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Schumpeter, Marshall, and Neo-Schumpeterian Evolutionary Economics

A Critical Stocktaking

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Summary

The focus of evolutionary economics is a process of continuous and irreversible economic and organizational change over time. Currently there is no agreement on the explanation of economic evolution.

From the perspective of the history of economic thought, at first the theoretical approaches of Schumpeter and Marshall with regard to economic development or evolution are dealt with in detail. For both authors technical and economic innovations are the engine of economic change. According to Schumpeter, they are created through newly established firms as the agents of change. For Marshall, innovations and economic development are a side effect of the manufacturing process and the division of labour. Technical and economic changes go off both gradually (Marshall) or discontinuously (Schumpeter).

After that, a concept of neo-Schumpeterian evolutionary economics is elaborated. Evolution is understood as a process of change that leads to the adaptation of complex systems, the result of the causal interaction between variation, selection and retention of variety leading to continuity over time. It has gained wide application to the theory of innovation and later to resource-based theories of the firm. Modern evolutionary economics includes the determinants of new knowledge and innovations into its analysis. Business enterprises not only follow their routine behaviour, in a dynamic view they also show capabilities to restructure their given resources and to build new ones. To sum up, technical and economic evolution are both the result of the unintentional market selection through competitive forces of the environment, and of the intentional, voluntary entrepreneurial choices, based on the firm's resources and dynamic capabilities.

1 Introduction

Despite a continuous discussion in the related literature there is no agreement on the explanation of economic development or evolution. Witt (2008: 555) distinguishes be-

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tween a generalized Darwinian and a generic concept of evolution as a heuristic strategy on the one hand and a monistic and a dualistic concept on the other hand. The former make expressly use of the neo- (or synthetic) Darwinian evolutionary mechanisms to causally explain assumed similarities between evolutionary processes in the natural and the social world, but with different explanatory substance, either as a description and explanation of reality of all evolutionary processes, or as a useful heuristic in the form of reasoning by analogy or by metaphors. According to the latter, nature and the social world are either common or different spheres of reality with regard to a systematic, irreversible change of a system in the course of time. But unlike these different interpretations there is an almost common consent in that continuous economic change and development, endogenously produced by technical and organizational innovations of firms and industries and their diffusion, is, as regards its content, the focus of interest of evolutionary economics (see e. g. Nelson 1995: 63; 2007: 80 ff.; Witt 2001: 49; 2004: 130; Fagerberg/Verspagen 2002: 1292). The result of the evolutionary process is unforeseeable, undetermined. In the Darwinian approaches the evolutionary principles are used as a preconception for structuring the explanation of evolutionary economic change (see Metcalfe 2005: 394 ff.; Silverberg/Verspagen 2005: 516; Stoelhorst 2008: 346 ff.). They are employed independently from their original use in biology. But there are reasons for the assumption that evolution in the social and the natural sphere, on a general level, share some common ground like population thinking, the emergence and selection of novelty. However, there are also important differences. In detail these evolutionary mechanisms are

- the existence and emergence of variety inside a population of heterogeneous but similar individual units of evolution,
- their consistently effective selection in the face of limitation of resources depending on their adaptation to the given environment, in this way determining the frequency of individual units,
- the internal development of forms and characteristic features of the individuals and the retention of selected attributes of the entities, leading to continuity in the course of time and to new variety.

In accordance with that, evolutionary change has roughly to be understood as a causal process of the simultaneous increase and the directed reduction of variety inside a population by selection leading to irreversible and cumulative adaptive change from within. The result is a dynamic equilibrium between adaptive individuals and the environment.

From the perspective of the history of economic thought, as founding fathers of an evolutionary theory of economic change above all Marshall, Veblen, Schumpeter and Hayek are of particular importance. In the narrow economic sense the work of Schumpeter is emphasized, but from an earlier period also the one of Marshall is named. Both authors have a common understanding of the development of the economy, claimed to be loosely explainable by the “variation-cum selection model of order and transformation” (Metcalfe 2009: 70). However, for both the evolutionary process goes off in a different way. Their conceptions of the acting market participants and also the characters of the innovation activities of entrepreneurs and firms differ from each other. Veblen is assigned to the older American institutionalism. For him evolutionary change consists of a succession of institutional regimes, understood as patterns of ideas. But he did not develop a systematic theoretical concept concerning the course of the evolutionary process and the principles of its explanation. Instead, he mostly confines himself to some aspects, f. i. evolution seen as a process of cumulative causation of cause and effect, in that the eco-

conomic forces of a market influence each other in a self-reinforcing way.¹ Hayek refers to the more comprehensive sphere of cultural evolution. In accordance with that, social institutions like markets are the result of an evolutionary process of the origin of a variety of intentional individual human actions and rule-based behaviour as well as their selection. But they are neither the outcome of a planned human design nor of natural evolution, regardless of human action, rather of a spontaneous order of the economy and the society, among others in the forms of the division of labour and of knowledge, in the tradition of Adam Smith.

It is at first the intention of this article to deal with and to compare Schumpeter and Marshall with regard to their theory of economic development and its evolutionary character according to the above mentioned three criteria. It turns out that Marshall uses more a Lamarckian than a Darwinian concept of evolution, Schumpeter even refuses the usage of any biological analogies to economic change. The second part builds a detailed characterization of modern neo-Schumpeterian evolutionary economics as – in the taxonomy of Witt – both a Darwinian and a dualistic approach and to what extent it corresponds to or goes beyond the theories of Schumpeter and Marshall regarding heuristic and content. Concerning the former, the interpretation and the usefulness of the principles of the synthetic Darwinian theory of evolution for explaining economic change is in the fore. They prove to be a promising research strategy to interpret and explain economic development on a general, abstract level. But they have to be completed by special economic attempts at explanations. Concerning content, as fields of application of evolutionary economics its theory of the firm and business organization and that one of technological change and innovation which complement one another are discussed. Both topics are in the centre of attention of Schumpeter and Marshall.

2 Schumpeter and the process of creative destruction

For Schumpeter the development or evolution² of the capitalist economy in historical time is the focal point of his pure economic analysis. It is regarded as the result of changes in the methods of supplying goods in the economy as a whole (see Schumpeter 1939: 84) and constitutes the core of his vision of the long-term economic process. A vision necessarily always precedes the analytic research (ibid., 1954a: 41, 570). His theory, described as social economics (see Swedberg 1991: 2) is composed, besides economic development, out of the stationary state of an economy and of economic sociology. The latter deals with the given institutional framework and its historical change that influence individual behaviour (see Shionoya 1997: 7; also Arena/Dangel-Hagnauer 2002: 3).³ The institutional and historical background is provided by the capitalist economy. The different areas of social life, each of them showing a development of their own, are linked with each other and lead to an indivisible social process in historic time (see Schumpeter 1912/2006: 545 ff.).⁴ In that, Schumpeter is a methodological pluralist (see Swedberg

¹ Hodgson (1992: 298) considers Veblen as the most important precursor of Darwinian inspired modern evolutionary economics, ahead of Schumpeter and Marshall.

² The term “Development” is translated in the sense of Schumpeter as “Evolution” and means an indeterminable process of irreversible change, not like “Development” as a goal-directed, pre-programmed process. See Andersen (2009: 4).

³ “...economic analysis deals with the questions how people behave at any time and what the economic effects are they produce by so behaving; economic sociology deals with the question how they came to behave as they do” (Schumpeter 1954a: 21).

1991: 23; also Fagerberg 2003: 129). “Each method has its own concrete area of application and it will come to nothing if one argues for its general validity” (Schumpeter 1908: 7 – author’s translation).

Schumpeter subdivides the pure economic process into the stationary state and the development of the economy. In this he follows Marx who differentiates between the schemes of simple and expanded reproduction, whereby the former, that shows the condition of the maintenance of the capital stock in time, is actually regarded merely as an abstraction, but part of the process of capital accumulation at a constant rate, also Cassel with his two simplified cases of a stationary and a steadily growing economy. According to Hicks (1939: 117): “The stationary state is that special case of a dynamic system where tastes, techniques and resources remain constant through time.” A dynamic economy is one where all its elements will grow at the same rate, correspondingly “...the stationary state is a growth equilibrium with a growth rate zero” (ibid., 1965: 133). For Schumpeter the stationary circular flow and the evolution of an economy as objects of analysis, statics and dynamics as analytical methods, are separate branches of economic theory, they do not constitute an indivisible economic process. They complement each other, but have to be developed for themselves (see Schumpeter 1908: 182 ff.; also Shionoya 1997: 37; Andersen 2009: 25 ff.).

Following the general equilibrium theory of Walras, the static analysis of the allocation of goods and productive factors within the framework of the circular flow is at the beginning of economic theory. Schumpeter regards economic equilibrium of exchange and production both as a methodical principle and a situation of economic reality. It leads to order in the economic system and to economic stability (see Shionoya 1997: 74). The static method is valid for those periods in which economic change has come to a halt, but also for economic sectors that do not develop from within at all. But the stationary state can show adjustments to gradual exogenous changes as accidental fluctuations and growth of population (see Schumpeter 1928a: 373). Following an impulse by exogenous forces it will follow a deterministic, goal-directed course of adaptive response (ibid., 1947: 150). The behaviour of economic agents is characterized by routine-based, that is near-rational behaviour. Routine-like may be treated as equivalent to rational behaviour “...if things have time to hammer logic into men. Where this has happened and within the limits in which it has happened, one may rest content with this fiction and build theories upon it” (ibid., 1934: 80). Rationally seen as consistent behaviour is the result of a sluggish process of adaptation and learning to change. It is the limitation of the static equilibrium theory that its applicability – if the conception of time is included – is restricted to an analysis of a stationary economy. Such a situation as it exists in reality without any development from within is an abstraction, “...but only for the purpose of exhibiting the essence of what actually happens” (ibid.: 9; but also 1914-5/1987: 230).

Around the turn of the century the leading authors of their age analyzed the economy exclusively in the form of the static equilibrium. In broadening the stationary state Schumpeter assumes the existence of economic evolution through endogenous changes of the circular flow. They are produced on the micro level of the economy by different forms of changes in the methods of the supply of goods by means of “...the carrying out of new combinations” (ibid., 1934: 66) of productive factors, with that innovation

⁴ Concerning the bibliography of Schumpeter and Marshall, the first year is the year of publication, the second one the year of the bibliographical reference.

activities, which are the result of the creative power of entrepreneurs as the final principle. Technical and organizational innovations include new products, the introduction of new production methods and organizational structures, the opening up of new markets and sources of supply (*ibid.*: 66). They do not have to be accompanied by new results of the latest research. They transform the prevailing economic order "...by its own initiative, from within" (*ibid.*: 63) and break routine behaviour in a stationary economy. "Development in our sense is a distinct phenomenon... It is spontaneous and discontinuous change in the channels of the flow, disturbance of equilibrium, which forever alters and displaces the equilibrium state previously existing" (*ibid.*: 64). New combinations are mainly carried out by newly established enterprises⁵ (*ibid.*, 1939: 94). They do not immediately replace existing firms on the markets since these can try to adapt to the new situation. All in all, both static and dynamic forces, even if separated from one another, have a simultaneous effect on the economic system. A situation of equilibrium and rest do not exist in an evolutionary process, at most a neighbourhood of equilibrium of the market process (*ibid.*, 1939: 71).

Economic evolution does not happen automatically, just like by law of nature. The carrying out of new combinations of productive means is rather the function of entrepreneurs with the intention to make a profit (*ibid.*, 1934: 74 ff.), unlike Marx, who regards innovations as the result of the competitive pressure among the capitalists. They not only coordinate the employment of the given factors of production. In the beginning, for Schumpeter the entrepreneur is the cause of economic evolution by introducing new combinations of the means of production, even against resistance, into the production process (*ibid.*: 86 ff.). Innovations are no longer or only to a small extent the side effect of manufacturing or the division of labour as is assumed in the classical economic theory, they just need an agent, the creative entrepreneur (*ibid.*, 1912/2006: 147, 480). He is a dynamic type, distinguished by energetic actions and a special kind of motivation (*ibid.*: 131). He takes the role as a leader (*ibid.*: 148).⁶ His motivation has its roots in his pleasure from a creative social position of power as final principle (*ibid.*: 138). Opposite to classical and neo-classical economic theory entrepreneurship does not mean at the same time private ownership of the means of production and weighing up cost and benefit of ones own activities. The person of the entrepreneur as a decision maker and the capitalist as the provider of financial means are separate from each other, too. In a later stage of his theoretical development (*ibid.*, 1928b; 1934) Schumpeter characterises the entrepreneur only through his function, as the agent of economic evolution, less through his motivation and personal attributes. His function is not tied to a concrete person any more. It can also be performed by large-scale enterprises (*ibid.*, 1914-5/1987: 213). In this, a de-personification of the entrepreneur is given expression (*ibid.*, 1928b: 486; also Becker/Knudsen 2003: 206). He can lose his function as an entrepreneur, too, when a phase of innovation ends. Entrepreneurs do not constitute a social class (see Schumpeter 1934: 78). Their different roles are causally related to the increasing calculability and rationalization of the innovation process in "managed capitalism" with its predominance of large-scale enterprises that becomes a routine matter compared to the "entrepreneurial capitalism" with its supremacy of newly established small and medium sized firms (*ibid.*, 1928b: 486; 1942: 132).

⁵ "...in general it is not the owner of stage-coaches who builds railways" (Schumpeter 1934: 66).

⁶ Schumpeter adopted his theoretical concept of the dynamic entrepreneur as a leader and as an initiator of innovations and technical change from his main teacher Friedrich von Wieser. See Streissler (1994: 34 ff.)

The precondition of innovations of newly established enterprises is the creation of purchasing power in the form of credits (ibid., 1934: 73). Bankers who have the knowledge to value the risks of innovations put pecuniary funds at the firm's disposal to finance intended risky innovations (ibid., 1939: 116 ff.). By means of borrowing enterprises, in case of fully occupied resources, withdraw the necessary means of production through price increases from those existing combinations that carry on utilizing the previous production engineering (ibid., 1934: 68). Rising prices drive out part of present demand. Through this they produce "...a process of Creative Destruction..." (ibid., 1942: 83) in that affected firms may have to leave their market.⁷ The possibility of self-financing does not exist in the stationary state since there are no savings (ibid., 1934: 72). To the capitalist process is characterized by simultaneous innovations and destructions. So sum up, innovations as creative actions through newly established firms, entrepreneurs as agents of change, and credit accommodation to the entrepreneur for carrying out innovations are the determining factors of economic evolution, non-existent in the stationary state of an economy. In this entrepreneurship is the real basic phenomenon of economic evolution (ibid., 1934: 74; also Shionoya 1997: 37; Gloria-Palermo 2002: 25). According to the utmost significance of the entrepreneur and also the banker as his financier, to Schumpeter – following Carl Menger (see Milford 1990: 217) – the epistemological basis of pure economic analysis is methodological individualism. In accordance with that, all socio-economic phenomena are traced back appropriately to individual actions alone. The individuals are the relevant units of analysis. But this does not mean to dispute the influence of the environment on individual behaviour (see Schumpeter 1908: 90 ff.).

To go into the details of an evolutionary process of economic change, innovations originate in long periods of economic immobility combined with price stability, in that corporate profits are under pressure. They produce a phase of economic prosperity on the overall economic level while they increase purchasing power by setting up new manufacturing facilities and also capital formation (ibid., 1934: 226). Out of a given continuous stream of inventions, innovations are put on the market intentionally and carefully targeted. Successful enterprises will temporarily realize monopoly profits by means of increasing proceeds and cutting costs.⁸ A single innovation triggers off a learning process of other, newly established enterprises and makes its diffusion easier after resistances are overcome, combined with the decline of monopoly profits. The realization of profits makes it possible for the entrepreneur – in contrast to the stationary state – to pay interest to the credit banks. Innovations do not happen occasionally but in a historical perspective more likely in swarms, concentrated only on a few economic sectors (ibid., 1939: 100 ff.). They go off differently in all firms resulting in a different firm sizes and industry growth. Existing firms which cannot utilize the new production engineering have to leave the market.

In the course of economic evolution, prosperity is followed by a period of sluggish adjustment of the economic system to the new economic data set (ibid., 1910/1987: 255). It phases out into a stationary condition of the economy (depression). The phase of depression is characterized by the end of the original entrepreneurial activities, the repayments of credits and the decline in output and prices (ibid., 1914-5/1987: 288 ff.). Innovations

⁷ "What we, unscientifically, call economic progress means essentially putting productive resources to uses *hitherto untried in practice*, and withdrawing them from the uses they have served so far. This is what we call 'innovation'" (Schumpeter 1928a: 378).

⁸ Schumpeter took on his positive evaluation of monopolies in favour of technical progress out of the German speaking literature of his age, among others again von Wieser. See Streissler (1994: 26 ff.)

and their diffusions with delay induce further gradual – unlike major – innovations that reduce economic and technical variety and lead back to the neighbourhood of a new but qualitatively different equilibrium. They are integrated into the stationary organism of the economy. In this way, Schumpeter achieves his most comprehensive definition of economic evolution: “The changes in the economic process brought about by innovation, together with all their effects, and the response to them by the economic system, we shall designate by the term economic evolution” (ibid., 1939: 86). The creative responses include adaptation to new innovations and elimination of those firms or production engineerings which are not able to adapt (ibid., 1939: 137). In the process of evolutionary economic change, the phase of innovation is in the fore compared to the following periods of diffusion and adaptation. In a stylized way, economic evolution consists of the emergence of variety through innovations of individual entrepreneurs or firms (technical artefacts, products, production processes, behaviour patterns, organizationally forms), the selection in the markets among the firms by means of competition and the retention of those characteristics of the individual units which are favoured by selection. On the whole, it is the result of major and minor innovations of pioneering entrepreneurs which give rise to growth of information and knowledge, that again endogenously lead to new combinations, and the following adjustment and coordination of resources by allocation activities of imitators as followers. Both entrepreneurial functions, the innovator and the imitator, exist next to each other. “So the instabilities, which arise from the process of innovation, tend to right themselves, and do not go on accumulating” (ibid., 1928a: 383 ff.).

In case of a new wave of innovations an upswing phase arises out of depression initiating a new, different path of evolution (ibid., 1934: 217). Economic development is not an organic entity in its entirety; it rather consists of relatively separate partial developments that follow one another (ibid., 1912/2006: 490). The consequence of the wavelike, discontinuous carrying out of new combinations and the following adjustment of the economic system is the origin of business cycles (ibid., 1934: 223). So Schumpeter combines long-term evolutionary economic change with the observable business cycles of the capitalist economy, a result of deviations from and returns to a stationary state (see Shionoya 1997: 181; Andersen 2009: 190). They show periods of prosperity and depression that lead away from an initial situation of nearness to equilibrium and – through a process of self-organization – to a new neighbourhood of equilibrium (Schumpeter 1939: 47). In contrast to most of the classical economists, economic evolution does not run steadily, but it shows business cycles of different length. These are an integral part of economic evolution (see Tichy 1984: 82 ff.).

In his “Theory of Economic Development”, at the beginning of his analysis of the long-term economic process, Schumpeter assumes that a stream of technical opportunities is given exogenously and will be implemented and disseminated on the market by the establishment of new enterprises (competitive capitalism). Entrepreneurs are assumed to spend their profits. In a later stage of the capitalist economic evolution as a result of changes of the organizational structure, technical innovations become routine especially of large-scale enterprises that compete with one another. Corporate profits are partly invested into expenses for research and development, creating the ability and the incentives for further innovations. Therefore, these are determined endogenously (trustified capitalism) (see Schumpeter 1928a: 384). Large-scale enterprises, arising from internal and external growth, have become the engine of economic and technological change (ibid., 1942: 106). The entrepreneurial function loses its original importance, that is to determine the objectives of the enterprise and its position on the market, acting stra-

tegitically when it carries on its enterprise within the framework of the circular flow of the economy (ibid., 1934: 78). The entrepreneurs become mere managers who keep the enterprises going, thereby deciding tactically (see Redlich 1964a: 97).

To criticize Schumpeter, in his analysis of technical and economic change he restricts himself to the phase of innovations, the first implementation of technical or organizational novelties onto the market. But he ignores the phase of invention and of diffusion, also an interdependence among the individual components of the innovation process as a whole (see Heertje 1988: 81 ff.). Further, he does not explain adequately the creation and the content of new knowledge as essential condition of innovations in a stationary economy (see also Witt 2002: 15; Becker et al. 2006: 5). But there is no deterministic explanation for that (see Becker et al. 2005: 111). It is regarded as always existing in plenty, independent of demand and supply factors. He emphasizes that inventions and innovations demand different personal abilities. "The inventor produces ideas, the entrepreneur 'gets things done', ..." (Schumpeter 1947: 152). Moreover, Schumpeter only looks at radical process innovations but neglects gradually improving ones (see Rosenberg 1976: 77), whereby it is hard to distinguish between these two manifestations. But it was difficult for the analysis of innovation activities as, at his time, there did not exist any considerable theoretical and empirical investigations. He also never looks at the capabilities inside the enterprise to discern new technical knowledge and to integrate it into existing resource combinations. He has not constructed a theory of business organization (see Fagerberg 2003: 133). His rudimentary theory of firm behaviour that distinguishes between the entrepreneur and the manager, just like the other "pairs of opposites" (Schumpeter 1934: 82) like the stationary state and evolution as economic processes and statics and dynamics as analytical methods, have been criticized as oversimplified and as a "black-white-woodcut" (Redlich 1964b: 304 – author's translation). In addition, he also does not sufficiently explain the wavelike appearance of innovations, the consequence of these business cycles instead of a steady stream of novelties. Remarkably, and important for the selected problem, concerning his orientation to evolution in nature he expressly does not make any use of possible communalities to biology in his theory of economic evolution (see Schumpeter 1912/2008: 466; 1934: 57 ff.).⁹ Regarding this it has to be taken into consideration that at the time when he had published his "Theory of Economic Development" Darwinism has entered a state of a crisis. The neo-Darwinian theory of natural evolution had not been elaborated yet. Concerning the origin it is maintained that he holds a generic variant of evolutionary economics, in that evolution is regarded as the capacity of the economic system to create and disseminate a stream of novelties of different kinds, but not a Darwinian-like one (see Witt 2008: 551).

Schumpeter's most important contribution to a theory of economic evolution is the elaboration of the central meaning of endogenously emerging technical and organizational innovations, combined with that variety, and their dissemination and internal development accompanied by a restructuring of productive resources into new combinations as the engine of capitalist economic change. Innovations overcome the stationary state of the economy. They go off differently in all enterprises with the result of a heterogeneous growth of firms and industries. The behaviour of entrepreneurs and firms, their organizational forms, technical artefacts are not unchangeable in the course of economic evolution. They adapt to the pressure from the environment according to their given poten-

⁹ For an attempt to reconcile Schumpeter's theory of economic development with a neo-Darwinian interpretation of evolution, see Kelm (1997: 111 ff.).

tial in an unforeseeable, indeterminable way. The result is a new but different stationary state. Periods of economic rest and change alternate with each other. Starting with Metcalfe (1998: 36 ff.; 2005: 396) from the assumption that the existence and creation of variety, its directed selection and the retention of the adapted variety within a population, driven by competition and scarcity of resources, constitute the basic principles of economic evolution, then Schumpeter – as an example for a rational (in contrast to a historical) reconstruction of an economic theory (see Blaug 1997: 7) –, with his theory of launching and disseminating technical and economic innovations (variational change), the selection of entrepreneurs or firms as their carriers on the market under competitive conditions and both the development of the new combinations leading in turn to new varieties (transformational and developmental change), provides a broadly orientated contribution to an evolutionary but non-Darwinian theory of economic change.¹⁰ Remarkably, he did not find successors in the field of evolutionary economics at that time, therefore he could not found a research tradition of its own.

3 Marshall and the process of gradual economic change

Schumpeter's theory of economic evolution represents a deliberate alternative to the value theory of Marshall in Book V of his "Principles of Economics" (1890/1961). The subject of the latter is the analysis of the forces of demand and supply in a single industry as the fundamental idea and the determination of the long-term normal values of economic quantities in case of different length of time. Static analysis that deals with "...the normal conditions of life in the modern age, ..." (ibid.: XIV) describes and analyses a situation of order of economic relations of the market process. But a state of relative rest and complete adjustment of the economic system will exist only temporarily. Like the stationary state of Schumpeter a static analysis is not suitable when dealing with economic development of industries (ibid.: 461). Both authors agree that this can only be the starting point of an economic analysis and must be extended. Under the influence of the Younger German Historical School (see Hodgson 2008: 95) they are shaped by the idea of the historical development of human society and the unity of social phenomena.

The smaller part of Marshall's theoretical structure besides the theory of value is a theory of production and economic change by means of technical and organizational innovations (Book IV of the "Principles"). Characteristic features of his theory of production (see Marshall 1961: 314 ff.) are the existence of internal and external economies of a firm, also the conception of the organic life cycle for its growth. Internal economies are the result of the division of labour in the individual enterprises and among them, and the specialization of managerial and entrepreneurial functions respectively leading to technical novelties, too. External economies follow from the level of industrial production and increasing technical knowledge. From an organic point of view they serve as the basis for his "evolution mindedness" (Schumpeter 1954b: 287) and his confidence in economic and social progress.

The economy evolves on the basis of its given order.¹¹ Having its roots in Adam Smith, economic development is created and driven by a continuously increasing division of

¹⁰ "Nothing to do with biology per se, but everything to do with evolution" (Metcalfe 2005: 421). – "Schumpeter was an evolutionary thinker through and through" (Mathews 2007: 86).

¹¹ "Evolution is not possible without a substrate of order to give guidance and purpose to change" (Metcalfe 2007: 99).

labour and specialization of production, initiating technical innovations, extension of the market, accumulation and utilization of the firm's internal and external knowledge as well as management competencies, in the end free competition (see Marshall 1961: 461). The division of labour leads cumulatively and self-reinforcing at the same time to a growing functional differentiation of social and industrial activities and individual competencies and their causal combination. They both are accompanied by a closer coordination and integration of their individual parts through firms and their different organizational forms, in that respect following a uniform principle or characteristic of this variety like, for example, the use and the higher need for coordinating managerial activities (ibid.: 241). Differentiation and integration are the basic aspects of technical and economic development and industrial organization, "...the relations of details to fundamentals" (ibid.: Vol. 2: 775) or, with the motto of "Industry And Trade" (1919), "The many in the one, the one in the many" (see Glassburner 1955: 590). It is the core of this explanation of the dynamics of the economic process to combine differentiation and innovations, change and creativity on the one hand, and standardization and routine of firms and industries on the other hand as its driving forces (see Raffaelli 2003: IX; 2009: 67). Hereby following rather Spencer and Lamarck than Darwin in his evolutionary orientation (see Moss 1990: 93), he employs the transformation of individual units as the mechanism of evolution, in contrast to Darwinian population thinking. In accordance with this alternative theory, variety is the consequence of adaptation of the individual units to their environment that is in the first place, driven by internal forces, resulting in increasing complexity or – as a result of his confidence in human and social progress – even in perfection. Evolutionism as a scientific theory and a philosophical question accompanied by a confidence in progress belongs to the Victorian world view (see Mayr 1994: 137 ff.). In contrast to Lamarck, for Darwin variety comes first, it is the cause of evolution, only after that adaptation as a result of selection (see ibid., 1984: 285).

Change and adaptation have simultaneous effects on the industrial process and its organization. They are combined by means of the principle of continuity. The result of this is uncertain and non-deterministic. Smith and Marshall, in contrast to Schumpeter, do not assume comparable active "business men" as the head of an enterprise (see Marshall 1961: 291 ff.), at the same time an enterprising personality and agent of technical and economic development. Economic change is rather the result of a multitude of minor innovations on the part of a large number of small firms, but not a small number of enterprises and major innovations (see Spengler 1959: 8 ff.; Lowe 1975: 419). These must have a thorough knowledge of their business activities (see Marshall 1961: 297) such as the accumulation of capital but also the acquisition of knowledge and competencies. All in all, Marshall provides a much more detailed analysis of the activities of enterprises and the development of industries than Schumpeter who restricts himself to radical innovations and their financing. Thus, in the preface of the "Principles" (ibid.: XIV) Marshall reaches his programmatic statement regarding the question whether economic and technical change shows – even if in a loose form – similarities to evolution in nature. "The Mecca of the economist lies in economic biology rather than in economic dynamics."

A further element of such a possible correspondence besides the long-term growth of an industry is the life-cycle of a business enterprise. Both aspects of production and economic change are connected with each other. The individual firm as the decisive agent of development grows and develops in the way it produces and disseminates new knowledge as the result of competition, it converts knowledge into technical and organizational

innovations and utilizes internal and external economies that are the result of the growth of production. The growth of knowledge and its use are the most important productive factors, but also the basic reasons for economic change. Knowledge is a component of capital. With that it consists of organization as an independent productive factor (see Marshall 1961: 138). Firms are different from each other with respect to their state of knowledge and management capacities of the businessmen. They follow different patterns of development with the result of their heterogeneity. They realize their economic opportunities to a different degree. According to the “principle of substitution” (ibid.: 341), enterprises with above average productivity growth and profits will grow and may extend their market up to a monopolistic position, those with below average profits or work with a loss will shrink or even withdraw from the market. Therefore it corresponds to the principle of creative destruction as with Schumpeter (ibid.: 597; Metcalfe 2009: 65). The emergence and use of new knowledge require coordination and organization in enterprises (see Marshall 1961: 138).¹² Organization takes different forms, that one of an individual firm, of many firms in an industry, many industries to each other (ibid.: 139). The managerial competences contribute to their differentiated internal development with respect to the efficiency of the production process that combines knowledge and organization. Altogether, business management and entrepreneurship are an organizational function, existing as a matter of priority both in the coordinated employment and the growth of labour, capital and land as the productive factors. Regarding manufacturing activities, reasoning by similarity between nature and the social world is used for the reconciliation of internal and external economies with the result of decreasing unit costs with static equilibrium theory.

Enterprises – in correspondence with nature – are at any time in different phases of their life cycles. “And as with the growth of trees, so was it with the growth of businesses as a general rule...” (ibid.: 316). Their internal growth is limited by a decline of managerial abilities and the market entry of new competitors. The long-run equilibrium in the advanced state of an industry that means a balance between the organic forces of rise and decay (ibid.: 318) is accompanied by an imbalance of individual firms. The main interest of Marshall is in the long-run equilibrium of a competitive economy. To sum up, one can say that in a broader sense Marshall makes use of the evolutionary mechanisms both with regard to the organic internal development of enterprises (differentiation and integration) and differences of managerial abilities as the result of the division of labour and of variation and selection concerning their gradual innovation activities (see Metcalfe 2007: 86 ff.). The heterogeneity of firms is a requirement, so that they can be subject to market selection according to the principle of substitution. “The tendency to variation is a chief cause of progress; ...” (Marshall 1961: 355). Looking at both the theory of value and of production, for Marshall there exists a combination in the correspondence of the economy with mechanics (the market as a coordination device) and with biology (the firm as an evolving unit) (see Niman 1991: 28).

According to Marshall as well as to Schumpeter, economic development or evolution is the result of technical and organizational innovations. Marshall, in contrast to Schumpeter, does not need a theory of innovation of its own besides a theory of production. Technical change and internal and external economies are an intentional side effect

¹² “Knowledge is our most powerful engine of production; it enables us to subdue Nature and force her to satisfy our wants. Organization aids knowledge; it has many forms...” (Marshall 1961: 138).

of the general principle of substitution in production on a higher level and with the aim of cost reduction (see Marshall 1961: 355). Both technical and economic changes go in a gradual and path-dependent way, increasing cumulatively. For Marshall, unlike Schumpeter (1910/1987: 232), they give expression to economic and social progress in form of conscious and accidental differentiation through knowledge and innovations and following integration of different activities and agents (see Raffaelli 2003: 103 ff.). According to Spencer, in this, for Marshall the uniformity is expressed between scientific disciplines and the common ground between the economy and the natural world. The symbol for the principle of continuity between nature and the economy is the motto of the “Principles”: “*Natura non facit saltum*” (Nature does not make a leap). The heart of evolutionary thinking is the understanding of the division of labour accompanied by an internal development of enterprises and an expansion of a market. It results – going beyond Adam Smith – in a self-reinforcing use of roundabout methods of production and specialization among industries, leading to an ever-recurring more efficient way of manufacturing, that means increasing returns (see Young 1928: 539)¹³ From this leading idea of change and development by means of a continuous interaction between innovation and following routinization, that is the simultaneity of order and change, Raffaelli (2003: 141) concludes: “All things considered, maybe he was closer to the Mekka than he himself was able to realize.”

Despite the frequent use of metaphors from biology in his analysis of the industrial organization of the economy, Marshall did not outline a unified theory of economic evolution (see Clark/Juma 1988: 203; Hodgson 1993a: 408; Roncaglia 2001: 383). In the beginning he intended an analysis of the dynamic capitalist economy for a second volume of the “Principles”, but that was not written. Biological concepts turned out to be more complex than those from mechanics (see Marshall 1961: XIV). The “Principles” as his fundamental work are mainly “strictly static” (Schumpeter 1954a: 836),¹⁴ not dynamically orientated, even for him “...the central idea of economics ...must be that of living force and movement” (Marshall 1961: XV). His interest in evolution and biology arose from the difficulty in integrating time into economic analysis satisfactorily, but also the realized limitation of static analysis with respect to the theory of the firm and value theory as a whole (see Groenewegen 2003: 243). Marshall mainly deals with the level of the firm and its development with respect to the given potential of the life cycle, but only less with individual men inside a population, in contrast to Schumpeter, for whom the entrepreneur is the centre of attention. To the reservation concerning the requirements of economic biology has also contributed that, at the beginning of his working on the “Principles”, Darwinism only meant “explanation of the living world through natural processes” (Mayr 1994: 142 – author’s translation). The successors of Marshall in Cambridge did not adopt his evolutionary ideas regarding a theory of the firm. Pigou and J. Robinson rather developed the neoclassical theory of the firm, understood as the firm as a production function that shows identical costs and engineering (the equilibrium firm).

¹³ “Perpetual motion results from the fact that the division of labour is a cause and an effect of economic progress” (Richardson 1975: 351).

¹⁴ “This does not prevent him from dealing with evolutionary phenomena or indeed any phenomena of economic life that are refractory to the application of the methods of statics” (Schumpeter 1954a: 836).

4 Differences and common ground

In Marshall's and Schumpeter's view, the starting point of the analysis of economic evolution is a condition of order and rest in a stationary state of an economy determined by the forces of demand and supply. However, both authors also saw that a static analysis of an economy must be enlarged by a dynamic analysis in order to explain economic changes (see Backhouse 2008: 58). For Marshall economic development is the side effect of the manufacturing process that does not need a separate theory. The economy changes continuously and without any specific direction, but it will result in economic and human progress. For Schumpeter, in comparison, the evolutionary process runs in form of business cycles of prosperity and depression, but not organically as with Marshall (see Schumpeter 1910/1987: 239). The course of evolution is driven by innovations of individual entrepreneurs which join the markets, striving for industrial leadership. Economic evolution in both explanations is founded on at any one time existing knowledge and goes along with the creation and dissemination of new knowledge. It will never show a position of rest and optimality. As a result of, at the same time, gradual and radical innovations, the latter occurring discontinuously, longer periods of (relative) stability and shorter ones of abrupt change ("creative destruction") alternate with one another. The characters of the acting economic persons differ from each other, too. According to Schumpeter, the entrepreneur is a dominant leader. For Marshall the acting subjects are more likely managers than self-employed entrepreneurs. Both authors see that entrepreneurship and management supplement the pricing system with regard to the coordination of economic activities and economic development.

Despite all differences in details, as regards their content, both theories of economic evolution partly complement one another. Marshall puts the main emphasis on manufacturing activities of business men as managers, Schumpeter, in comparison, on major innovation activities of heroic entrepreneurs. Technical change and economic development go in a gradual and incremental way (according to Marshall), and also intentionally and less frequently punctualistic and discontinuously as the result of creative entrepreneurial activities (according to Schumpeter) (see Awan 1986: 44 ff.; Mokyry 1990: 290 ff.). Both forms of innovation are mutually dependent. Between these extreme cases there is a continuum of technical changes to a different degree. Both theories may in retrospect broadly be interpreted in accordance with the Darwinian mechanisms as evolutionary, even if these are not expressly named. Marshall, in the corresponding part of his "Principles", shows a more explicit evolutionary orientation, but with the understanding of evolution as an ongoing course of internal development of enterprises, characterized by increasing complexity of individual and social activities, dependent of the environment and accompanied with the inheritance of acquired characteristics by individual units as an auxiliary principle. Schumpeter, in comparison, refuses a Darwinian concept of evolution for the economy that follows possible communalities with biology. Instead, he pursues a generic research strategy in which innovations of different kind are generated within the economic system leading to evolution, and in addition nature and the social world exist separately from each other. Not until with Nelson and Winter (1982) the discussion revives the question whether economic evolution could, in loose correspondence, be explained by means of the neo-Darwinian evolutionary principles.

5 Principles of Neo-Schumpeterian evolutionary economics

Among the different interpretations of modern evolutionary economics at present the neo-Schumpeterian approach represented by Nelson and Winter and their close partners predominates (see Witt 2008: 571). How far does it go beyond Marshall and Schumpeter with regard to its heuristic frame and its content concerning entrepreneurial or firm and innovation activities? Corresponding to the former, the explanation of adaptive economic change is from the beginning carried out in loose communality with the three basic principles of evolution. But these Darwinian mechanisms will take a more comprehensive form in the socio-economic compared to the natural domain. Accordingly, on the one hand evolution requires the existence and continuous emergence of an infinite variety among the individuals of a population, that comes about not only by chance as in nature, but also intentionally and for a special aim. On the other hand it destroys variety and in this way produces a directed, structured course. Selection of technical and economic variety that has to take place slowly and steadily is both the result of environmental pressure and also of foresighted human activities. It is a universal method that takes effect in case of alternatives on the external and the internal sphere (see Geisendorf 2004: 89). The selected individual units are retained for future usage. They become the basis for further evolution. In this way continuity over time is ensured. So, following Witt (2008: 571), neo-Schumpeterian evolutionary economics represents both a generalized Darwinian heuristic strategy that applies to population systems as well as a dualistic concept of evolution.¹⁵ However, it has to be emphasized that these evolutionary mechanisms only represent a general framework for causally explaining processes of adaptive change in the social world, but not necessarily in detail (see Hodgson/Knudsen 2008: 64; Nelson 2007: 91). They can be interpreted differently strict following biology either as reasoning by metaphors or by analogies, whereby the former represents a weaker form of similarity between the natural and the social world. Concerning the details of economic evolution,

¹⁵ The assumed distinction between Generalized (or Universal) Darwinism as a monistic and neo-Schumpeterian evolutionary economics as a dualistic variant is hardly significant. According to Witt (2008: 551), it results from a different attitude concerning the structure of reality and is "...part of the researcher's informal world view...". They have in common – even if differently strict – the foundation following the neo-Darwinian principles. But the latter approach has less the intention to develop a complete neo-Darwinian inspired model of evolutionary change. Additionally, it has to be noted that at present Nelson is more sceptical to a Darwinian evolutionary approach as Generalized Darwinism as originally in the Nelson/Winter-book (1982) though he does not completely reject it. He notices both "interesting similarities" and "important differences" between an evolutionary social science and modern biological theories (2007: 85). Both have to be looked at equally. He concludes: "..., a Universal Darwinism is acceptable, welcome, if the character of evolutionary process associated with that conception is broad and general enough to square with the details of what is going on in both arenas" (ibid.: 85). So he judges both Darwinian evolutionary approaches as "...a broadly compatible view..." (ibid.: 91). But he denies the existence of close analogies between the evolution of biological species and evolution of human culture. For comparing both named evolutionary approaches one must also take into consideration the fact that Hodgson as a leading advocate of Generalized Darwinism has pronounced himself against Schumpeter as a spiritual father of evolutionary economics. For him, Schumpeter's concept of economic evolution only "... forms an adjunct of Walrasian equilibrium, and represents an ostensible but ultimately unsatisfactory attempt to reconcile general equilibrium theory with notions of variety and change" (Hodgson 1993b: 150). But this is more or less an individual view (for a critique of this interpretation, see Kelm 1997: 98 ff.). So despite this strong objective we hold to a loose Darwinian inspired interpretation of neo-Schumpeterian evolutionary economics in accordance with the taxonomy of Witt (2008).

the evolutionary mechanisms have to be completed through specific economic explanations (see Hodgson 2002: 270). A close functional correspondence in case of a maintained similarity between two disciplines and the form of the evolutionary mechanisms does not exist (see Nelson 2007: 85 ff.; for details see Rahmeyer 2007: 161). That is why Nelson (2007: 92) now recommends "... a broad and flexible view of evolutionary theories of change."

With regard to content, evolution in general comprises a process of creation, coordination, exploitation and diffusion of new information and productive knowledge in different forms that results in continuous change (see Hermann-Pillath 2002: 22; Loasby 2002: 1231). Knowledge is always incomplete, available only scattered and subject to error. Its growth is the result epistemologically of conjectures and refutations, the selection of hypotheses (see Popper 1972: 261), but it also consists of a history of competing research programmes which happen more continuously (see Lakatos 1970: 155). Learning activities and experiences of individuals as entrepreneurs and of firms as organizations mainly in the surrounding of existing knowledge in a self-perpetuating process, increase the knowledge base. In more detail, a main subject of modern evolutionary economics – in agreement with the above definition – is the description and explanation of technical and economic change in business enterprises and industries, especially the discovery and implementation of technical novelties on the market. Forces of inertia retain continuity, in respect of which individual and collective characteristics will survive the selection process and disseminate (see Nelson 1995: 56). Regarding the great importance they place both on technical and economic change and on bounded rationality Nelson and Winter (1982: 39) correspondingly categorize their evolutionary approach as "Neo-Schumpeterian". By emphasizing the gradual course of economic change and the management activities of firms, they also find themselves in the tradition of Marshall (see Loasby 1989: 56; Foss 1994: 1128; Roncaglia 2001: 382; Raffaelli 2003: 54). In contrast to Schumpeter and Marshall, besides the entrepreneur and the individual firm, Nelson and Winter and their close followers do not only look at the market level but also the industry as a population of firms and at their internal organization and the role of institutions for innovation activities. So phenomena above the individual level such as firms and also institutions have a meaning of their own compared to individuals as entrepreneurs. For this firm members are assumed to be homogeneous and cooperative. The firm's internal incentive structure and decision-making process is not looked at. Therefore, evolutionary economics does not follow methodological individualism. Instead, it is non-reductionistically, but collectively orientated (see Vromen 2004: 233; Castellacci 2007: 588). The neo-Schumpeterian approach as regards content but less as a heuristic strategy has gained broad application particularly in the theory of innovation and the theory of the firm, the latter in the variant of the resource-based theories. Based on the analyses of Marshall and Schumpeter, in the following a concise neo-Schumpeterian description and explanation of economic and organizational evolution, resulting from both routinized and innovative activities of enterprises, will be pursued.

5.1 Routine- and resource-based theories of the firm

Nelson and Winter consider firms as goal-oriented, purposefully behaving organizations of individual economic activities. Coming from behavioural theories of the firm, they assume the behaviour of intended but limited rationality as well as the initial goal to meet an aspiration level (see Simon 1979: 502 ff.). Firms are seen as profit-seeking but not as profit-maximizing organizations (see Winter 1988: 174). They are, above

all, carriers of production knowledge and production techniques. In the tradition of Marshall the process of manufacturing is the focus of interest, but not plain exchange, contractual relations or transaction costs.¹⁶ The stock of private and collective knowledge, experience and competences of enterprises is accumulated in the skills and habits of individuals and a hierarchy of rule-based organizational routines in production, investment, search and innovation activities (for this differentiation see Nelson/Winter 1982: 73). Routines that, to a high degree, are of local and specific nature constitute an almost rational, i.e. consistent behaviour of firms, as was also emphasized by Schumpeter in case of a stationary economy (1934: 80) as well as in the stage of trustified capitalism. They reduce uncertainty and facilitate the coordination of their information and decision processes. They also increase the productivity of their own activities and guarantee continuity and internal stability (see Winter 1975: 101). Routine-based behaviour does not lead to optimal outcomes, but is best adapted to the prevailing environmental situation. Thus the term 'routine' refers to a broad range of regularities in the economy (see Becker 2004: 662). Skills, habits and routines are assumed to have the same functional meaning as the genotype in nature, the totality of genetic information of an organism, as much as firms are comparable with their phenotypes, the outside appearance of an organism (see Nelson/Winter 1982: 14, 134). As the result of the selection both within a firm and among a population of firms, which is a hierarchical selection, the share of skills and routines which are successful and adapted to the environment will grow within their population. Both forms of selection supplement each other and are important in a theory of economic evolution (see Aldrich/Ruef 2006: 26 ff.). Processes of learning of individuals and of organizations to be directed at seeking profits, but also mistakes in the replication and the combination of routines may change existing behavioural rules gradually and with delay.

The intentional search for novelties of different kinds as a routine of higher order and their practical application in the production process breaks the existing routine behaviour in a stationary economy. It is regarded as being comparable to the mutation of genes in the natural world (see Nelson/Winter 1982:18). But search takes place not only blindly as mutations and recombinations in nature, but also for a specific purpose (among others, see Cordes 2006: 533; Castellacci 2007: 602). Therefore, firms get a causal significance in the process of economic evolution. In contrast to optimal adaptation, in case of bounded rationality, a variety of routines of firms as well as skills and habits of individuals will occur, triggering evolutionary change (see Metcalfe 1995: 471). According to their specific routines and competences to change this kind of behaviour, firms will differ, for instance, in their size and the level of productivity, unit costs, and following from that, profitability, an expression of population thinking. Those firms which show a below average level of productivity and correspondingly an above level of unit costs and prices as measures of market performance have to adapt to the demands of the environment. Those with an above level of productivity and profits, e. g. as the result of management talent and differences in input quality, open up new activities by means of technical and organizational innovations (see Winter 1975: 105; Witt 1996: 712). The result of this intra-industry reallocation will be shifts in market shares and entries and exits of firms, also a differential industry growth, leading to a higher average productivity growth and continuous economic change (see Syverson 2011: 347 ff.). The intended

¹⁶ "The fact that incentives are not taken into account is a drawback shared by all the evolutionary theories of the firm" (Garrouste/Saussier 2005: 186).

and not-intended modification of routines impedes the exact retention and transmission of knowledge and rules, thereby the assumption of stability and persistence of firm behaviour (see Becker 2004: 662 ff.).

In this evolutionary understanding, firms are regarded as experience- and knowledge-based organizations, capable of learning, or as “repositories of productive knowledge” (Winter 1988: 175). They are, as a whole, subject to selection within their industries, and as a single entity they also show a flexible, internal development in order to adapt to the environment and its alteration, even though with delay, in this way regenerating new variety. In contrast to the natural domain there exists a reciprocal stream of information between the phenotype and the genotype that modifies the latter (for that, see Cordes 2006: 537). In socio-economic evolution, learning, training, knowledge are able to transmit acquired characters by individuals like experience and knowledge over time. This way the knowledge base of individuals and firms will grow steadily. So in economics Darwinian evolution through variation of a population is accompanied by Lamarckian evolution by means of the transmission of acquired features. The latter variant is compatible with a more purposeful behaviour of individuals and organizations. Variation and transformation of a population by means of both a change in the relative frequency of its individual units and of these individual elements themselves, evolution and internal development go along with each other (see Witt 2005: 340, 354; Metcalfe 2005: 396). As a consequence of gradual and delayed adaptation of behavioural patterns to environmental change and of bounded rationality, the evolutionary, behavioural approach is not sufficiently capable of explaining new activities like the creation and employment of resources for innovation activities. It could not develop an adequate long-term strategy of the firm at that time (see Winter 1987: 161).

In view of this criticism of rule-guided firm behaviour the research program of neo-Schumpeterian evolutionary economics has extended its behavioural approach to the theory of the firm by results of management theories concerning business strategy. In accordance with that, firms are characterized by their market strategy, internal organizational structure and specific competences for the use of their given resources (see Nelson 1991: 67).¹⁷ The central question is: Why do efficient, successful firms differ persistently at their own discretion? (ibid.: 61). A strategy comprises the long-term commitments made by a firm determining its objects, based on its given resources. The structure includes the internal organization of an enterprise in order to reach its goals. Competences for a coordinated employment of given resources supplement the routine and learning activities. As forms of specific productive knowledge, they serve as a basis for the intentional development of value creating activities. They are the result of cumulative entrepreneurial processes of search, learning and innovation that take place path-dependent, thus irreversible and directed. This way the knowledge base of individuals and firms will grow steadily over time. It establishes new forms of persistent competitive advantages and strengthens the firm’s ability to grow and survive (see Teece et al. 1997: 515). All three characteristics of a firm change only slowly as a result of bounded rationality and the given hierarchy of routines.

Following Penrose (1959: 24), in complementation of Schumpeter for the formulation of the internal structure and operation of a firm, firms may be more comprehensively seen as a bundle of their specific physical and human resources as productive factors, implemented and coordinated by administrative decision-making, and capable of internal de-

¹⁷ “...I’m not a passive evolutionist at all” (Nelson 2010: 357).

velopment. Resources are carriers of productive knowledge and the basis to generate firm and overall economic growth. They are combined into a bundle of performances, each one different and unique, by the firm's management. These, in turn, determine their services. Corporate growth will result in surplus firm-specific resources, for which no market exists. They make possible an expansion on production in previous and in new business activities, which on their part again lead to innovation in knowledge and resources in enterprises. Management capacities of a firm increase endogenously in the course of internal corporate growth (ibid.: 85). So firms, in the form of their provision of the resources and the supply of services, show both qualities of heterogeneity and coherence (in the words of Marshall: differentiation and integration). Their growth, caused by competences and learning and knowledge activities, may be looked upon as a model of regularity in their internal development.

As individual types of resources, tangible, physical, also intangible, for instance human capital, technical knowledge and organizational ones are distinguished. Entrepreneurship may be regarded as a special resource of a firm, too. In contrast to tradable productive factors, resources are not completely movable, they are difficult to imitate and substitute or none at all. Furthermore, they are considered as heterogeneous and differently distributed among firms and will result in persistent competitive advantages (see Barney 1991: 101 ff.; Peteraf/Barney 2003). In a dynamic view, firms must also discern new opportunities on the markets by means of their search routines, above all their capacity to enlarge and modify their resource bases intentionally (see Helfat et al. 2007: 4). Consequently, internal (firm related) such as the provision and deployment of valuable resources, organizational capabilities, and external (industry related) factors as characteristics of market structure of an industry determine corporate success of a business enterprise and complete one another (see Spulber 2003). Altogether, the resource-based and in its extension the dynamic capability-based approach as a management unlike an economic approach to the theory of the firm assigns a more active, more intentional role to the entrepreneurial function and to management activities as merely their adaptation to the given environment as in the early and strict interpretation of evolutionary economics. Apart from that, entrepreneurship and management in modern competitive economies will combine in an entrepreneurial management (see Augier/Teecle 2009: 411). To complete the present building blocks of an evolutionary theory of the firm that comprises very little about its organizational structure, the firm has also to be looked upon as a governance structure, besides as a bundle of resources and a repository of productive knowledge and capabilities. This comprises a system of control and supervision to establish order, to reduce conflicts and realize gains from exchange (see Williamson 2002: 180 ff.).

5.2 An evolutionary approach to innovation

Based on the variation-selection approach as well as the routine- and in its expansion into the resource-based theories of the firm, following and broadening Schumpeter the analysis of innovation activities of private enterprises constitutes the crucial building block for an explanation of economic evolution. It describes and explains causes, characteristics and the course of innovations, understood as the generation of new technical knowledge and resource combinations, and their ensuing implementation into the manufacturing process and dissemination.

Finding out the determining factors of knowledge and technical novelties is the most important task in completing Schumpeter's theory of innovation. They must not be as-

sumed as exogenously given. Regarding this question, while discarding the demand pull and the technology-push hypothesis that are complementary to each other and whose relative importance are not well known (see Mowery/Rosenberg 1982: 195; Kamien/Schwartz 1982: 36), fundamental “third” factors are assumed to mainly determine the rates and directions of innovations that compete with each other. With this, on industrial markets scientific-technical opportunities fed from common internal and external sources, both the capability and incentive to privately appropriate and exploit new knowledge, as well as financial market incentives as the extent and growth of the relevant market are part of it. On the firm level especially available resources and the competences of their productive use in the innovation process are among them (see Dosi 1988: 1141; Cohen 1995: 210 ff.; Klevorick et al. 1995: 186 ff.). The required creation of knowledge in order to generate an invention is both the result of in-house research and development carried out in the organizational form of vertical integration between intermediate and final producers, of formal and informal cooperation with competing firms, the acquisition of external knowledge from specialized firms or organizations, i. e. universities and research laboratories, and it also comes from the experience and learning of employees in manufacturing, therefore the continuous improvement of own products and production techniques (see Malerba 1992: 847 ff.; Antonelli 1999: 247 ff.). This way, inventions and innovations are not only the activities of individual entrepreneurs or large-scale enterprises, as it still was for Schumpeter. They have increasingly become a collective, systemic process, in that a lot of private and public participants are involved who influence each other through the simultaneous creation and utilization of positive externalities (see Pyka 1999: 71 ff.). As a result of that, knowledge is not only a non-excludable, and non-rival public, but also a private good whose returns can be partly appropriated. In this way the “common pool” of knowledge increases as a basis for positive externalities for its further creation and exploitation.

Cooperation among firms in networks and alliances as a kind of knowledge sharing results in an increase of joint expenditures for research and development, because their positive externalities are internalized to a great extent, also in their effectiveness as a consequence of their more extensive diffusion. At the same time, cooperation agreements bring about disadvantages by way of reducing technological independence of the participating firms (for details see Rahmeyer 1995: 49 ff.). The ability of an enterprise to absorb and exploit knowledge from external sources depends on its own knowledge base and demands previous expenditures in research and development. The different sources of new knowledge and innovations are no alternatives to one another. More likely, firms employ the internal and external ones in combination. The management of the different sources of knowledge to form its knowledge base is a part of the dynamic capabilities and the strategy of the firm. If industry- and firm-specific features are taken into account then a direct correlation between company size or business concentration and innovations, as has been derived from Schumpeter (1942: 106), does not exist (see Cohen 1995: 184 ff.).

Both firms and industries differ in the way they acquire and utilize their sources of knowledge, which means depending on management practices, the nearness to scientific research and the size and growth of the market. Accordingly, they show different levels of their knowledge base even in the same industry. In addition, they do not know for certain about the result of their strategies to produce and apply new knowledge. Differences concerning its individual causes and of innovations determine the rate and direction of technical and economic change and result in a corresponding heterogeneity both of the levels of productivity and unit costs, and of intra-industrial production engineer-

ing. Firms in industries with large technical opportunities and, at the same time, high capabilities to appropriate new knowledge and introduce it into production, will realize above average productivity and profits respectively, with that incentives and financial possibilities to new innovations (“success breeds success”) (and vice versa). If a variety among technical novelties and firms in their entirety exists, from that productivity, a selection process will occur. The frequency of above average efficient firms within the industry population increases, in comparison to that the share of the below average efficient ones decreases. The former group will dominate the market in the long run, in this way accelerating average productivity. The weighted mean of productivity as a population characteristic of a firm or an industry increases, the one of unit costs decreases accordingly. Innovations both of existing profitable and of newly established firms will again raise productivity on the firm level resulting in an ever-recurring new variety. Therefore the evolutionary process continues to exist. It becomes an incessant process of selection between and innovative change within firms as economic units. Competitive conditions in the markets and a sufficient difference among firms and industries are pre-conditions for the selection process. Both course and result of innovations will lead to learning effects and new knowledge of individuals and organizations in the next round of research and development through transmission and have an influence on the creation and application of future techniques. These follow from indivisibilities and complementarities of manufacturing activities. The employment and exploitation of resources, with the separate step of learning and experience, and the subsequent growth of knowledge and innovation activities, the in this way triggered transfer and retention of productive knowledge produces a knowledge-based evolutionary process (see Zollo/Winter 2002: 343). However, in their innovation activities firms have to find a balance between the exploration of new opportunities by inventive activities and the exploitation of existing knowledge and competences by innovative capacities in the course of economic evolution (see March 1991: 71 ff.; also U. Lichtenthaler/E. Lichtenthaler 2009: 1317 ff.), either by simultaneously or successively carrying out of both activities, or, to put it another way, between innovation and routinization. Both activities require some learning, even though to a different amount.

As the result of this cycle of evolutionary knowledge creation and application, inventions and innovations tend to constitute a stable technological paradigm or, synonymously, a technological regime and following from that also a path-dependency of technical change (see Nelson/Winter 1977: 57; Dosi 1988: 1127), with that a part of the environment for technical novelties, and determines its rate and direction. Afterwards business enterprises will first and foremost search for novelties around their specific production techniques and their existing markets. The variety of technical opportunities is limited. A routinization of innovations contributes to the stability of the technological development in case of gradual innovations especially in large enterprises as also maintained by Schumpeter, It reduces uncertainty. As already mentioned, the process of socio-economic evolution also takes place in accordance with the evolutionary model of Lamarck (see Nelson/Winter 1982: 11). According to that, evolution also means the continuous development of an organism or a routine, or a technical artefact (as units of selection) in the direction of higher complexity and perfection in adaptation to environmental demand. At the same time the retention of acquired features passes to the next phase of development through transmission. So, unlike in biology, Darwinian evolution through variation and selection and Lamarckian evolution by means of transmission of acquired characteristics do not exclude each other in economics. Instead, they complete one another.

But the neo-Darwinian theory explains that only advantageous attributes are inherited and retained, the unfavourable ones are selected (see Dawkins 1998: 20; Hodgson 2001: 98).

Altogether, the creation and diffusion of technological innovations on the basis of new knowledge is in all phases characterized by uncertainty and also chance regarding their technical and market results. In addition, they are not exclusively unique and drastic events or the sole results of human intention. This holds good for radical innovations to a higher degree than for minor improvements of existing techniques. The former continuously stimulate incremental innovations which are also the side effects of the division of labour (see Mokyr 1990: 292). That is why drastic innovations often created by newly established enterprises and routine ones of large-scale enterprises are complementary to each other (ibid.: 297; Baumol 2002: 72). The consequence of this juxtaposition of radical and gradual innovations is that evolutionary change must not be considered exclusively as a continuous process of selection and adaptation of novelties. It rather runs at different rates and may cause wave-like economic fluctuations of variable duration (punctuated equilibrium). But the ongoing economic evolutionary process is not regarded as having a close connection with the regular formation of business cycles as it has for Schumpeter. Assuming bounded rationality, firms prefer incremental instead of radical innovations. Therefore technical and economic evolution alternatively shows periods of rapid output growth and relative stability (see Balassa 1988: 25), in this way economic fluctuations of different length.

6 Final remarks

Schumpeter and Marshall are two precursors of modern evolutionary economics who complement one another concerning the great significance of innovations and entrepreneurial or firm activities for economic change, but less explicitly concerning its heuristic frame. Schumpeter restricts his analysis in an abstract, simplified way to the implementation of technical change and its financing through individual, heroic entrepreneurs and later on large-scale enterprises in the course of a business cycle. For Marshall, technical improvements are mere side effects of manufacturing based on the division of labour. In addition, Neo-Schumpeterian evolutionary economics includes the determining factors of innovations into its analysis which consists basically of the creation, transfer and retention of individual and collective learning and knowledge both from internal and external sources. Furthermore, innovations are not regarded as separate events each time, but they occur more cumulatively and in a path-dependent way. Correspondingly, business enterprises not only follow their routine behaviour using their given resources, they also show dynamic capabilities to intentionally restructure their resources and to build new ones.

As regards heuristic, evolutionary economics in the modern Neo-Schumpeterian version carries out the explanation of economic change explicitly in loose accordance with the basic principles of the neo-Darwinian theory of evolution in biology unlike than Schumpeter and Marshall do, despite, admittedly, considerable differences in detail concerning the interpretation of the evolutionary mechanisms. Functional counterparts in the economic domain for entities which for the purpose of an explanation of economic change may correspond to the genotype and phenotype in nature (as still in Nelson/Winter 1982) are not assumed any longer. The evolutionary principles represent a general and unified theoretical frame for explaining processes of change in the natural and

the cultural world. But as shown, evolution in both spheres is different mainly regarding the emergence and reduction of variety. They have to be completed by the Lamarckian doctrine admitting the inheritance of acquired favourable characteristics of the individual units. So finally, technical and economic evolution are both the result of unintentional inventions and innovations and their market selection through competitive forces of the environment, and of the intentional, voluntary entrepreneurial choices, based on the firm's resources and dynamic capabilities (see Vanberg 1996: 690).

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