way industry dynamics as the evolution of a population of firms is supplemented by a more detailed characterization and the development of individual firms. This second approach is looked into here. The heterogeneity of firms as the result of rent-generating resources, first and foremost knowledge, is emphasized. Knowledge is created, intentionally and blindly, converted into innovations which are subjected to the selection pressure of the market, but are also adaptable to changes in its environment. Confirmed productive knowledge is preserved and grows in the course of evolution. By considering the internal conditions of success, such as resources and capabilities, in addition to their routines, evolutionary economics will be completed by normative aspects of strategic management. But, all in all, neither the emergence of rent-generating activities is explained as yet in an entirely satisfactory manner nor will a unified theory of the firm be constructed, but more likely a hybrid

one being composed of different technological, institutional, and efficiency-based elements.

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