1. Introduction

Guido Buenstorf

1 EVOLUTIONARY ECONOMICS AS BEHAVIORAL ECONOMICS OF INDIVIDUALS AND ORGANIZATIONS

Evolutionary economics is behavioral economics – it studies the behavior of individuals and organizations in economic contexts. Evolutionary economists share parts of their research agenda with (other) behavioral economists and with management scholars, and the more the three communities interact, the more they can each learn from the others. These three premises underlie the present collection.

That evolutionary economics is behavioral economics is by no means a new idea, but has been proposed – and practiced – for more than 100 years before these lines were written. The starting point of evolutionary economics can be dated to 1898, the year when Thorstein Veblen posed his famous question: ‘Why is economics not an evolutionary science?’. Veblen’s programmatic essay chastised economics for not engaging in a causal analysis of economic processes, which to him was the essence of evolutionary thinking (Veblen, 1898; see also Hodgson, 1998). To do so presupposed studying the behavior of human agents, who after all are ‘the motor forces of the processes of economic development’ (Veblen, 1898, p. 388).

For Veblen, the rational choice approach of neoclassical economics emerging at the time – portraying human agents as ‘lightning calculators of pleasures and pains’, as he sardonically put it (p. 389) – would not do the job. His alternative vision of economic agency was derived from contemporary instinct psychology (see Cordes, 2007, and the references therein). In this view, the individual agent’s desires, thoughts and behavioral dispositions are not exogenously given and permanently fixed, but are the dynamic ‘products of his hereditary traits and his past experience’ (Veblen, 1899, p. 390). Thus, to understand the behavior of human agents we have to ask how they became what they are. And to answer this question both individual learning experiences and the phylogenetic processes that shaped human nature in the species’ evolutionary history need to be

taken into account. This perspective, even though developed in the late nineteenth century, comes very close to contemporary views in evolutionary economics.

Understanding human agents as products of their past, moreover, leaves room for interaction with and learning from other agents. For Veblen, economic agents are not isolated decision makers. Their goal-oriented activities unfold in the context of their cultural environment, which is in turn modified through the activities of individual agents. Firms are a relevant part of the cultural context shaping (and being shaped by) individual behavior. It is therefore not surprising that Veblen's perspective on economic agency provided the theoretical foundation on which other American institutionalists built their critique of labor relations and corporate cultures prevailing in US corporations at the time (Cordes, 2007).

Joseph Schumpeter (1934; first published in German in 1911), the other founding father of evolutionary economics, likewise saw the need to understand human behavior to make sense of economic development. His innovative entrepreneur – the driver of Schumpeterian economic development – is a multifaceted individual. The entrepreneur's complex motivational structure could hardly be more different from the utilitarian agent of the rational choice approach who optimizes an income–leisure trade-off. It is not the expectation to make a profit from successful innovation that motivates Schumpeter's entrepreneur, and he (sic!) does not calculate a return on investment. Rather, he is restless and driven by the will to achieve, to win against his competitors, and to 'found a private kingdom' (Schumpeter, 1934, p. 93).

Nonetheless, as Witt (2002) has succinctly pointed out, in Schumpeter's (1934) elitist theory of economic development all interesting behavioral facets are limited to the entrepreneur. Both competing 'mere managers' and consumers are portrayed as passive, and much of the challenge faced by the entrepreneur is to overcome the obstacles posed by a social environment hostile to innovations. Thus, the behavioral perspective is clearly present in the younger Schumpeter, yet it remains sketchy and far from being fully explored. Furthermore, the process of invention is not part of Schumpeter's (1934) theory. Schumpeterian entrepreneurs are innovators, not inventors. Their creative activity is limited to discovering the economic opportunities provided by ideas that already pre-exist outside the market sphere. The Schumpeterian entrepreneur is likewise not necessarily a capitalist, firm owner or manager. As a consequence, how entrepreneurial ideas are realized in business firms is not part of Schumpeter's theory, either.

As is well known, firms came to play a dominant role in Schumpeter's later theorizing. Following the historical ascent of the industrial research

and development (R&D) laboratory, in *Capitalism, Socialism and Democracy*, Schumpeter (1942) argued that the locus of innovation had mostly shifted from individual entrepreneurs to large corporations. A less noticed change in Schumpeter's thought relates to the motivation underlying innovative activities. He now portrayed business firms as profit oriented, and while they were not argued to be profit *maximizing*, they require the prospect of monopoly profits to be induced to engage in innovative activities. Otherwise, in spite of its important role in *Capitalism, Socialism and Democracy*, the firm essentially remained a black box in Schumpeter's later work.

This is very different in Richard Nelson and Sidney Winter's seminal *Evolutionary Theory of Economic Change* (1982), which started the modern tradition of evolutionary economics. Nelson and Winter's conception of evolutionary economics focuses on competition in innovative markets. As a consequence, firms are at the center of interest. Taking up ideas developed in the Carnegie tradition (for example, March and Simon, 1958; Cyert and March, 1963), the rule-based character of firms' decision making is stressed. As Winter (1971, p. 239) had put it in an earlier article, 'firms establish decision rules and apply them routinely over extended periods'. These organizational routines, which also encompass the 'relatively constant dispositions and strategic heuristics that shape the approach of a firm to the nonroutine problems it faces' (Nelson and Winter, 1982, p. 15), are at the heart of Nelson and Winter's theory of the firm.

Nelson and Winter thus shift the focus of evolutionary economics from individual to organizational behavior, which is of primary relevance to explain competition in markets. To be sure, the book does contain an entire chapter dedicated to a discussion of individual skills, drawing extensively on insights from cognitive psychology. However, individual skills are seen as an analogue to organizational routines, and they are mainly discussed to motivate the subsequent discussion of how partially tacit organizational routines underlie the coordinated performance of firm organizations.

The routine concept also provides the link to the selection concept borrowed from biology. Winter (1971) had already argued that selection is a meaningful concept in industrial economics only if some dimension of firm activity can be found that is long-lived enough for selection to operate upon, and suggested firms' decision rules as a suitable candidate for such a concept. In Nelson and Winter (1982), the routine-based theory of organizational behavior is combined with agent-based simulation models to develop an alternative growth theory based on competing heterogeneous firms operating in innovative markets. Characteristic of their evolutionary model is that the development of firms (and, as a consequence,

industries) is informed by their past: '[t]he condition of the industry in each time period bears the seeds of its condition in the following period' (ibid., p. 19). Continuity in firm behavior is further enhanced by assuming satisficing behavior of firms. Firms' primary objective is to preserve their routines, and they only search for improved processes when profits fall below their aspiration level.

The analogy between market competition and natural selection is prominent in the Nelson–Winter book, and there is liberal use of biological rhetoric (such as characterizing 'routines as genes'; p. 134). At the same time, the authors explicitly disavow the idea that market competition is driven by precisely the same processes as natural selection, or even the objective to develop a more general theory of evolution. Likewise, they make no attempt to link presently observable human behavior to past evolutionary processes shaping human nature during the phylogeny of the human species. This is a striking difference to Veblen's vision of evolutionary economics, but also – as will be seen immediately – to another strand of modern evolutionary economics.

It was only a few years after Nelson and Winter (1982) that an independent line of evolutionary economic thought was started in Germany by Ulrich Witt. In a book that was never translated into English, Witt (1987) endeavored to provide individualistic foundations of evolutionary economics. Conceptualizing evolutionary economics as a general approach to the study of emergent novelty and dynamic change in the economy, Witt set out an ambitious agenda that went far beyond industrial economics. Underlying his approach are two premises. First, that the scattered evolutionary ideas in economics (in addition to Schumpeter, the Nelson–Winter approach, as well as some contributions by German-speaking authors, Witt discusses at length the (neo-)Austrian school of Friedrich von Hayek, Israel Kirzner and others) lack a unifying theoretical foundation. And second, that this foundation needs to be provided by a sufficiently general theory of individual behavior and human interaction. Evolutionary biology is highly relevant in this perspective of evolutionary economics – not to provide a template for evolutionary processes in the economic sphere, but because the behavioral dispositions and cognitive capacities of contemporary agents were shaped during human phylogeny. Witt's general conception of evolutionary economics thus comes closer to that developed by Veblen than either to Schumpeter's or Nelson and Winter's views.

Where Nelson and Winter (1982) drew their primary inspiration from organizational theory, Witt (1987) is heavily influenced by behaviorist and cognitive psychology. He develops a rich account of individual economic agency based on inherited traits as well as a variety of learning processes.

For example, in the field of consumer behavior, Witt proposes that humans share a universal set of innate wants and needs. (These ideas were later elaborated in Witt, 2001.) This genetic endowment, however, is only a starting point for the acquisition of new desires as well as increasingly sophisticated ways of satisfying them. Learning results from individual experience but also from vicarious learning based on observing the behavior of role models (Bandura, 1986). Learning from role models allows for some individuals to have a disproportionately strong impact on how views in their community develop.

In Witt's behavioral model, idiosyncratic individual framing of the environment and the human capacity to learn from observing others are linked to provide an account of self-reinforcing dynamics of convergent worldviews in communicating communities, and likewise increasingly different worldviews between groups that do not communicate. In several contributions, Witt (1998, 1999, 2000) applies his general behavioral model to the theory of the firm. He suggests that successful founders act as role models. In face-to-face interaction, they are able to shape the worldviews of employees and effectively diffuse their own view of the firm's mission and strategy in the firm. This process of 'cognitive leadership' helps ensure coordinated activities in the firm. To the extent that the entrepreneur's views are internalized by employees, it also helps to keep opportunistic behavior at bay. As the firm grows, face-to-face interaction becomes increasingly difficult to sustain for the entrepreneur. This provides an endogenous cause of firm development, which may take one of several directions: increased monitoring and formalization of procedures (routines), delegation of leadership functions to second- and third-tier managers, or even spin-off activities by disenchanted employees.

These ideas may be interpreted as providing an – admittedly indirect – link from Schumpeter's entrepreneur to Nelson and Winter's view of organizations. If Schumpeterian entrepreneurs establish firms to pursue their innovative ideas, they may imprint their own ideas on employees. As entrepreneurial visions differ, so will the worldviews of employees and, as a consequence, the organizational routines emerging in the firm. Witt's cognitive leadership may thus help account for the heterogeneity of firm routines and capabilities that is observable in many industries.

Since the 1980s, accounting for individual behavior in various contexts has been a core subject in evolutionary economics. In particular, numerous authors have focused on the learning of human agents and incorporated learning into the analysis of various economic processes (see, for example, Dosi et al., 2005, for a survey). In this way, our understanding of an important aspect of economic behavior has been enhanced substantially. Learning is a natural candidate as a focal point of evolutionary economics,

as it is inherently a dynamic process unfolding over time. To the extent that learning is done deliberately in order to attain some objective, learning moreover links the process perspective of evolutionary economics to the intentional character of most economic activities. Learning agents may be forward looking, and an evolutionary economics focusing on learning is not restricted to modeling individual or organizational agents as passive objects of (however specified) selection processes.

The evolutionary analysis of learning has often been linked back to conceptual research originating outside economics. One important link is provided by the work on genetic algorithms and evolutionary strategies modeled after principles of evolutionary processes in nature. These algorithms were originally developed as applied (normative) problem-solving devices, but they have also informed a (positive) theoretical literature on learning in economics (see Brenner, 1998, for a critical discussion). Another link is with complexity theory, notably the notion of adaptive search in fitness landscapes (Kauffman, 1993). For example, building on Herbert Simon's (1962) notion of nearly decomposable systems, Frenken et al. (1999) show that satisficing may be superior to optimization in complex search spaces when search time is a relevant performance parameter (which is certainly plausible in innovative markets). Finally, learning is a key driver of the dynamics in the agent-based computational modeling approach, which has been found to be well-suited for evolutionary economics. Learning can relate to the actions taken by agents according to some specified decision rules, or it can relate to the parameters or even structure of these rules (Dawid and Harting, ch. 6, this volume).

2 NEW OPPORTUNITIES FOR INTERACTION AND MUTUAL LEARNING

Since the foundations of the modern approach to evolutionary economics were developed in the 1980s, there have been various developments in economics more generally that open new opportunities for fruitful interaction between evolutionary and 'other' economists. Most importantly, with the ascent of laboratory experiments as a socially acceptable empirical practice in economics, behavioral economics has gained increasing traction in the broader discipline. Numerous results have been established in the lab that are hard to reconcile with the rationality axioms of standard economists or at least with the generally accepted notions of what rational decision making implies (see Wilkinson, 2007). The perspective on economic agency that informs at least some of the contributions to this line of research is quite congenial to evolutionary economics.

Not only have economists outside the evolutionary camp rediscovered an interest in actual human behavior, going beyond axiomatic rational choice and taking seriously findings from other social sciences such as psychology. Economists have also begun to link human behavior to the inherited nature of the human cognitive apparatus. The most visible development in this context is neuroeconomics (see Camerer et al., 2005). Based on their interdisciplinary interaction with neuroscience, economists have come to accept that human behavior is multidimensional, and that, for instance, decisions may vastly differ according to whether they are made by automatic or controlled processes, or with different involvement of the brain's affective system. These insights lead at least some economists to conclude that '[t]he way the brain evolved is critical to understanding human behavior' (ibid., p. 25). And even in Chicago, economists have realized that when real-world agents fail to conform to the predictions of the rational choice model, the policy implications of that model may not be appropriate in a variety of real-world contexts (Thaler and Sunstein, 2003).

In this way, more than 100 years after Veblen's (1898) programmatic essay, economics may eventually be on its way to becoming an evolutionary science. En route there is still much that evolutionary economics has to offer to the rest of the discipline. Organizational behavior tends to be underexplored by behavioral economists, and likewise the issue of how complex macro-level patterns emerge from the micro-level interaction of individual agents. Evolutionary economics has a long and rich tradition of empirical studies of how firms, markets and industries develop. The body of empirical insights thus developed will be an important ingredient toward a better understanding of organizational behavior, which is more difficult to replicate in the lab than individual decision making. Closely related – and equally important to understand industrial dynamics – is the evolutionary research on innovation based on the insight that real-world knowledge is generally *not* a public good that can be costlessly replicated. On the demand side of markets, the recent upswing of behavioral economics has yet offered little in terms of an improved theory of consumer behavior. Similar to innovation, here is a real opportunity for evolutionary economics to have an impact on how economics develops in the future.

At the same time, behavioral economists are working on ideas that are highly relevant to evolutionary economics – such as the attempt to develop a general (and mathematical) theory of satisficing, a potentially powerful challenge to the engrained rational choice model of standard economics. In the same vein, the empirical work on subjective well-being not only challenges conventional welfare economics. It may also integrate insights into the substance and dynamics of evolved human needs and desires into notions of economic welfare.

Evolutionary economics has likewise much to learn from management scholars with their wealth of in-depth empirical knowledge about firms. In this context, a lively discussion and further refinement of the routine concept began at the intersection of evolutionary economics and the management literature (see, for example, Cohen and Bacdayan, 1994; Dosi et al., 2000; Becker, 2004; Becker et al., 2005). In particular, routines have been suggested as important repositories of organizational capabilities. The capability-based view of the firm emphasizes *strategic* capabilities, that is, capacities to use the firm's resources that are tied to a customer need, unique to the firm and hard to imitate by competitors (Teece and Pisano, 1994). As the knowledge base underlying organizational routines is partially tacit and not fully available to any single individual member of the firm, capabilities residing in organizational routines are often strategic in this sense.

In studying firm organizations, the routine concept is not the only contribution that evolutionary economists can bring to the debate. As noted in the previous section, there has been a long interest in evolutionary economics in the personality of the entrepreneur, and also in the cognitive and motivational dynamics within developing firms. In the field of industrial dynamics, evolutionary economics has made key theoretical and empirical contributions (Klepper, 1996, 2002; Klepper and Thompson, 2006). Again these interests resonate with recent developments outside evolutionary economics. For instance, entrepreneurship has emerged as a dynamic field of research that shares both its Schumpeterian roots and many specific research topics with evolutionary economics. Various contributions to entrepreneurship research are moreover informed by behavioral economics (for example, the work on entrepreneurial overoptimism by Lowe and Ziedonis, 2006), or even have a distinctly evolutionary flavor (such as the work on genetic foundations of entrepreneurship by Nicolaou et al., 2008). Both behavioral economists and management scholars are keenly interested in motivational aspects of labor relations and their repercussions on individual effort and firm performance (for example, Fehr and Schmidt, 2004, 2007; Sauermann and Cohen, 2010). Management scholars have also adopted concepts and methods from the evolutionary work on industrial dynamics. All these recent developments provide rich opportunities to enhance the state of knowledge in the economics of the firm. This seems all the more important not only because most economists outside the evolutionary community have so far shunned the evolutionary perspective on firms, but because economics has generally shown little interest in how firms actually behave and decide. That the field of management research has traditionally been open to many different theoretical inputs may make the dialogue even more fruitful.

This volume is intended as a contribution to the tripartite communication between evolutionary economists, behavioral economists, and management scholars. Each of the individual chapters of the volume takes up one or several aspects of the overlapping research agendas. Earlier versions of many of the chapters were presented at the 2009 European Meeting on Applied Evolutionary Economics (EMAEE) in the German city of Jena. To dedicate the 2009 EMAEE conference in Jena to this communication between the three communities was a straightforward choice for historical as well as present-day reasons. Historically, as is highlighted in both Markus C. Becker's and Uwe Cantner's chapters, Jena experienced a managerial natural experiment in the late nineteenth and early twentieth centuries that transformed the city into one of the world's earliest regional innovation systems. At the core of this experiment was Ernst Abbe, a scientist, Schumpeterian entrepreneur, philanthropist and architect of close interaction between public research and private-sector innovation at the regional level. Abbe's own management principles are surprisingly close to the evolutionary view of firm organizations (Buenstorf and Murmann, 2005). More recently, the Jena economics community formed by the Friedrich Schiller University and the Max Planck Institute of Economics has engaged in the close interaction between evolutionary economics, behavioral economics, and the economics of entrepreneurship and innovation.

3 PART I: ECONOMIC BEHAVIOR: INDIVIDUALS AND INTERACTIONS

The present volume is organized into three parts. The first part consists of four chapters focusing on individual agents and their interactions. Werner Güth and Hartmut Kliemt (Chapter 2) set the stage with a discussion of boundedly rational decision making under uncertainty. Their conceptual chapter is one element of a broader research agenda that aims to provide a mathematical formulation of satisficing behavior in the Simonian tradition (see, for example, Güth, 2007, 2010). Güth and Kliemt suggest that when deciding under uncertainty, real-world agents do not normally maximize their expected utility based on assigning probabilities to the possible states of the world they may encounter. Instead, agents selectively focus their attention on specific scenarios about what may happen (including other agents' decisions) and form aspiration levels of what outcomes would be satisfactory in the selected scenarios. In this framework, a choice option is 'optimal' if there is no alternative option that yields higher utility under one of the scenarios considered by the agent while yielding at least

the same utility under all other scenarios. Optimal aspirations profiles are such that they can just be satisfied by the respective choice option in all selected scenarios.

In the Güth–Kliemt framework, boundedly rational agents do not make decisions that are dominated by alternatives in the set of considered scenarios. However, bounded rationality will not normally lead agents to choose *the* optimal decision (among all possible ones), but only *a* satisficing one based on the scenarios taken into consideration. The authors also argue that preferences cannot be deduced from observable actions. In their view, economics as a discipline needs to experience a ‘cognitive turn’ like the one made decades ago by psychology, and develop theories about how preferences are actually formed by human agents. Finally, they employ the abstract framework developed in the chapter to delineate conditions under which external advice may help boundedly rational decision makers to arrive at improved decisions.

Seeking ‘a middle ground between the methodological individualism of many social sciences and methodological collectivism’ (pp. 39–40), Christian Cordes (Chapter 3) shifts the focus from the individual agent to the interaction of many agents. Cordes argues that cultural phenomena are emergent macro-level phenomena resulting from micro-level interaction, while they in turn shape the behavior of these interacting agents. Insights from anthropology provide the theoretical foundation of the chapter. Cordes emphasizes humans’ unique capacity to understand others as intentional agents, which underlies our social learning abilities, as the key micro-level foundation of culture. Drawing on dual inheritance theory, he suggests that a bias toward cooperative behavior was established in the human psychological setup during a period of gene–culture coevolution. In addition to this ‘direct’ bias in favor of cooperation, human nature is characterized by other biases that helped boundedly rational agents make functional decisions during human phylogeny. Specifically, anthropologists have identified biases toward conformist behavior and the imitation of successful role models.

Based on the theoretical considerations about evolutionary influences of human behavior, Cordes then develops a model of how new cultural traits can diffuse in a population of interacting agents. The model provides a coherent behavioral foundation for the logistic diffusion pattern that is well known from empirical diffusion studies, yet difficult to reconcile with sequences of purely individual rational choices from a set of given alternatives. In a broader context, models of the same basic structure – starting at the level of individual behavior but also incorporating the reverse causality from population-level processes back to the individual level – are suggested as fruitful tools for understanding social phenomena.

The consumption models developed by Zakaria Babutsidze in Chapter 4 are of the type advocated by Cordes. The main objective of the chapter is to alert readers to the importance of interaction among agents in studying consumer behavior: as personal communication and peer effects are important drivers of consumer decision making, neglecting interaction patterns in consumption may lead to false inferences about aggregate demand patterns and also to erroneous policy (or business strategy) recommendations.

Babutsidze uses two stylized model contexts to illustrate this point. In a model of global interaction resulting in frequency-dependent adoption patterns (analogous to the conformity bias in Cordes's model in Chapter 3), accounting for interaction leads to dramatic changes in the long-run market shares of the competing products. In contrast, in Babutsidze's second model local interaction is shown to affect the model's transitional dynamics. Consumers in this model are assumed to acquire skills enhancing their valuation of the consumed good (as is predicted by Witt's (2001) approach to consumer behavior). Consumer skills derive both from the agents' own experiential learning and from their interaction with neighboring agents (who may consume a different variety of good). Babutsidze shows that the effectiveness of advertising for one variety depends on the relative ease with which consumers can acquire skills relevant to the product (its 'user friendliness'). More importantly, how user friendliness relates to the effectiveness of advertising is determined by the strength of interaction. Without social learning, advertising is most effective if products are similar. With local interaction, effectiveness is enhanced by product heterogeneity in user friendliness. Interestingly, this effect is stronger for intermediate than for extreme levels of interaction. Babutsidze suggests that since learning is always a dynamic process unfolding over time, effects such as those shown in his exemplary models should be of particular interest to evolutionary economists.

The first part of the book is concluded by an empirical chapter by Stefan Krabel (Chapter 5) that turns to norms and attitudes in public research. This is a particularly well-suited context to study the evolution of agents' behavior, as norms in public research have changed considerably over the past decades. Traditional standards of 'open science' (Merton, 1968; Dasgupta and David, 1984) have increasingly been challenged by new demands on researchers and universities to prove their relevance by producing results that can be commercialized. Under these conditions, the chapter asks whether individual age, peer effects and organizational tradition have empirically measurable relationships to individual norms and incentives perceived by scientists. In other words: has the focus on

technology transfer and ‘entrepreneurial universities’ affected the way researchers think about science and their own role as scientists?

To answer this question, Krabel presents results from a survey of researchers working at the Max Planck Society, Germany’s foremost public research organization dedicated to basic research. The chapter thus differs from the thrust of the empirical work on university technology transfer, which has primarily been based on patent and publication data – and has therefore been unable to detect changes in attitudes and perceived incentives. By focusing on a single basic research-oriented organization, it is moreover able to control institutional differences (for example, stemming from differences in technology transfer strategies), doing so in a context where researchers are under comparatively little organizational pressure to partake in commercialization activities. The empirical findings indicate that a substantial shift in norms and perceived incentives may indeed be underway. Older researchers are more likely to subscribe to the norms of ‘open science’, and perceive systematically lower reputational effects of commercialization, than their younger peers. A candidate for a (partial) explanation is also provided, as individual attitudes closely reflect those of peers working in the same institute.

4 PART II: THE EVOLUTION OF FIRMS

The three chapters of Part II deal with the behavior and development of firm organizations. It is here that evolutionary economists can most fruitfully interact with management scholars. Indeed all three chapters – each in its own original way – apply ideas and concepts from management to the evolutionary analysis of firms.

As noted in Section 1 above, agent-based computational modeling has been a prominent modeling approach in evolutionary studies of industries and entire economies ever since Nelson and Winter (1982). The strength of this approach – being able to model rich behavioral dynamics of a variety of heterogeneous, interacting agents – has also resulted in a key challenge: how to select decision rules for the agents that are grounded in well-established behavioral findings, and yet come up with a model whose dynamics are reasonably transparent? Herbert Dawid and Philipp Harting (Chapter 6) suggest that a consensus on this question would improve the ‘external’ usefulness of agent-based models for practical applications. It would also enhance the ‘internal’ validity of results by facilitating robustness tests and the comparison of results from alternative models. The authors propose a ‘management science approach’ to the modeling of firm behavior. The essence of this

approach is to implement ‘relatively simple decision rules that match standard procedures of real-world firms as described in the corresponding management literature’ (p. 109). The approach is illustrated by the assumptions about production and pricing decisions employed in a large agent-based macro model that the authors co-developed in a collaborative research project.

The similarity of Dawid and Harting’s management science approach and the original approach taken by Nelson and Winter (1982) is striking. After all, the notion of organizational routines originated from the prior findings established in the Carnegie tradition that firms tend to rely on stable and often quite straightforward heuristics to deal with recurrent tasks and problems. Against this backdrop, the contribution made by Dawid and Harting is to show how more complex agent-based models can be based along the same principles, and that well-established heuristics and decision rules are available from management science. In model building, these may be used for modeling firm behavior just as experimental findings can be used for modeling individual behavior.

‘Clan control’ (Ouchi, 1979) is a management approach to solve the ubiquitous problem of organizational control, that is, to ensure that the actual decisions made in a firm conform to the objectives of the firm’s top management. Clan control attempts to align the objectives of managers and employees based on commitment, traditions, socialization and stable membership. It is well-suited to manage R&D operations because individual output is difficult to measure and, given the inherently uncertain character of R&D, specific behaviors to attain the organization’s objectives cannot be prescribed.

But how does clan control actually become established in a firm? This question, which is obviously highly relevant to understand firm development, is center-stage in the contribution by Markus C. Becker (Chapter 7). Becker traces the emergence of clan control in the empirical context of Carl Zeiss, which pioneered microscope making in the nineteenth century and has remained one of Germany’s most prominent firms in the optical industry to this day. He shows that the firm’s management – most importantly Ernst Abbe – employed a variety of means to install a control system consistent with the notion of clan control. Commitment was fostered by mutual agreement on the relevance of precision; science-based product innovation was turned into a tradition (and subsequently codified in binding statutes prescribing detailed management principles for the Zeiss firm); firm members were socialized in master–apprentice relationships based on intense face-to-face communication; and stable membership was fostered by labor relations aiming at long-term (frequently, lifelong) employment.

In the broader theoretical context, clan control can be understood as a specific type of higher-level organizational routine (a strategic heuristic). The Zeiss example indicates that organizational control systems develop over time in a firm organization and have a lasting character. Becker's chapter can thus be read as an empirical case study of how routines emerge in the firm. At the same time, the chapter contributes to the crucial yet underresearched topic of how entrepreneurial ventures transform into organizations less strongly dependent on any single individual.

Chapter 8 by Thierry Burger-Helmchen and Patrick Llerena is conceptual in character. With organizational learning, the chapter discusses a crucial prerequisite of sustained competitiveness and an important driver of firm development. The authors' point of departure is what may be considered the economic essence of the firm: creating and capturing value. Burger-Helmchen and Llerena suggest that creating value has an individual as well as an organizational dimension. At the individual level, creating value is linked to the creation of new knowledge, which in turn is linked to interaction with other individuals (often other employees of the same firm). At the organizational level, creating value involves finding appropriate divisions of knowledge and labor both within and across the boundaries of the organization.

Based on how knowledge and labor are divided, firms may differ in their capacity to create value through exploration (acquiring new knowledge) and through exploitation (using their existing knowledge). In turn, both forms of organizational learning are favored by different conditions in terms of network structures, trust, and specialization in knowledge about the design of goods and services. To manage the alternative learning processes, Burger-Helmchen and Llerena suggest a focus on creative individuals. These may be either internal or external to the firm organization, and contractual relationships with them may be either of a more transactional or of a more relational character. The suitable form of contractual arrangement along these two dimensions depends on the value and uniqueness of the respective individual's human capital. Within the firm, somewhat different implications for the suitable work structures, forms of remuneration and learning opportunities follow from considerations related to the divisions of labor and knowledge.

5 PART III: EVOLVING FIRMS AS DRIVERS OF ECONOMIC DEVELOPMENT

Part III contains three chapters that are also concerned with evolving firms, but emphasize the broader implications they have for the development of

regions and entire economies. Chapter 9 by Koen Frenken and Ron A. Boschma presents a verbal model that is inspired by Herbert Simon's work on firm growth, and simultaneously looks at the growth of firms and regions. The point of departure is Schumpeterian innovators coming up with product innovations. These innovators decide, first, whether to stay with their current employer (leading the employer to establish a new product division), to join another existing firm, or to start a new spin-off firm. Second, they decide whether to remain in the region where they presently work, move to another region, or settle in a 'new' (in the context of the respective industry) region.

Assuming that the likelihood of staying in the same firm (region) increases with the technological relatedness of existing and new products, and that innovators are likewise attracted by firms (regions) already active in related product markets, the branching model proposed by Frenken and Boschma is able to capture some well-established stylized facts from industrial dynamics. The branching process results in related diversification trajectories at the firm and regional levels. Moreover, if there is a core-periphery structure in the space of products (as is suggested by recent empirical evidence), growth opportunities will depend on the current position in product space. Firms and regions located in densely populated parts of product space will then have better growth prospects than those located in the product periphery. The chapter, which provides a rich source of opportunities for further theoretical and empirical research, concludes with a discussion of how technological relatedness can be identified in empirical data.

In the ensuing Chapter 10, Pernille Gjerløv-Juel and Michael S. Dahl scrutinize the economic importance of the spin-off process, which is one of the processes driving the branching model developed by Frenken and Boschma. Their chapter is a vivid example of the fruitful interaction between evolutionary economics and the research on strategic management in the realm of industrial dynamics. The chapter starts by observing that numerous studies by evolutionary economists and management scholars have found spin-offs to be more long-lived than other startups. Arguing that its job-creating potential is a crucial reason why policy makers are interested in entrepreneurship, Gjerløv-Juel and Dahl ask whether spin-offs are also superior as providers of employment, and compare job creation and job destruction over the first nine years for the two types of new firms.

Gjerløv-Juel and Dahl employ arguments from organization ecology and evolutionary economics to predict that compared to other startups, spin-offs command a larger pool of capabilities due to their pre-entry experience. Accordingly, they enter the market at larger size, which helps

isolate them from the liability of newness. As a group they are more homogeneous in their growth performance, and have a stronger positive effect on employment than other startups.

An empirical investigation at the level of the entire Danish economy covering close to 30,000 startups created between 1995 and 2006 (22.5 percent of which are spin-offs) finds support for these predictions. When entering the market, spin-offs are larger than other startups. They experience a smaller hazard of exit, and also show less variation in growth rates. Interestingly, while their rate of net job creation is larger (as predicted), this is not because spin-offs grow faster, but because fewer of them exit, which leads to a lower rate of job destruction. Gjerløv-Juel and Dahl illustrate the economic relevance of these differences for the oldest cohorts in their sample, which can be traced for at least eight years. With increasing age, spin-offs account for a consistently increasing share of the total employment created by the new firms. For every 100 spin-offs started, total employment amounts to 211 workers after eight years, while for every 100 other startups, only 134 workers are employed. In the view of Gjerløv-Juel and Dahl, these differences are large enough to think about entrepreneurship policies targeted to spin-offs.

The final chapter by Uwe Cantner on the post-transition economic development of the Jena region has elements of the Frenken-Boschma branching model as well as the spin-off process highlighted by Gjerløv-Juel and Dahl – with a twist, since Cantner's account involves an extraordinary degree of Schumpeterian creative *destruction*. Moreover, one of the most important protagonists in the development studied by Cantner is the firm of Carl Zeiss, which has already provided the empirical context for Markus C. Becker in Chapter 7.

The Jena region has received substantial attention for its ascent after 1989 in popular as well as scholarly literature. Against this background, Cantner first specifies in what sense Jena is really special, referring to a series of empirical studies he conducted with various associates. As Cantner relates, Jena's post-transition record is spectacular not in terms of economic prosperity, but in terms of innovativeness, most notably innovation based on cooperation among local agents. The roots of cooperative innovation are found in the restructuring of the Zeiss firm, which during socialist times had been nationalized and turned into a huge conglomerate (a 'Kombinat') with close to 30,000 employees. The majority of these employees lost their job in the transition process, but they still provided the backbone of the region's post-transition innovative performance – as inventors working in successor firms, scientists in public research, or founders of 'enforced' spin-offs.

Cantner presents evidence from social network analysis showing that

during the post-transition years the regional innovation system in Jena became larger, less fragmented, more centralized, and more strongly oriented to intraregional linkages. The comparatively dense network structure is associated with an increasingly coherent base of technological knowledge. Bilateral cooperation is not very persistent, while being positively associated with labor mobility. These patterns are explained by mutual trust based on sharing a common background at the Zeiss Kombinat.

The regional case study presented by Cantner touches upon several interesting points that may provide new research opportunities where evolutionary economists may successfully leverage earlier evolutionary ideas and concepts. For example, it indicates that not only the transition from entrepreneurial activity to a routine-based firm is a relevant research topic, but also the reverse transition from the firm to entrepreneurial activity. This transition is of course at the center of the research on spin-offs and their regional repercussions. However, spin-offs are mostly studied in the context of young and innovative industries where success breeds success. We know much less about how entrepreneurial activities may contribute to a systematic rejuvenation of obsolete industries, and to structural change in regions and countries where such industries are located. In a more historical perspective, we have observed that Schumpeter's prediction that the corporate R&D laboratory would replace individual entrepreneurship was outlived by the re-emergence of the high-tech startup. However, there is little in terms of a general theory why this would have been the case, and under what conditions yet another transition from a 'Schumpeter Mark I' to a 'Schumpeter Mark II' could be expected. Yet another issue that Cantner touches upon is that during the spin-off juggernaut that Jena experienced after 1989, the corporate culture that Ernst Abbe instilled at the Zeiss firm in the early twentieth century seems to have transcended the corporate boundaries of Zeiss, informing the regional business culture more broadly. This is an indication that individual entrepreneurial leadership may be extremely long-lasting and powerful, which calls for further study by behavioral evolutionary economics.

6 CONCLUDING REMARKS

The chapters collected in this volume can obviously make only limited, selective contributions to the ongoing research agenda of evolutionary economics. They do so each in their own style and with their own focus. Nonetheless, a common message emerges from the set. The intersection of evolutionary economics, behavioral economics, and management is a

rich source of research opportunities. Tapping into this source will enable researchers to find better answers to the questions that (not only evolutionary) economists have long been tackling. Significant progress has already been made; still more can be done in the future.

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