

# Austrian theories of entrepreneurship: Insights from complexity theory

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**Abstract** This paper examines various Austrian theories of entrepreneurship through the lens of complexity theory, more specifically via the concept of a dancing fitness landscape. Problems in many fields (including economics) can be characterized as attempting to find the highest peak on a fitness landscape (which corresponds to an efficient or optimal resource allocation). A rugged fitness landscape is one characterized by many peaks and troughs, while a dancing fitness landscape is one where the peaks and troughs change over time due either to exogenous or endogenous activity. I argue that several key disagreements among Austrian economists can be better understood through the metaphor of a fitness landscape. The implications of this insight for various branches of Austrian economics are also considered. This study is timely as radical Austrian views are starting to percolate into business schools leading to increased debate among management scholars about the precise nature of the entrepreneurial process (Chiles et al. 2007; Sarasvathy and Dew 2008; Alvarez et al. 2010).

**Keywords** Complexity · Entrepreneurship · Prediction · Subjectivism · Natural selection

**JEL Classification** M13 · B52 · B53

## 1 Introduction

Austrian economics has had a major influence on the field of entrepreneurship, much to the surprise of some market process scholars, who see their work as having nothing to say about the secrets of entrepreneurship (Kirzner 2009). Moreover, the work in entrepreneurship seems to draw on different flavors of Austrian economics, with one school drawing on Kirzner's notion of alertness (Shane 2003), another on Schumpeter's creative destruction (Sarasvathy 2008), a third relying on the work of Lachmann (Chiles et al. 2007), and a fourth building on Misesian theories of action (Klein 2008b).

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In turn, these different starting points have generated a good deal of philosophical debate in entrepreneurship on the nature of opportunities and how entrepreneurs should behave to pursue opportunities (Alvarez and Barney 2007, 2010). Unlike economists, entrepreneurship scholars are interested in the micro-implications of their theories rather than the system wide effects on the economy. However, these attempts to resolve differences among theories of entrepreneurship have the potential to provide insights to scholars in Austrian economics.

Recently, complexity theory has been touted as a potential solution to many theoretical disagreements in entrepreneurship (Boland et al. 2014; Phelan 2014). This paper seeks to extend those arguments to inform some of the debates in Austrian economics, around the issues of equilibrium, subjectivism, prediction, and spontaneous order. The device used to achieve these insights is a dancing fitness landscape, where the height of the landscape is a metaphor for the payoff of a particular resource combination. The payoffs are subject to change over time in response to exogenous and endogenous activities creating a dancing fitness landscape shaped by the actions of all agents in the economy. While the payoffs are ontologically objective, the beliefs of entrepreneurs about the payoffs are subjective with the payoff only being realized when action is taken.

Austrian scholars who are committed to finding regularities in the market process and those that see a tradeoff between planned and spontaneous order at the margin will likely see complexity theory as a potential new tool in their methodological arsenal. Those that subscribe to what I refer to as the ‘strong form’ of Austrian economics will have more problems with the approach because of their insistence on spontaneous order in all things. However, even in the most extreme case, I argue there is still common ground between the two perspectives.

In the remainder of paper I lay out the influence that Austrian economics has had on entrepreneurship theory and discuss the debates that have arisen in entrepreneurship about the nature of entrepreneurship and entrepreneurial action. Following this discussion, I introduce the notion of a dancing fitness landscape and explain how it can resolve a number of debates in entrepreneurship that, in turn, has implications for theoretical debates in Austrian economics. The paper concludes with a discussion of the implications of the approach for different flavors of Austrian economics.

## 2 Austrian economics in entrepreneurship

### 2.1 Kirzner/Shane

The Kirznerian notion of alertness has been quite influential in entrepreneurship (Klein and Bylund 2014). This view characterizes the entrepreneur as an arbitrageur who is alert to opportunities to buy low and sell high. From an economy-wide perspective, this process drives markets towards equilibrium. Kirzner’s theory is silent on why one person is more alert than another but anyone with the requisite level of alertness (which may vary by time and place) will be able to exploit a given opportunity. Thus, opportunities are objective

phenomena independent from the entrepreneur available to anyone with the “right stuff”.

A great deal of research in entrepreneurship has attempted to determine the characteristics that make one person more alert than another. A lengthy elaboration on this theme can be found in the work of Shane and his collaborators (Shane and Venkataraman 2000; Eckhardt and Shane 2003; Shane 2003). For Shane, differences in industry experience, education and professional training, cognitive ability, psychological makeup, and demographic background combine to create different levels of entrepreneurial alertness. Furthermore, variations in background create “knowledge corridors” that enable one entrepreneur to see certain opportunities that others do not. An opportunity is thus only visible to someone with the requisite background to perceive the opportunity. Entrepreneurship scholars have also greatly expanded the steps required to make an entrepreneurial profit, claiming that perception is not sufficient and must be accompanied by other processes, such as realization, motivation, and execution (Denrell et al. 2003). These factors vary from person to person and will also determine the relative success of an entrepreneurial act.

These elaborations on the mechanism of alertness surprised Kirzner who, as we have seen, did not intend to make a contribution to entrepreneurship. Rather entrepreneurship served a functional role that moved the economy towards equilibrium. “For Kirzner’s purposes, it doesn’t matter what alertness *is*, only what alertness *does*.” (Klein and Bylund 2014, 271).

## 2.2 Schumpeter/Sarasvathy

Schumpeter’s notion of creative destruction has also been quite influential in entrepreneurship, with Alvarez et al. (2010) claiming a direct intellectual linkage between Schumpeter and the ascendant creation school of entrepreneurship. For a Schumpeterian economist, the entrepreneur is an agent that generates new products, markets, processes, or governance structures that initially create disequilibrium in the economy, which then reverts to equilibrium over time as market prices adjust, usually at a higher level of productivity. This approach can be contrasted with Kirzner who sees the entrepreneur driving the economy towards equilibrium rather than away from equilibrium (although in a later paper, Kirzner (2009) argues that creativity is also a form of arbitrage).

The creation school in entrepreneurship has focused on the process by which novel ideas can be generated and is represented in its most sophisticated form in the work of Sarasvathy (2008). From interviews with successful entrepreneurs, Sarasvathy surmised that creative solutions rarely emerge *de novo*. Instead, entrepreneurs use a process of trial and error to evolve novel solutions over time in a path dependent fashion, a process she refers to by the neologism *effectuation*. Entrepreneurs start by finding profitable uses for the resources at hand then explore new directions as new resources are added and new relationships are formed. For instance, no one involved with Apple Computer in 1977 could have foreseen the size or diversity of Apple in 2014. In this sense, an entrepreneur constructs an opportunity because the means or ends may not be apparent at the start. Opportunities unfold over time.

### 2.3 Lachmann/Chiles

The work of Ludwig Lachmann has also started to gain some traction in the entrepreneurship literature. Lachmann placed plans at the center of his theory of human action, with individual entrepreneurs forming different expectations about the value of capital combinations. Imperfect knowledge causes these plans to diverge and as a result some plans fail. Failed plans, in turn, will need to be revised leading to further adjustments. As these adjustments are continuous rather than episodic the system is constantly in disequilibrium. “Every day the network of production plans is torn, every day it is mended anew” (Lachmann 1947, 13).

Lachmann’s views have been advanced in entrepreneurship by Todd Chiles and his colleagues (Chiles et al. 2007; Chiles et al. 2008). In his most recent work, unsettled with the notion that disequilibrium is often equated with chaos or market anarchy, he proceeds to create a theory of market order in disequilibrium drawing on the radical subjectivism of Lachmann in combination with theories of self-organization, modularity, and empathy (Chiles et al. 2009). In this theory, entrepreneurs use their creativity to imagine novel capital combinations, deploy heterogeneous resources, and build institutions to coordinate the plans of others working in the same space. The result is the emergence of a new order that is qualitatively distinct from the prevailing market structure.

### 2.4 Mises/Klein

For Mises, the study of purposeful human action was the key to understanding the market process. However, he was careful to separate the praxeological from the psychological “The field of our science is human action, not the psychological events which result in an action” (Mises 1949, 11). Humans are assumed to have desired ends and to use the means at their disposal to pursue those ends. Mises is careful to elaborate on the pre-requisites for human action, including: an image of a better state of being, a desire for that state, the belief that one’s actions can create a better state, and knowledge about cause and effect or the actions required to achieve the desired state. He also describes how people are constrained by natural and ideological constraints that shape both their concept of ends and means.

Klein (2008b) has used the Misesian focus on action to question ongoing debates in entrepreneurship on the nature of opportunity. Entrepreneurship scholars have debated whether opportunities exist “out there” waiting to be discovered, or whether opportunities are created through the actions of entrepreneurs without having an independent existence. For Klein, action is real. Presumably some image causes the entrepreneur to act but examining motives is superfluous. Action forces an entrepreneur to use judgment, sell others on the idea, and put resources at risk. Thus, for Klein, entrepreneurship should be the study of entrepreneurial action rather than the pursuit of opportunity.

## 3 Ongoing debates

### 3.1 Subjectivism

There are a number of ongoing debates in the entrepreneurship literature that find a parallel in Austrian scholarship. One such debate surrounds subjectivism. In

entrepreneurship, this debate takes the form of the epistemological status of the entrepreneur and whether an opportunity is “really” out there. At one end of the spectrum is the view that entrepreneurs are able to perceive opportunities because opportunities possess an ontological reality that is accessible by human actors. This is the so-called realist approach, which combines an objectivist epistemology with an ontological realism. However, there is evidence that entrepreneurs will often see a range of different opportunities from a given technological change (Shane 2000). This has led to the embrace of *critical realism*, which admits an ontological reality that can only be imperfectly perceived and thus subject to different interpretations and revisions (Alvarez and Barney 2010).

More recently, the field has started to discuss evolutionary realism, where the market viability provides a test of an entrepreneurial project (Alvarez and Barney 2013). In this view, the success for a new idea will be a function both of the underlying ontological reality and the subjective beliefs of market participants about the product. Evolutionary realism is thus seen as a blend of realist and constructionist positions.

Finally, at the other end of the spectrum are various constructionist positions that see opportunities as created rather than perceived (Chiles et al. 2007; Sarasvathy 2008). For Chiles, the radical subjectivism of Lachmann implies not only a subjectivist epistemology (where no two people can share the same knowledge) but also a constructionist ontology. This flirts dangerously close to relativism and has provoked a sharp reaction from Sarasvathy, who argues that there is an inter-subjective space where people can share knowledge and that the existence of this knowledge suggests an underlying (ontological) reality (Sarasvathy and Dew 2008).

The subjectivist debate has also taken place in the Austrian literature although in less explicit terms. The Kirznerian entrepreneur is alert to opportunities but there is a sense in which the opportunity is objectively available to all. Thus, the proverbial \$10 bill lying on the sidewalk is available to anyone who notices it. Similarly, although the Schumpeterian entrepreneur engages in a creative act, the technological innovation is “known to all sorts of people” and it is the will of the entrepreneur rather than the creation of novelty that drives change (Witt and Foster 1992; Chiles et al. 2007).

Of course, Hayek argues that knowledge varies by time and place (Hayek 1945) suggesting that an omniscient knowledge is not possible. To the degree that people never occupy the same place and time, we must accept that knowledge varies by subject. Mises also adopts the position that future knowledge is uncertain. He argues that praxeological knowledge provides generalities but not certainties about the future and that human understanding, based on the subjective weightings of relevant factors, is the only possibility (Mises 1949). Lachmann, of course, fully embraces the notion of radical subjectivity, arguing that every economic actor will have a unique plan or set of expectations about the future value of a set of resources (Lachmann 1976).

Despite variations in epistemology, most Austrians appear to subscribe to ontological realism. Thus, while different economic actors might possess different scraps of knowledge, all of the knowledge they have is about an independent reality that rewards accurate perception. Recently, Storr (2010) has argued from an Austrian perspective that the market is a social construction that combines objective and subjective reality. For Storr, the market is perceived by economic actors as an objective reality but is ultimately a human construct in the sense that it does not exist independently from humanity. This approach

is very close to the evolutionary realism espoused in the entrepreneurship literature described above.

### 3.2 Prediction/Calculation

Another debate concerns the nature of foresight. In the creation school, little weight is placed on the entrepreneur's ability to plan. Instead, entrepreneurs are encouraged to act first and then allow themselves to be guided by the results using whatever means are at their disposal and acquired during the journey (Sarasvathy 2008). This can be contrasted with the discovery school, which assumes that entrepreneurs are guided by experience to pursue relatively viable opportunities (Shane 2003). The task is then to attract the resources required to execute the plan.

Austrian economics has an ambivalent relationship with the notion of prediction or calculation. On the one hand, central planning is vigorously eschewed in favor of decentralization and the knowledge of time and place (Hayek 1945). However, most flavors of Austrian economics depict the entrepreneur as someone who is able to make accurate predictions about the future. This is true of Kirzner's alert entrepreneur, Schumpeter's willful entrepreneur, Mises' praxeological entrepreneur and Lachmann's plan-based entrepreneur. In fact, both Kirzner and Schumpeter have been criticized because their respective entrepreneurs are infallible – always profiting from their actions (Chiles et al. 2007). On the other hand, both Mises and Lachmann accept that entrepreneurs can make mistakes and need to revise their plans. However, in every case, entrepreneurs are assumed to be successful because of their ability to more accurately predict the future.

An example of this ambivalence can be found in the work of Mises (1949) on human action. For Mises, praxeological knowledge sits between scientific and historical knowledge. Scientific knowledge is characterized as the ability to identify regularities that can be reduced to probability distributions (which he called class probability). Historical cases, although unique events, can be subjected to an analysis of contributing factors, although experts might disagree on the composition and relative contributions of the factors. As a middle case, Mises felt that praxeological knowledge could identify qualitative regularities (e.g., increasing prices will reduce demand but in an unknown quantity). This enabled Mises to present economics as a science of the uncertain, comprised of general principles but lacking specifics.

### 3.3 Spontaneous order

Another area that has generated debate in both fields is the concept of spontaneous order. Austrian economics is much enamored with spontaneous order, the notion that optimal resource allocations can arise through "human action but not human design". The idea has a direct intellectual lineage from Adam Smith's invisible hand through the founder of Austrian economics, Carl Menger, to Friedrich Hayek (Horwitz 2001). In this view, the market is assumed to be too complex for any one group to control. Instead, the localized actions of millions of self-interested economic agents act to allocate resources to their most productive uses.

Nevertheless, the positive outcomes of the market system are acknowledged to take place against the backdrop of institutions, namely "well defined and enforceable private

property rights, freedom of contract and freedom of exchange all protected by the rule of law and embedded in a moral code of behavior that legitimizes these practices” (Boettke 2014, 10). While these institutions are often assumed to have evolved in a bottom up fashion, Austrian economists are beginning to view institutions as not “merely the product of historical accident and force, but instead as genuine products of reflection and choice” (Boettke 2014, 12). In fact, even Menger was alleged to have stated that common law was not superior to made or contrived law simply because you could point to examples of unintended consequences (Boettke 1989).

In entrepreneurship, the creation school exhibits a strong affinity for emergent principles. In effectuation theory, entrepreneurs start with the means available to them to test different conjectures about profit opportunities. As success is realized, the entrepreneur is able to incrementally add resources and relationships to the mix, thus increasing the range and scope of possible activities in ways that were unforeseeable at the start of the process. The resulting organization is a tapestry (or crazy quilt) that bears little or no resemblance to the starting position. The organization is literally co-created (or emerges) from the interactions of its parts over time.

This approach can be contrasted with the design school, which assumes the entrepreneur starts with a clear opportunity in mind and then proceeds to assemble the resources required to achieve the vision (Shane 2003). This approach has more in common with the notion of planned or top-down order in Austrian economics. In this case, it is the venture, rather than the economy, which is actively managed in a certain direction.

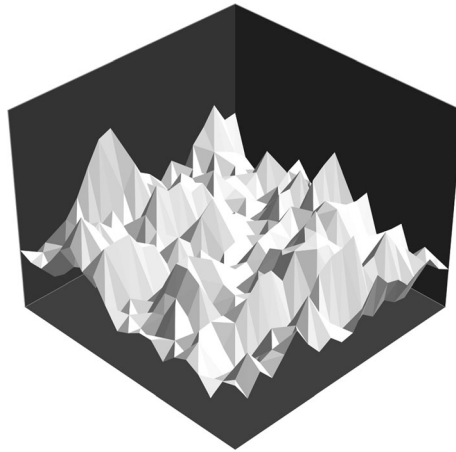
#### 4 Some ideas from complexity theory

The concept of a fitness landscape was first introduced in theoretical biology by Wright (1937) and subsequently applied to physics, computer science, and business (Beinhocker 1999). The height of a given point on a fitness landscape represents the payoff to a given combination of finite elements. Actors in the landscape are assumed to prefer higher payoffs (or peaks) to lower payoffs (or valleys). It is possible to conceptualize the market process as the search for higher peaks on a fitness landscape. In the case of individual entrepreneurs the peaks represent higher personal payoffs, while the peaks in the economy represent more efficient allocations of resources.

A fitness landscape is said to be rugged if it contains many peaks and troughs (see Fig. 1). Although a landscape is usually pictured in three dimensions for expositional purposes, it is actually an  $n+1$  dimensional space, where  $n$  is the number of elements being combined. An NK-model is a theoretical model where the ruggedness of a fitness landscape can be ‘tuned’ (Weinberger 1991; Rivkin 2000; Rivkin and Siggelkow 2003). The ruggedness of a landscape is relevant for search as agents can be trapped on ‘local’ peaks where moving to a global peak involves moving through troughs or valleys of lower fitness.

Time has been incorporated into complexity studies through the notion of a ‘dancing’ fitness landscape, where the actions of various agents cause the landscape to endogenously change over time (Kauffman and Johnsen 1991). Changes in the landscape may also occur due to exogenous forces or shocks. This complicates the search process as the landscape may change over time and there is no guarantee that a





**Fig. 1** A Rugged Fitness Landscape.

perceived opportunity in one time period will still exist at a later time. It also means that the requirements for a successful combination will change over time.

Entrepreneurs are assumed to combine resources or factors of production to form new combinations, some of which will be successful. Several economists have used the term ‘project’ to describe a potentially profitable combination (Casson 1982; Klein 2008b), while entrepreneurists prefer business idea or conjecture (Shane 2012). The set of all possible combinations is unbelievably large, much larger than the number of stars in the universe, or even seconds since the big bang because we are not only talking about the physical proximity of one factor to another but also the way that each factor can be deployed over time or used to yield different services (Lewin and Phelan 2000). For instance, an airliner might be more valuable if allocated to hauling passengers on a New York-Boston route from Monday to Friday but more profitable flying cargo from New York-Los Angeles on a weekend. The number of ways that even a single airliner can be deployed are enormous, let alone the possibilities with a fleet of hundreds of planes. However, only a tiny set of all possible economic projects will be viable and an even smaller set will be profitable.

Of course, we are not aware of all combinations or the likely beneficial (or detrimental) effects of novel combinations. We have certainly not experienced every possible combination nor will we ever do so in ten lifetimes. Thus, we can always be surprised and delighted by novel combinations. Our society has combined resources together in ways that were simply unimaginable for humans from an earlier era. It is in this sense that creating a new combination is bringing something novel or unseen into existence.

#### 4.1 Search on a fitness landscape

The field of complexity science owes much of its existence to the development of agent-based computer models that allow researchers to search for regularities in complex systems (Phelan 1999). Whereas, traditional science posits simple causes for simple outcomes, and general systems theory posits complex causes for complex



outcomes, complexity theory holds that simple interactions between agents seeking to adapt to their environment can create complex outcomes. Much effort, in turn, has been expended in computer science attempting to find algorithms that will enable these agents to locate global optima on different types of fitness landscapes.

The algorithms are usually contrasted with *brute search* (i.e., trying every possibility), which is clearly expensive and time consuming, and *hill climbing*, which involves altering one element at a time and retaining variations that improve performance. While hill climbing is guaranteed to reach a local optimum, it invariably proves ineffective on a rugged fitness landscape, as searchers are unable to cross troughs in the landscape to regions of higher payoff. Search algorithms may thus be evaluated on their effectiveness (ability to achieve a global optimum) and efficiency (the resources required to complete a search). Successful algorithms can then be used to solve problems in a particular domain and perhaps even inform the search strategies of human agents.

In physical, biological and computer sciences, the agents searching the fitness landscape are typically engaged in blind search, that is, they have no ability to perceive the contours of a fitness landscape, thus all search must be guided by feedback. An entrepreneur, on the other hand, may *anticipate* that a particular combination may yield a higher payoff. This is akin to being able to see a higher peak on a fitness landscape. The implications of this property will be explored in greater detail throughout the paper.

## 5 Applying the complexity metaphor to entrepreneurship and economics

### 5.1 Subjectivism

Because the factors of production belong in the physical world, the act of combination is a physical act. When I move an airplane and aircrew from a Boston-Los Angeles route to a Dallas-Phoenix route *real* things *really* move. There is nothing subjective about a new combination.

As we have seen, the literature has been greatly concerned about how evident new combinations are to different individuals. From the perspective of a complexity theorist, these debates can be conceptualized as arguments about the perceptibility of the fitness landscape. If the landscape is visible to all agents then an opportunity is simply the observation that there are higher positions to occupy on the landscape, and the best opportunity is the highest peak. This corresponds well to the notion of *opportunity recognition*, the Kirznerian notion that anyone that bothers to look can recognize an opportunity (Sarasvathy et al. 2010). Of course, given the Austrian dislike of omniscience, later writers have interpreted this to mean that at a given place and time, some entrepreneurs will be more alert than others to opportunities.

Shane's (2003) concept of opportunity discovery corresponds well to this more restricted view. In complexity terms, some agents have a better view of the landscape due to their relative position. Metaphorically, being at the top of a local peak may give you a better view of the surrounding terrain than being in a valley or on some other peak. Different agents will perceive different opportunities and some agents will be more perceptive than others. However, if perception has a limited range, no single agent will be able to see all of the landscape, even when on the highest peak.

The effectual entrepreneur, on the other hand, assumes little knowledge of the landscape at all. The entrepreneur starts at virtually any point on the landscape and then uses feedback to move to areas of higher fitness. Sarasvathy et al. (2010) refer to this as *opportunity creation* but it is clear from our earlier discussion that nothing is being created in the process. It might be more accurate to call this *opportunity revelation* as the fitness landscape is still present but opportunities are not perceptible *ex ante*; revealing themselves over time instead.

The effectuation process thus has a great deal in common with blind search on a fitness landscape. As we have seen, brute search and hill climbing are two techniques that can be used to search complex fitness landscapes but more sophisticated techniques have also been developed. Ultimately, the choice of algorithm will depend on the characteristics of the landscape. In some ways, effectuation represents an algorithm, or perhaps a family of algorithms, for blindly exploring fitness landscapes.

## 5.2 Influences on the business idea

Both fields often portray the entrepreneur as a misunderstood genius who struggles to assemble resources to realize a vision that is unappreciated by the majority. However, to quote Donne, “no man is an island”. As a very human construct, the business idea is subject to a wide range of psychological and sociological influences. Dopfer and Potts (Dopfer and Potts 2007; Dopfer and Potts 2009) have argued that every economic agent is embedded in a micro, meso and macro context that evolves over time.

On the micro-level, every interaction with a stakeholder in the business, including co-founders, employees, investors, customers, partners, associations, and other agencies will influence the entrepreneur’s business idea, possibly taking it in a new direction or confirming existing beliefs. In turn, the actions of the entrepreneur will also influence the belief systems of the stakeholders that come into contact with the business, leading to a co-evolution of micro-institutions, relationships, and beliefs reminiscent of a structurationist approach (Sarason et al. 2006).

At the meso-level, the institutions are typically other firms in the same industry or sector that are using similar combinations of resources and pursuing similar strategies (Hannan and Freeman 1993). The actions of these firms, and their resultant successes and failures, will feed into the business idea of the focal firm, just as the actions of the focal firm will influence the industry. At the macro-level, traditional macro-environmental trends and events, such as the state of the economy, the political system, and social values will also shape the business idea over time and be influenced by the actions of firms.

The business idea must then be in constant flux as all levels of the entrepreneurial system are in constant flux. This has led the Lachmannian branch of Austrian economics to view the economy as a system in constant disequilibrium with no intrinsic tendency towards rest (Lachmann 1976; Chiles 2003; Chiles et al. 2009). Disequilibrium economics is closely related to the concept of a dancing fitness landscape. Chiles (2003) has described this as a kaleidic process, where combinations shift from one pattern to another as the underlying payoffs change.

The process is also intensely subjective. Every entrepreneur will have a different set of interactions with these micro, meso and macro institutions and will bring a different set of demographic, psychological, and experiential attributes to the

situation. The result is that no two entrepreneurs are likely to have exactly the same business idea.

This raises the question of whether entrepreneurs are seeing different parts of the landscape or whether they are looking at the same landscape and seeing different things. In the first case, entrepreneurs have unique knowledge by virtue of their position in place or time. The knowledge is subjective in the sense that it is not shared with others. In the second case, Chiles et al. (2009) has seized on these ‘different ways of seeing’ to argue that some entrepreneurs can inject Schumpeterian novelty into the system because they are able to see new ends and means rather than being limited to recombining existing resources/factors/services.

From a landscape perspective, there are always numerous ways to redeploy resources that have never been tried or even perceived by economic agents. As one set of resources are redeployed to new uses, hitherto unperceived services for old resources may be unlocked. For instance, the invention of the automobile unlocked a new set of services for oil. The fact that no human had perceived the way that oil could facilitate internal combustion does not mean that the latent potential did not exist until it was noticed. I am not prepared to grant the entrepreneur a god like status. The total mass-energy in the universe is fixed so no new resources are ever created. Every new combination uses the existing building blocks of the universe albeit in different and potentially interesting ways. The clay that the entrepreneur uses to mold a venture is the same clay that we all use.

### 5.3 Errors

Another consideration is that the entrepreneur’s perception might simply be wrong. Errors may occur for two reasons. First, because the viability of the project was never a physical possibility, for example seeking to turn lead into gold, or secondly, because the market shifted in the gap between perception and execution leading to an initially accurate perception of profit that inevitably fails during execution. As a society, we would like to avoid the first type of error but if success can only be determined with a market test (i.e., the viability or profitability of a project cannot be determined in advance) then it is practically impossible to distinguish between the two types of errors *ex ante*. However, everything being equal, we would perhaps like to discourage non-viable projects if at all possible.

### 5.4 Prediction

Critics of prediction have focused on humanity’s general inability to predict viability in advance of experimentation (Alvarez and Barney 2013). Indeed, history is full of inventions that were imagined, declared to be impossible, then realized at a later date, human flight being just one storied example. This creation of new means (or ends) lies at the heart of Sarasvathy et al. (2010) conception of opportunity creation, where the means or ends or both are presently unknown.

Clearly there is no sure thing in the complexity world as a global optimum can shift at any time in a dancing fitness landscape as a result of exogenous and endogenous influences. But it is also possible to make educated guesses. The reason that humans

have 99.9 % of their DNA in common is because our genes are finely tuned to our environment. In complexity-speak, humans are clustered around some sort of optimum. We do not know if this is the global optimum but it is definitely better than many other alternatives.

#### *5.4.1 Natural selection*

Natural selection is a form of blind search, where sexual reproduction enables variation on a common theme, which enables a species to explore its local fitness landscape. Mutations enable species to escape local optima and find regions of greater fitness (although most mutations are non-viable). Computer scientists have developed a technique called a 'genetic algorithm' based on the principles of natural selection, to explore theoretical fitness landscapes with some success in complex optimization problems (Goldberg 1989, 2002).

Beinhocker (1999, 2007) has suggested the use of similar principles in business, arguing that business strategy should involve a combination of short jumps (to optimize local performance) and medium-long jumps (to escape local optima and develop capabilities in advance of landscape shifts). Although the number of small jumps should exceed the number of larger jumps, Beinhocker is relatively silent on the exact proportions. Beinhocker's prescriptions are a good example of Misesian praxeological knowledge, which indicates a general solution but admits that the specific determinants are uncertain.

#### *5.4.2 Artificial selection*

It is tempting to conclude that opportunity discovery involves local search (or small jumps) and opportunity creation involves bold leaps into the unknown. However, the discovery school is also arguing that entrepreneurial search is not blind. In biology, such directed search is known as artificial selection (or selective breeding). Dogs are a good illustration of artificial selection. Most breeds of dogs today did not exist a few hundred years ago but within that time humans have managed to produce hundreds of distinct breeds, a result that would have taken natural evolution many thousands of years, if at all.

A number of important points for entrepreneurship can be drawn from artificial selection in biology. First, two animals must be able to reproduce together. Breeders have not spent much time trying to create dog/cat hybrids because those species cannot reproduce together. This did not prevent people from imagining (or attempting) something like a dog/cat hybrid but such attempts were doomed to failure. Second, animals with desirable traits like size, speed, or aggressiveness were mated together by breeders. Although not guaranteed to produce an improvement in the desired trait, over several generations the breeder was usually able to achieve a more desirable result. Third, the desired traits were already present in the population in some way. Breeders did not alter the underlying genes although mutations could always give rise to new traits. The result was a process that accelerated natural selection and nudged the results in desired directions.

Alvarez and Barney (2010) have characterized discovery as some sort of risk management activity (in the Knightian sense) in that a probability can be assigned to

certain courses of action through analyzing trends and collecting market research allowing the use of risk-based decision tools like net present value, real options, and scenario analysis. In practice, it is often exceedingly difficult to assign probabilities of success to novel combinations.

Artificial selection is a different sort of risk-management technique. The purposeful selection of traits limits the search to the most viable part of the landscape. For instance, if you were seeking to produce a purely white dog, you would mate two mostly white dogs in the hope of producing an even whiter dog. You would never mate two black dogs together and hope for a white dog nor would you mate a dog with a cat and hope for a white dog. In this sense, selective breeding combines relatively fit instances together to seek a higher level of fitness. Artificial genetic algorithms also use this technique to accelerate search by weighting the selection of parents on the basis of relative fitness.

It is important to note that this calculation does not involve any sort of probabilistic determination in a Knightian sense. Using a known technology involves an almost 100 % chance of success even if the viability (or fitness) of the resultant combination is uncertain. In this sense, discovery entrepreneurs are advocating the use of praxeological knowledge (Mises 1949).

#### 5.4.3 Regularities

As Mises correctly perceived, the lynchpin of prediction is the ability to identify regularities or patterns in events. Statistical knowledge allows us to aggregate large numbers of past events to form probability distributions that allows us to posit a range of likely outcomes with reasonable certainty. However, the prediction will only be as good as the stability of the generative mechanism (i.e., the fitness landscape) and the homogeneity of the items being studied.

Implicit in the effectuation approach is the view that past data is of no (or limited) use in predicting future market outcomes. Instead, small local experiments should be relied upon. Of course, the theory is still relying on a regularity, namely that the results of the experiment will stay valid into the future. While there is clearly an argument that older regularities may become outdated in high velocity environments, it still remains an empirical question whether rapid sampling on small samples yields more useful results. My suspicion is that a given approach will work better under a particular set of conditions and that no one approach will fit all.

#### 5.5 Spontaneous order

In complexity theory proper, the generative mechanisms are assumed to be agents following simple rules – understand the relevant rules and you can model how a system might evolve. This contrasts with the older systems theory tradition of Hayek and others that tends to see multiple levels of analysis interacting in complex ways that often defied analysis (Phelan 1999). Thus, Hayek sees the market as essentially too complex to be managed. The ascendant school in entrepreneurship, the creation school, also sees the market as essentially unknowable *ex ante*. It then follows that the rules should be allowed to evolve organically. This is akin to a natural selection perspective where

natural variation and selection mechanisms will result in the fitter examples being retained.

There is no doubt that the interaction of different agents in a complex system can cause the fitness landscape to evolve (or dance) in unpredictable ways and produce unexpected results. However, we have also seen how the use of artificial selection can greatly accelerate the process of natural selection. Complexity theorists believe that the rules of the game can be changed in beneficial ways. This has made some economists nervous because of the possibility of unintended consequences (Montgomery 2000). However, as we have seen, anecdotal evidence of unintended consequences should not be used to justify the outright rejection of a potentially useful tool.

One important insight from complexity theory is that variation should stay close to successful models. We have seen how human genomes share 99.9 % of active genetic material. While large leaps are possible (and sometimes necessary), the chances are that variations on existing institutions are most likely to yield sustainable improvements. Thus, a license to create variation is not a license for ‘anything goes’. This holds equally well for those contemplating a new venture as well as those seeking to manage an economy. If anything a policy of limited and cautious experimentation might be warranted.

Another insight is that different institutional regimes can improve outcomes. For instance, complexity theorists were able to demonstrate that dividing a highly interconnected landscape into patches and asking agents to optimize within their own patch produced better global results than asking one agent to optimize for the entire landscape (Kauffman and Macready 1995). This result clearly suggests an emphasis towards decentralization in complex systems. One promise of this work is that economic rules might be tested for unintended outcomes in a simulated economy before being released to the world.

In summary, complexity theory is able to incorporate much of the theoretical apparatus of entrepreneurship and Austrian economics. First, there is a clear distinction between ontology and epistemology. There is a metaphorical landscape (or decision space) that corresponds directly to tangible resource dispositions. Second, agents are assumed to have idiosyncratic (subjective) knowledge about this landscape. Third, economic calculation is difficult, not least because landscapes change over time in response to exogenous and endogenous forces which, in turn forces errors and plan revisions. Finally, in the complexity paradigm, regularities are assumed to exist meaning there are better and worse ways to explore different categories of landscapes. The implications of this position for Austrian economics are discussed in the next section.

## 6 Discussion

The implications of complexity theory for Austrian economics and entrepreneurship can best be explored by dividing Austrian economics into three versions that, in a hat tip to efficient market theorists, I define as its weak, semi-strong, and strong forms. As with efficient market theory, the semi-strong form encompasses all of the assumptions of the weak form but adds additional assumptions, while the strong form embraces the boldest assumptions of all.

### 6.1 The weak form

Adherents to the weak form of Austrian economics maintain that the economic system can only be fully understood with a richer description of the market process, particularly a more realistic model of *homo economicus* (Garcia-Brazales 2002). The neoclassical model, with its hyper-rational, omniscient actors in a state of equilibrium, is replaced with a messier world of subjectivity, uncertainty, disequilibrium, and idiosyncratic knowledge. Austrians contend that these assumptions can explain aspects of the economy that elude neo-classicists, such as the forces towards equilibration and disequilibration, economic progress, failure, and the role of the entrepreneur. As Baumol (2010) and many others have pointed out, the gains from dynamic efficiency swamp the gains from allocative efficiency by several orders of magnitude so these are not trivial issues. Contributors to this stream of thinking include some of the major names in the Austrian school, including Mises, Kirzner, Lachmann (1976), and the early Hayek (1945). They are generally seen as seeking to reform the neoclassical school rather than replace it.

Entrepreneurship scholars have been the beneficiaries of this approach because of the development of a richer understanding of their target area of study, namely the entrepreneur and the entrepreneurial process, and ultimately how to create better entrepreneurs. For economists, like Kirzner, this richer understanding of the entrepreneur is merely an unintended by-product of the quest to understand (and improve) the broader economic system. Thus, the two disciplines are not working at cross-purposes, but rather are concerned with different levels of analysis, one focusing on the individual, the other on the economy.

Interestingly, complexity theory is able to operate at both levels of analysis as agent-based models can be used to test the sufficiency and validity of theories that might otherwise be difficult to test using traditional empirical or mathematical methods. This includes Austrian theories of market process. For instance, as we have seen, Kirzner (1973) argues that alertness is sufficient for a push an economy towards equilibrium. The act of modeling this argument forces the modeler to become very precise about the market processes involved and one realizes quite quickly that simply being alert to opportunities is not sufficient to exploit an opportunity. Klein and Bylund (2014) have defended Kirzner by arguing that he is describing an abstract function not a particular situation and that alertness implies action. However, the demand for greater theoretical precision does lead credence to the entrepreneurship scholars' quest for more detailed explanatory mechanisms.

The default position among Austrian economists is that the current level of abstraction is sufficient for understanding the market process. For instance, (Kirzner 2009, 5) states that:

Not only did my work abstract from the creativity of real-world entrepreneurs, it did not even aim to exploring the roots and the determinants of individual entrepreneurial alertness. Its focus was upon the dynamic competitive-entrepreneurial process driven by such alertness.

The promise of (and challenge for) complexity theory is to demonstrate that a more nuanced model of the entrepreneur can generate novel insights about the operation of



the economy. One potential application is to resolve disagreements within the Austrian school. For instance, the Misesian-inspired Austrians, such as Rothbard and Kirzner, have been critical of Hayekian and Lachmannian formulations because they associate subjectivism with a rejection of an underlying ontological reality and therefore a denial of regularities (Rothbard 1992). However, agents can be constructed that possess Misesian *a-priori* categorizations, Hayekian local knowledge of time and place, and/or Lachmannian subjectivism. The relative merits of each position can then be considered. As argued earlier, the landscape metaphor provides a way to bridge these disagreements and it is likely that all three conceptualizations can co-exist within the same framework. The result is likely to be better theory.

## 6.2 The semi-strong form

The semi-strong version of Austrian economics shares the weak form's concern with market process but also highlights the unintended consequences of human action. This is the world of the invisible hand and spontaneous order, something that Klein (2008a) refers to as Smith-Hayek economics. Self-interested actors interact with market institutions, such as the rule of law and property rights, to create beneficial outcomes for society that were not intended or foreseen by individual economic agents. Interference with this system is seen as fraught with peril because the system is complicated rather than complex. As we have seen, a complex system emerges from the interaction of individual agents following relatively simple rules (Phelan 1999). In theory, it may be possible to identify and manipulate these rules and thus influence the macro-properties of the system (Kilpatrick 2001). A complicated system is one where everything can potentially affect everything else. This is the world of general systems theory, where a butterfly flapping its wings over the Pacific may be the difference between a tornado in Texas or a gentle breeze. A complex (or closed) system has regularities whereas a complicated (or open) system does not (Lewis and Runde 2007).

In the semi-strong version of Austrian economics, the parts of the economy that are complex or complicated are open to debate. One such example is the conversation surrounding an Austrian theory of the firm (Dulbecco and Garrouste 1999; Lewin and Phelan 2000; Foss and Klein 2002; Sautet 2002). The boundaries of a firm occur at the margin where the benefits of scale and fiat authority are offset by the costs of coordination and control. In fact, the story of the modern corporation can be seen as a set of technological and managerial innovations that have pushed the boundaries (and thus the size) of the firm greatly beyond the immediate oversight of its founders or owners. One implication of this line of thought is that the economy is just as reliant on the visible hand as the invisible hand (Chandler 1993). A similar discussion has emerged around the degree to which institutions can be planned or enable economic agents to coordinate plans (Langlois 1992; Lewis and Runde 2007; Boettke 2014).

Fortunately, agent-based models are capable of not only modeling cognitive agents (such as entrepreneurs) but also other elements of the economy, such as institutions (corporations, banks, stock markets, legal rules), institutional agents (policy makers, consumers) and spatial relations (Tsfatsion 2003). It is even possible to model the effects of institutions on the behavior of economic agents, which Lewis (2011) refers to

as ‘downward causation’. In the latter case, methodological individualism is preserved but a wider range of influences can be considered.

A number of interesting questions arise when we accept that the best strategies operate at the margin, often as a function of the type of landscape. For instance, we know that the search strategy on a static landscape will be very different from one on a dancing landscape. All dancing landscapes are not created equal either, with the rate of change determining if one faces a kaleidic or chaotic landscape. In turn, this may affect whether a system is moving towards or away from equilibrium. Similarly, rugged landscapes require very different search strategies than undifferentiated landscapes. Such questions are currently beyond the purview of Austrian theory but each situation requires a qualitatively different approach. As such, while the complexity approach has the potential to provide some additional rigor to verbal argument it also has the ability to extend the scope of current theories.

### 6.3 The strong form

The strong form of Austrian economics goes one step further than the semi-strong version by rejecting marginalism and arguing that all (or almost all) forms of centralized economic planning are detrimental to economic well being and that voluntary exchange is the only way to ensure economic efficiency and political freedom (Hayek 1988; Stringham 2011). In this conceptualization, the best institutions are assumed to have evolved slowly over time without (or in spite of) government intervention. The prescription for economic prosperity is everywhere and always less government and more individual liberty. The economy is always assumed to be complicated (or open) in the sense given above with coercive intervention always leading to unintended (negative) outcomes. These negative outcomes may occur directly (such as when loose monetary policy encourages mal-investment) or indirectly (for instance, when a successful intervention encourages more unproductive interventions). As a result, strong Austrians are deeply suspicious of complexity approaches. While they applaud models that incorporate BRICE features (bounded rationality, rule following, institutions, cognition, and evolution), the reality remains that no model will ever incorporate all of the complexity of the real world and will thus inevitably end up providing misleading advice (Montgomery 2000; Koppl 2006; Rosser 2010).

A few observations are in order. First, Rothbard (1992) has characterized the strong form as “anti-economic” because without regularities there can be no economic science. Second, as we have seen, many Austrians as early as Menger in 1883 and as late as Boettke (2014) accept that planned change can sometimes be beneficial and that organic change can sometimes be detrimental. Third, as technology, population, resources, borders, even fashion have changed over the past 200 years, so have institutions. To hearken back to some golden age is to ignore that fact that, to paraphrase Heraclitus, one cannot step into the same historical context twice (even assuming such a golden age ever existed). Fourth, it is quite naïve to presume that economic agents will not try to improve their condition by tinkering with institutions. Finally, as we have discussed, directed evolution (or artificial selection) can greatly speed up evolution and, as such, may reach results that would take millennia to achieve in an anarchic system.

Even so, it is still possible to find common ground between complexity theory and the strong form of Austrian economics. As we have seen, in the absence of external shocks, the system of institutions that has evolved is likely to be highly efficient, such that any variations should be clustered around existing successful models. It is probably also the case that long-lived, deeply embedded institutions, such as the rule of law, are even more central to prosperity, particularly when they are found to be present in productive economies and absent in less successful economies (Kling and Schulz 2011). However, given the poor track record of economic developers, there is likely to be a complex interplay between institutions so that one can never be sure if an institution is critical (or not) to an economy's success.

The secret to evolutionary success lies in the triple mechanisms of variation, selection, and retention (Hodgson 1997). If we assume that successful innovations will be rapidly copied then the keys are variation and selection. The strong Austrian economist is concerned that there is too much variation in the system. Hopefully, the reader is convinced by now that variation is a beneficial property of economic systems because it allows one to search the fitness landscape to find regions with higher payoffs. Instead, the concern should be that there is not enough selection going on. The real power of the market system is that it places decisions and consequences with the actor. An unsuccessful variation (or experiment) will have negative consequences for an entrepreneur that, in turn, provides a motivation to act prudently and correct mistakes. One of the biggest concerns about totalitarian government is the lack of a market test to reverse adverse policies. In a democracy, there is at least a small opportunity to reverse bad institutional choices. Although the search for more effective ways of culling bad policies continues (Boettke 2014), we should continue to heed Churchill's famous dictum. "Democracy is the worst form of government, except for all those other forms that have been tried from time to time".

## 7 Conclusion

It is not surprising that entrepreneurship scholars and Austrian economists share some common disagreements about key theoretical issues because entrepreneurship theory has drawn so heavily from the Austrian literature. Casting these disagreements in the language of complexity theory, using the metaphor of a dancing fitness landscape, reveals that the differences may not be as significant as some have suggested with a unified theory of the entrepreneur a distinct possibility (Kirzner 2009).

The analysis also revealed that the Austrian reaction to complexity theory is likely to depend on which form of Austrianism was adopted. Agent-based models are capable to testing the sufficiency of various models of the entrepreneur and exploring the efficacy of different models of economic organization and institutional change. This should be attractive to two of the three forms of Austrian economics. While the strong version will probably continue to display an aversion to complexity ideas, there remains some common ground between the two perspectives that may create grounds for a rapprochement.

One of the strengths of the Austrian approach has been a more realistic depiction of the market process and the role of entrepreneurs (Garcia-Brazales 2002). One of its weaknesses has been a disdain for formal methods. Complexity theory allows Austrians

to both build on its strength and counter its critics. This may go some way to altering the perception that Austrians are defined more by what they are against rather than what they support (Langlois 1982). It should also trigger more discussions between Austrian and entrepreneurship scholars, as richer descriptions will be required to build better models.

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