**COMPLEXITY AND AUSTRIAN ECONOMICS**

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**Introduction**

 There is a deep link between complexity economics and Austrian economics, with ideas of complexity foundational in the work of Austrian economics from its generally recognized beginnings in the work of Carl Menger on to the modern day, with F.A. Hayek (1967) being probably the most important carriers of this theme in the school. While many other Austrian economists have also exhibited ideas from complexity theory, Hayek did so more broadly across varieties of complexity ideas, which are numerous, and of course, he is one of the most important of the Austrian economists.[[1]](#footnote-1) More broadly, it would appear that while complexity ideas were important in the founding work of Menger (1871), they became less important in the thinking of the next generation of Austrian economists such as von Wieser (1884) and von Böhm-Bawerk (1888). However, they have become more important since then, with von Mises (1966) exhibiting some interest in these ideas and Hayek becoming increasingly enamored of them as his long career progressed. Today such ideas are quite influential in the work of many Austrian economists (Koppl, 2006, 2009), particularly those involving the the idea of the emergence of spontaneous order in economic systems.

 That interest in these ideas among Austrians has waxed and waned over time suggests that there is a conflict over them within Austrian economics. We must note that this conflict has not been simply one between such developers of Austrian complexity economics as Menger and Hayek in contrast with those less so inclined such as von Böhm-Bawerk, but also within the work of individual Austrian economists. We have already noted that Hayek’s views changed over time to become more sympathetic to such views. We shall also see that such a conflict exists within the work of Menger as well, with him also arguably becoming more favorably inclined later in his life, ironically doing so at a time when other Austrian economists were not so interested in such ideas, including Hayek. We also must note that an element of this conflict involves the issue of mathematics, with most approaches to complexity being quite mathematical, whereas there is a strong tradition within Austrian economics of being critical of most uses of mathematics in economics.

**Varieties of Economic Complexity**

 Obviously any discussion of the relationship between complexity theory and Austrian economics must entail laying out what the relevant parts of complexity theory are for such a discussion. Up front we must confront the simple fact that there are many different ideas regarding what complexity is, with the physicist Seth Lloyd having come up with over 45 definitions of “complexity,” and his list arguably being incomplete.[[2]](#footnote-2) Rosser (2009) offers three levels of considering this question: the meta-complexity level, the dynamic complexity level, and the agent-based complexity level.[[3]](#footnote-3) The first considers the question from the perspective of Lloyd, taking into account the full array of approaches to complexity. The second more specifically emphasizes forms of complexity that are defined by the dynamical patterns of phenomena that they are associated with. The final is a more narrowly defined approach that is nevertheless important now in economics that emphasizes local interactions of heterogeneous agents in systems that are often studied using computer simulations given the difficulty of finding analytical solutions for such systems. Most of these complexity approaches involve mathematical definitions or views of some sort or other. In the spirit of building up a higher order perspective from lower level ones, we shall consider these three in reverse order.

 While agent-based complexity is usually studied by use of computer simulation exercises, the widely accepted beginning of this approach is due to Schelling (1971), who used a go board to simulate the dynamic emergence of racial segregation in urban systems out of initial states of integration. His model involved simply local interactions, with agents having only a slight preference to be located next door to those of the same race as themselves. Even a slight such preference was sufficient to lead to this emergence of segregation over time as agents bought and sold housing and moved over time.

 Arthur, Durlauf, and Lane (1997) offer a useful set of six characteristics that can be associated with this view of complexity, and which also shows up in some of the others as well. The first is that there be dispersed interaction among heterogeneous agents acting locally in some space. This idea has been very appealing to many Austrian economists. The second is that there is no global controller that can exploit all opportunities or interactions, despite the possibility of some weak global interactions. This also appeals to many Austrian economists as it harks back to their historically strong position in the socialist calculation debate that argues for the impossibility of any efficient central planning. The third involves cross-cutting hierarchical organization with tangled relations. This is a theme that is less obvious in earlier Austrian work, although discernible occasionally, but that has become more important in some recent Austrian work such as the entangled political economy ideas of Wagner (2010). The fourth is that of continual adaptation and learning by evolving agents. This has been especially important for those emphasizing the importance of the role of entrepreneurs in economic development, ranging from von Wieser through Schumpeter (1911/1934) and von Mises to Kirzner (1973, 1985). The fifth emphasizes perpetual novelty as new markets, technologies, behaviors, and institutions create new niches in the ecology of the system. This fits closely with the Austrian approaches to entrepreneurship just mentioned, but also brings in more evolutionary views as developed by Menger (1883, 1923) and Hayek (1988). The final aspect emphasizes out-of-equilibrium dynamics with either zero or many equilibria and the system unlikely to be near a global optimum, a world of bounded rationality and unexpected events and processes. This one lies at the heart of differences over complexity within Austrian economics, with many accepting equilibrium approaches, even as more recent Austrians have moved more towards accepting disequilibrium ideas. Also, there is more of a tendency to argue that spontaneous market processes produce desirable outcomes, if not necessarily ones that are “optimal” in the formal sense of Pareto. There are also differences over the degree of rationality involved in economic decisionmaking, although Koppl (2006) has embraced bounded rationality as the “B” in his “BRICE” formulation of complexity Austrian economics.[[4]](#footnote-4)

 The level of dynamic complexity was defined by Day (1994) as involving systems whose dynamic paths fail for endogenous reasons to converge to a point, a limit cycle, or a smooth expansion or contraction. Due to Rosser’s (1999) expansion of this (which he initially labeled as the “big tent” perspective), Velupillai (2011) called this type of complexity “Day-Rosser complexity.” It is known that such systems involve nonlinearities, although not all nonlinear systems will generate such patterns with this generally being a matter of the values of parameters within the system. Curiously this definition is not precisely one of those on the original list of Lloyd, and it has some problems and ambiguities, although certainly being a very important form of complexity within economics.

 One ambiguity involves the matter of what counts as “endogenous” within any system, a long-running point of contention among many economists. In general in a mathematically defined model, or set of equations, those variables are endogenous that are determined by the model itself, with exogenous ones coming from outside the model to impact it. This might be straightforward in mathematics, but in economics there becomes the problem that the model might be viewed as inadequate or incomplete, as failing to describe the real world system. Such an accusation may be more likely to be made when the observer is an Austrian economist, given their history of viewing mathematical models more skeptically than most other economists. However, when such questions are raised by those who take such models seriously, they are often raised with the argument that something being viewed as exogenous is really endogenous when modeled in a way that more accurately reflects reality. Indeed, it is an old saw that “the only truly exogenous factor in the economy is the sun.”[[5]](#footnote-5)

 The other matter of ambiguity involves the matter of which dynamic patterns really count as dynamically complex, even if one accepts that particular model is accurate or relevant. Thus to those preferring to allow more models or systems to be viewed as dynamically complex, any form of endogenous fluctuation is sufficient to constitute dynamic complexity, whereas for others only aperiodic fluctuations count. This is in some sense arbitrary. However, clearly many observers view any sort of endogenously generated fluctuation as being problematic for those within the system. On the other, it must be recognized that as periods of oscillation grow longer more observers will find the system to be difficult to understand and to be more complex somehow. Clearly in such a view aperiodic fluctuations constitute a system that is more difficult to understand.

 In any case, such dynamic complexity has been described by Rosser (1999) as containing within it the “4 Cs” of cybernetics, catastrophe theory, chaos theory, and the agent-based or “small tent” complexity already described above. Few Austrian economists have dealt specifically with either of the middle two, with Lavoie (1989) being an apparent exception, although he did not develop specific models that generated either pattern. However the first of these was very much on the mind of Hayek as he developed his own views on a complexity approach, and he personally approached both Ilya Prigogine of the Free University of Brussels and Hermann Haken of the Stuttgart Institute of Theoretical Physics, both of them physicists associated with cybernetic analysis of physical systems as well as the other Cs of dynamic complexity.[[6]](#footnote-6) He was also influenced by the work of the founder of cybernetics, Norbert Wiener (1948), as well as general systems theorists, Ludwig von Bertalanffy (1968) and Warren Weaver (1948). However, it must be noted that Hayek himself did not develop specifically mathematical models himself that generated such complex dynamics.[[7]](#footnote-7)

 Finally we come to the broader meta-complexity conceptualization that encompasses the full array of possible complexity approaches that have been used in economics. Besides dynamic complexity, leading alternatives include structural complexity (Pryor, 1995), hierarchical complexity (Simon, 1962), and especially computational complexity (Albin, 1982). Regarding the first of these it might be argued that it is not really an example of complexity but rather of the closely related concept of complicatedness. Pryor’s argument boils down to arguing that the US economy is complex because an input-output matrix of it shows many links between sectors that one might not readily understand or know about. The US economy is complicated. But this is not what most definitions of complexity involve, which depend on something more happening, some sort of “the whole is greater than the sum of the parts” element, which can be argued to trace back as far as Aristotle.[[8]](#footnote-8) Israel (2005) argues that complicatedness is an epistemological concept rather than an ontological one, with the two coming from different etymological roots: complexity from the Latin *complecti*, “grasp, comprehend, or embrace,” and complicatedness from the Latin *complicare*, “fold, envelop.” Nevertheless, it must be noted that many have used the terms interchangeably, perhaps most importantly von Neumann (1966).[[9]](#footnote-9)

 Without doubt the most important rival of dynamic complexity as an approach to economic complexity is computational complexity, and it has many advocates who argue that it is a superior approach due to being more well defined and precisely measurable (Markose, 2005; Velupillai, 2009). While dynamic complexity may allow one to distinguish the complex from the non-complex, computational complexity approaches potentially allow one to measure degrees of complexity quantitatively. One problem for those advocating this approach is that there are many different definitions of it, with it being the broad category that includes more of the 45 definitions of Seth Lloyd as candidates than any other broad category of complexity. We shall not discuss all of these here, but note that they are covered in Rosser (2009). Many of them entail measures of how long a computer program will take to solve a problem, with the still-unsolved problem of whether or not polynomial computability (“P”) is the same as exponential or non-polynomial computability (“NP”). Dating in economics to work by Albin (1982) hierarchies of computational complexity are invoked citing Wolfram’s (1984) work using linguistic hierarchies first postulated by Chomsky (1959).[[10]](#footnote-10) At the highest level of computational complexity are programs of infinite length, in short, that never solve the problem. Many of these involve do-loops arising from self-referential paradoxes that are associated with the work in logic on incompleteness due to Gödel, Church, Turing, and others from the 1930s.

 While such a mathematically focused view might seem antithetical to most Austrians, in fact Hayek in particular glommed onto it, even if in a somewhat unrigorous way. He invoked Gödel (1931) in particular in his 1952 book, *The Sensory Order*, which was based on his work in psychology from his experiences doing medicine during World War I. Thus the key to Gödel’s proof fundamentally involved the so-called diagonal method developed earlier by Georg Cantor (1883), which depends on self-referencing, although Hayek applied it to the idea of a mind knowing itself. Thus we have him saying (1952, pp. 188-189):

“Applying the same general principles to the human brain as an apparatus of classification it would appear to mean that, even though we may understand its *modus operandi* in general terms, or, in other words, possess an explanation of the principle on which it operates, we shall never, by any means possess an explanation of the principle on which it operates, we shall never, by any means of the same brain, be able to arrive at a detailed explanation of its working in particular circumstances, or be able to predict what the results of its operations will be. To achieve this would be to require a brain of a higher order of complexity, though it might still be built on the same principles. Such a brain might be able to explain what happens in our brain, but it would in turn be unable fully to explain its own operations, and so on.”

 Koppl (2009) argues that this led to Hayek’s advocacy of using *verstehende* psychology and ultimately a moderately hermeneutic approach to economics (Koppl and Whitman, 2004). Koppl and Rosser (2002) cited Hayek’s invocation of Gödel’s result as providing a deeper entry into the socialist calculation debate by showing the impossibility of a fully knowing central planner. Such a planner would have to know not only the impact of its plans on the economy but also how those impacts would affect its own planning; that is it would have to have a plan of its own planning in the way that a brain might attempt to understand its own thinking. The only way to overcome this impossibility due to incompleteness would be to have a higher order planner, which would in turn face the same problem regarding its own planning, with this problem of knowledge being far profounder than those raised by Hayek (1945) in his more famous essay on the problems of knowledge in the economy, which were also relevant to the socialist calculation debate.

 This line of argument suggests an element of many forms of complexity that the advocates of computational complexity find problematical, even though it is deeply connected to their approach, particularly in the phenomenon of the highest forms of non-computability derived from incompleteness, that is *emergence*, something that Hayek (1967) was also deeply aware of and alluded to as a central issue in his essay on complex phenomena, with many other complexity theorists agreeing with Hayek on this matter. However, even though Hayek adopted some of the computational complexity view, more recent advocates of this view such as Markose and Velupillai argue that emergence is a poorly defined and vague concept, that its vagueness is part of why the more quantitatively precise and rigorous computational approaches are superior to the less well defined dynamic and other complexity views. In turn, advocates of these other approaches invoke the role of emergence in evolution and other processes to defend its usefulness, with Hayek agreeing with this, particularly later in his life (Caldwell, 2004).

**Austrian Complex Economic Emergence**

 It can be argued that emergence is the central complexity concept in Austrian economics. In particular, the idea of the spontaneous emergence of order out of a decentralized but self-organizing economy is seen as a central theme coming down from the Scottish Enlightenment of David Hume, Adam Ferguson, and Adam Smith. This was indeed a foundational argument for the putative founder of the Austrian School, Carl Menger. Thus we have him declaring that the problem of exact research to be to discover (Menger, 1883/1985, p. 148):

“…how institutions which serve the common welfare and are extremely significant for its development come into being without a *common will* directed toward establishing them.”

Vaughn (1994, p. 30) identifies among these “money, law, language, markets, the origin of communities, and of the state itself,” with the most famous example being his analysis of the emergence of the use of commodity money for transactions uses in primitive societies thereby reducing the costs of barter (Menger, 1892). As we shall see below, this emphasis on such spontaneous emergence of order by Menger would be forgotten or downplayed by many of his immediate successors, but it would reappear in the work of Hayek (1948, 1967) who would increasingly stress it in the later years of his career.

 That Hayek identified emergence with complexity became clear in his 1967 essay on complex phenomena as exemplified by the following statement (Hayek, 1967, p. 26):

“The ‘emergence’ of “new” patterns as a result of the increase in the number of elements between which simple relations exist, means that this larger structure as a whole will possess certain general or abstract features which will recur independently of the particular values of the individual data, so long as the general structure (e.g. by an algebraic equation) is preserved.”

 Hayek furthermore cited the long line of “emergentist” thinking that had been going on in Great Britain since the mid-19th century, even as this thread had faded after the 1920s. While as noted above the roots of such ideas can be traced back as far as Aristotle, Hayek fingered Mill (1843) as posing it in what he labeled *heteropathic laws*. Mill saw such laws arising when qualitative changes occur in processes that seem to constitute wholes being greater than the sum of their parts.[[11]](#footnote-11) His initial example came from chemistry, in particular the equation that shows how when methane is combined with oxygen, carbon dioxide and water emerge, a distinct transformation of one pair of entities into two quite different ones.

 Hayek would note that Mill influenced psychologist George Henry Lewes (1875, p. 412) to coin the term “emergence,” defining it as happening when “cooperation of unlike kinds” results in something for which “it cannot be reduced to their sum or difference.” Later such irreducibility would be labeled *strong emergence* (Broad, 1925), with a competing group supporting *weak emergence* where the emphasis would be less on such irreducibility and more on the *novelty* appearing with the newly emergent form (Alexander, 1920; Morgan, 1923). Indeed, the 1920s would be the highwater mark of this British emergentist movement, with the strong emergentist group focusing more on the emergence of mind and the weak emergentist group, particularly C. Lloyd Morgan, focusing on the evolution of higher order species over time. The 1930s would see a backlash against such thinking in both areas as reductionist ideas associated with quantum mechanics and the neo-Darwinan synthesis in evolutionary theory would come to dominate (Rosser, forthcoming). However, for Hayek with his interest in both psychology and evolution, he remained strongly influenced by this movement that was strong in Britain when he first arrived there in the 1920s.

 There is also a substantial literature in philosophy on the nature of emergence involving much debate over various aspects of it. This debate in recent times extends the earlier one over strong versus weak emergence, which really boils down to the question of the relationship between the higher order emergent form and the parts from which it emerged, with the term *supervention* becoming central to the discussion (van Cleve, 1990). This term implies both novelty and also the presence of *downward causation* from the higher emergent order the lower level. Some are skeptical of this, such as Kim (1999), who argue that causation can only flow upwards from the lower level parts to the higher level whole. However, Lewis (2012) argues that in his later writings Hayek saw such downward causation as possible, with the example of the emergence of money as a leading example. Once money emerges in an economy, its presence alters the behavior of the agents and entities operating at the lower micro levels of the economy. As it is the harder line skeptics tend to accept emergence as happening in connection with mind, which as we know was a central concern of Hayek’s in *The Sensory Order*.

 **The Struggle Over Complex Emergence in Menger’s Work**

 To the extent that the debate over the role of complex emergence is an important issue in Austrian economics, this debate can be found within the work of Menger’s own work, although not posed as a debate. Rather it is more a matter of him taking one position in one part of his writing and another position in another part of his writing that he himself may not have seen as being in conflict. It may be only through the lens of us looking back that we see this possible conflict within his work. In any case, his views on this subject played a role in his importance and work being downplayed and even shoved aside later in his career as those not so open to this perspective came to dominate thediscussions in Austrian economics, with the ultimate manifestation of this being the almost embarrassing decision by Hayek not to reprint the posthumously published second edition of Menger’s *Grundsätze der Volkwirtschafslehre* (1923), with only the first edition (1871/1981) being translated into English as *Principles of Economics* (so far).[[12]](#footnote-12) The irony here is that Hayek himself would follow a somewhat similar path, moving from the more orthodox position that had come to dominate Austrian economics in the 1920s to a position more like Menger’s, arguably even more so eventually.

 That Menger played an important role in the development of marginalist neoclassical economic cannot be disputed, even if many will argue that this side of him was not the “real Menger.” The standard view is that the “neoclassical revolution” emphasizing optimizing marginalism within an equilibrium framework was made in the 1870s by three people: Walras in the French language tradition, Jevons in the English language tradition, and Menger in the German language tradition, and there is much truth to this. Indeed, while this diminishes Menger’s role somewhat, Erich Streissler (2001) has argued that Menger represented the culmination of a proto-neoclassical tradition that had been developing for at least 30 years in Germany as represented by such figures as Karl Heinrich Rau, Wilhelm Roscher, and Hermann Gossen[[13]](#footnote-13), which would be crushed in Germany after the political unification in 1870, after which the German Historical School led by von Schmoller would come to dominate and contest with the Austrian School led by Menger. Despite this, Streissler agrees with those who view Menger even in that period as being an “incomplete neoclassical” with a more complicated and historically oriented view than the more theoretical Walras and Jevons, despite his later identification with the theoretical perspective during the *Methodenstreit* between him and von Schmoller in the 1880s and later.[[14]](#footnote-14)

 In any case, Menger certainly had his neoclassical credentials and readily used equilibrium analysis in connection with his development of his version of the theory of marginal utility, which also became the foundation of the later emphasis upon supremacy of subjectivism among Austrian economists. Thus he wrote of prices as “symptoms of an economic equilibrium between the economies of individuals” (Menger, 1871/1981, p. 191). His emphasis upon equilibrium even in the midst of dynamic historical processes involving technological change and the invention of new products can be seen in the following (Menger, 1871/1981, p. 188):

“The foundations for economic exchanges are constantly changing, and we therefore observe the phenomenon of a perpetual succession of exchange transactions. But even in this chain of transactions we can, by observing closely, find points of rest at particular times, for particular persons, and with particular kinds of goods. At these points of rest, no exchange of goods takes place because an economic limit to exchange had already been reached.”

While this fits with many views of equilibrium, it can be contrasted with that of Walras (1874) in that for Menger transactions and activity actually occur out of equilibrium and come to a halt when equilibrium is reached, whereas for Walras nothing happens until the auctioneer gets prices to their equilibrium levels (and a general equilibrium at that of all markets) through repeated rounds of tâtonnement. For Menger the economy is a dynamic process mostly out of equilibrium, whereas for Walras it is in equilibrium that the most important economic activities occur.

 In addition to his development of marginal utility theory and his occasional use of the equilibrium concept, Vaughn (1994, p. 14) argues that he laid the theoretical groundwork for his follower, von Wieser (1884), to develop the concept of opportunity cost, one of the most recognized of Austrian contributions to standard neoclassical theory. Furthermore, he is seen as having provided a foundation for determining imputed factor prices. Certainly Menger deserves his position in the neoclassical pantheon, particularly after his defense of theory in the *Methodenstreit.*

 In any case, the conventional history of thought view of Menger exaggerates this side of Menger while ignoring his non-neoclassical side, the side that influences current Austrian economics. Careful examination of the *Methodenstreit* shows that Menger was much closer to the German Historical School in his views in many ways than has been thought (Vaughn, 1994; Caldwell, 2004; Becchio, forthcoming a, b). He had dedicated his *Principles* of 1871 to his friend, Wilhelm Roscher, the founder of the “old German Historical School,” and he viewed his work as providing organizational principles for studying historical processes. Besides being political after the unification of Germany, the conflict appears to have been intensely personal, with Menger hoping to find the good relations with von Schmoller, the successor to Roscher that he had with Roscher, only to be disappointed in this, with Menger and von Schmoller emphasizing their differences after the conflict exploded in the 1880s. Later followers of Menger such as Hayek would tend to focus on the differences in the conflict rather than the many areas of agreement between Menger and von Schmoller.

 While indeed Menger emphasized methodological individualism, he also recognized a role for groups in the historical process, with this arising from his subjectivist analysis of needs, which was tied to his advocacy of marginal utility theory. This recognition of the role of groups became stronger as Menger aged and appeared more clearly in the semi-suppressed second edition of his *Principles*. Becchio (forthcoming a) particularly emphasizes how an expanded view of needs led him to recognize two different categories beyond strictly individualistic needs, social needs. One of these was collective goods (*Gemeinbedüfnisse*) such as transportation infrastructure. Such needs still came from individuals themselves, but in the form of adding up individual demands with some scale issue involved that involves production not by an individual. This was already present in his early work.

 However, in his second edition he extended this by introducing “human associations” that could as groups have needs that needed to be provided to the association as a whole that could even have an independent life (‘*ein selbständiges Leben*’) with their own personality (‘*Eigene Persönlichkeit*’) following their own purposes (‘*Eigene Zwecke*’) (Menger, 1923, p. 9). These human associations could take the form of “societies, associations, corporations, communities, and the State, of the national or global economy” (‘*Gesellschaften, Genossenschaften, Korporationen, Gemeinden, Staat, Volks- und Weltwirtschaft*’) (Menger, 1923, p. 7). Furthermore, as argued by Becchio (forthcoming b), in this second edition Menger introduced evolutionary arguments drawing both on the work of Herbert Spencer (1867-1874) and also the emergentist arguments popular in the 1920s, although he tended to go back to Mill’s (1843) formulation in terms of heteropathic laws. Nevertheless, in this final work Menger posed his view of the spontaneous emergence of order in terms of evolutionary emergence that included the possibility of such processes occurring for social groups or associations as well as just individuals. It is not surprising then that Hayek in his early career was not eager to publicize such views, even as he arguably moved toward them himself later in his life, in that regard following Menger’s path.

**The Debate After Menger**

 While Menger would move more toward a position supporting ideas of evolution of institutions and associations that spontaneously emerge from lower level structures, the generation after him of Austrian economists tended to move in the opposite direction towards emphasizing the marginalist neoclassical equilibrium side of the founder of the Austrian School’s work.[[15]](#footnote-15) The leaders of the next wave of Austrians were Friedrich von Wieser and Eugen von Böhm-Bawerk. Of the two von Wieser adopted more of the dynamic emergent views of Menger than did von Böhm-Bawerk. A part of Menger’s vision was that of economic progress manifesting itself through increasing division of labor associated with newer and more complicated products. Von Wieser picked up on this and highlighted the role of the entrepreneur in this process, an emphasis picked up by two of his most important students, Joseph A. Schumpeter and Ludwig von Mises, which continues to the present as a major theme of Austrian economics. He was also a deep student of evolutionist Herbert Spencer like the older Carl Menger.

 On the other hand von Wieser may have been the most important figure emphasizing and codifying the association between Menger and the neoclassical school in the eyes of most observers. He was the person who coined the term “marginal utility” (in German, “*Grenznutzen*”). He formalized the concept of opportunity cost and also explicitly drew out the imputation of factor values implicit in the analysis of Menger. He also identified Menger with the other founders of neoclassical marginalism, Walras and Jevons, also bringing in Gossen, while arguing that Menger’s version of the idea and of equilibrium was superior to theirs because of his developing it verbally rather than mathematically, thus advancing the anti-mathematical tradition within the Austrian tradition (Menger, 1883/1985). He would also introduce the theme of information and the need for market-determined prices as part of a critique of the possibility of socialist planning (von Wieser, 1914/1927). Indeed, he may have been more responsible than anyone else in establishing Menger’s reputation as an orthodox marginalist neoclassical economist.

 Von Wieser’s brother-in-law, Eugen von Böhm-Bawerk, would become perhaps the most resolutely orthodox of all leading Austrian economists, even causing Menger to complain about some of his ideas, such as his reintroduction of Ricardian elements in his theory of capital and interest (Schumpeter, 1954, p. 847). He developed a theory of essentially homogeneous capital associated with his average period of production measure as a measure of capital (von Böhm-Bawerk, 1888/1959), which would lead to Hayek’s critique of him in his 1941, *The Pure Theory of Capital*.[[16]](#footnote-16) This argument would form the basis of his critique of the Marxian argument that capital is not an independent source of value (von Böhm-Bawerk, 1896/1949) along with a subjectivist emphasis on the importance of marginal utility in the determination of value. He would also assert the neoclassical credentials of Menger, and this observer can find nothing in his work that can be identified with a complexity perspective at all. He was the most neoclassical of all Austrian economists, and his influence would remain strong among the followers of the school for a long time after his death in 1914.

 The leader of the next generation of Austrians would move somewhat back toward being somewhere between the conventional equilibrium perspective and dynamic complexity view, Ludwig von Mises. He would remain under the neoclassical influence of the previous generation of Austrian economists, initially expressed in his 1912/1980 *Money and* Credit, but moved somewhat away from it in later works such as *Socialism* (1922/1981) and *Human Action* (1966). Two aspects of his thinking remained more neoclassical. One was his continued adherence to an equilibrium approach and the other was his adherence to a subjectivist and rationalist *a priorism*, a point that Hayek would later draw away from when he moved more into an approach of evolutionary emergent complexity. For von Mises he posited three different forms of equilibrium: a “plain state of rest” essentially very short run, a “final state of rest” towards which an economy without shocks would tend to converge in the long run, and theessentially steady-state “evenly rotating economy” (Vaughn, 1994, pp. 81-82). However, it must be noted that for von Mises, with the possible exception of the first, these were essentially imaginary theoretical constructs that do not occur in the real world economy. This would be because in the real world the market process is dominated by the ongoing dynamics induced by entrepreneurs, following on the influence of von Wieser and continuing in such followers as Kirzner (1973, 1985).

 His strongest assertions of the importance of the dynamic market process driven by technologically innovative entrepreneurs arose from his role in the socialist calculation debate. While his initial essay on the topic in 1920/1935 arguably emphasized static equilibrium arguments in its emphasis on the inability of the central socialist planner to be able to determine efficient equilibrium prices without private markets, his expanded arguments in 1922 in his book, *Socialism*, highlighted this more dynamic issue, emphasizing the technological dynamism of market capitalism driven by entrepreneurs and “speculators” in contrast with a tendency to stagnation inherent in a centrally planned socialist economy that lacked the profit incentive arising from private ownership of the means of production. As he put it (von Mises, 1922/1981, p. 142):

“To assume stationary economic conditions is a theoretical expedient and not an attempt to describe reality.”

Nevertheless, in contrast with Hayek and many later Austrian economists, he never stressed such concepts as the spontaneous emergence of order or evolutionary processes, with these implicit in the dynamics of the competitive market process as emphasized by Kirzner.

**Hayek’s Journey and the Later Development of Austrian Complexity Views**

 To a substantial degree we have already laid out the general pattern of Hayek’s trajectory of thought on this matter as documented definitively by Caldwell (2004) from an early more neoclassical position following the early von Mises in such works as his 1933/1966 *Monetary Theory and the Trade Cycle* through later works that would emphasize the spontaneous emergence of order such as his 1948 *Individualism and Economic Order* to those emphasizing the role of evolution, even at the group level, such his final work his 1988 *The Fatal Conceit*. We have already noted in this regard the irony of his having helped suppress early in his career the second edition of Menger’s *Principles*, only to move towards that view in the later stages of his career.

 There remains an unresolved debate regarding the extent to which Hayek’s change of views was gradual or constituted a sharp break, with Birner (1994) arguing for the first view and Hutchison (1992) the second. Caldwell comes down somewhere in between, accepting that indeed there was a “U-turn” in Hayek’s views, but that he only gradually developed this over time. Its first appearance was in his 1937/1948 essay on “Economics and Knowledge,”[[17]](#footnote-17) a part of his contribution to the socialist calculation debate, which contained an implicit criticism the a priorism view of von Mises, which he would only more clearly

 As noted earlier his ideas on emergent complexity gradually emerged from his 1948 book through his 1952 *The Sensory Order* and reaching a clear explication in his 1967 essay on complexity. His views on evolution, particularly that at the group level, developed somewhat more slowly (Hayek, 1979). It is thus somewhat curious that one of the last ideas of the old neoclassical orthodoxy that he let go of was that of equilibrium, really only doing so in a little known essay in 1981. Thus we have the following strong statement (Hayek, 1981, p. 8):

“It is tempting to describe an ‘equilibrium’ an ideal state of affairs in which the intentions of all participants precisely match and each will find a partner willing to enter into the intended transaction. But because for all capitalistic production there must exist a considerable interval of time between the beginning of a process and its various later stages, the achievement of an equilibrium is strictly impossible. Indeed, in the literal sense, *a stream can never be in equilibrium*, because it is disequilibrium which keeps it flowing and determining its directions. Even an apparent momentary state of balance in which everybody succeeds in selling or buying what he intended may be *inherently* unrepeatable irrespective of any change in the external data, because of the constituents of the stream will be the results of past conditions which have changed long ago.”

 Given Hayek’s ultimate prominence in Austrian economics, particularly following his receipt of the Nobel Prize in 1974, his views on these matters have led to an enormous amount of influence on current views among Austrian economists across most of the divides that exist within the school over the role of government, degrees of subjectivism and a priorism. Even as many continue to emphasize the importance of rationality and equilibrium efficiency, such as Boettke (2012) who emphasizes the continuity he sees in the “mainline” of economics stretching from the Scottish Englightenment to the modern Austrian School through a considerable number of strongly neoclassical economists in between, economies from market processes, even if they do not go along fully with all of the evolutionary ideas that one finds in the later work of Menger and Hayek. Among those adopting such a view, at least partly under the influence of Hayek, arguably include Shackle (1972), Loasby (1976), O’Driscoll and Rizzo (1985), Lachmann (1986), Lavoie (1989, 1990), Horwitz (1992), Vaughn (1999), Koppl (2006, 2009), and Wagner (2010). At least to some degree, the idea of complex emergence in some form or other has entered deeply into the corpus of modern Austrian economic thought.

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1. There is an ongoing debate over whether Ludwig von Mises or his student, Friedrich A. Hayek is the most important Austrian economist. This essay will make no effort to assess this matter. One can note that Hayek is the only Austrian economist so far to win the Swedish Bank Prize in Economic Sciences in Memory of Alfred Nobel, but this does not establish his superiority to von Mises as the latter died fairly shortly after the prize was established. [↑](#footnote-ref-1)
2. For Lloyd’s list as of the late 1990s, see Horgan (1997, Chap. 11). Many of his definitions are variations on each other that can be grouped together into a smaller set of groups. [↑](#footnote-ref-2)
3. Rosser (1999) initially labeled this form of complexity to be “small-tent” in contrast to “big tent” views that involved other forms of complexity. While that terminology became somewhat widespread, I have since shifted to my current usage, which is more descriptive of what is involved and avoids hints of apparent disapprobation that some found in this earlier terminology. [↑](#footnote-ref-3)
4. In Koppl’s formulation of BRICE, the B is bounded rationality, the R is rule following, the I is institutions, the C is cognition, and the E is evolution. Rosser (2010) provides a critical discussion of Koppl’s approach. [↑](#footnote-ref-4)
5. This observer has heard William A. (“Buz”) Brock make this remark on several occasions, although it is highly likely that it predates him. [↑](#footnote-ref-5)
6. Rosser learned of Hayek’s approach to the Brussels School from Peter M. Allen, a student of Prigogine’s, and of his approach to Haken, the founder of synergetics theory, from Haken himself, both from personal conversations. [↑](#footnote-ref-6)
7. While Hayek was only indirectly mathematical himself, Vriend (2002) sees him as a forerunner of modern agent-based computational economics. [↑](#footnote-ref-7)
8. “The totality is not, as it were, a mere heap, but the whole is something besides the parts.” Aristotle, *Metaphysics*, Book H 1054a, 8-10. [↑](#footnote-ref-8)
9. Indeed, it is probably the case that if one pushes the etymological origins further back to proto-Indo-European the two Latin words will ultimately come from a common origin. Rosser (2004) argues that the epistemological problems associated with mere complicatedness are essentially trivial, simply a matter of figuring out parts and their linkages without any special interactions between these parts that ontologically alter the nature of the system. [↑](#footnote-ref-9)
10. We note that Velupillai (2000) distinguishes between computational economics and his own neologized *computable economics*. Whereas the former studies essentially mechanical issues of how to make programs shorter or more efficient to solve given problems, the latter studies such deeper issues as the nature of computability and when problems are solvable at all. [↑](#footnote-ref-10)
11. Lewis (2012) sees Mill’s view as close to that of Hegel (1842) who spoke of quantitative changes bringing about qualitative changes, with the changing of the states of water at different temperatures the canonical example, with such changes now being labeled “phase transitions” in modern chemistry and physics. See also Rosser (2012) for further discussion. [↑](#footnote-ref-11)
12. For discussion of the treatment of Menger’s second edition, see Becchio (forthcoming a, b). She notes that Karl Polanyi (1971) complained about this decision of Hayek’s, charging almost a conspiracy theory to silence Menger’s views, although she argues that Polanyi misinterprets Menger as wanting to embed economics into a broader social-historical perspective that would have gone further than Menger’s view. [↑](#footnote-ref-12)
13. Rau would be the first to draw supply and demand curves in a space with price on the vertical axis as is done within the English language tradition following Marshall. Roscher is often viewed as von Schmoller’s predecessor in the Historical School, but had a more independent perspective, including personal friendship with Menger. Gossen independently developed the theory of marginal utility in 1854, but apparently Menger was unaware of this work when he developed his own version of it. [↑](#footnote-ref-13)
14. There was a political element to this conflict due to the continuing independence of Austria from Germany, with von Schmoller coining the label “Austrian School” initially as a term of contempt. [↑](#footnote-ref-14)
15. For a discussion on just how marginalist the early Austrians were see Streissler (1972), who perhaps appropriately enough long held the Carl Menger Chair in Economics at the University of Vienna. [↑](#footnote-ref-15)
16. In this critique Hayek noted the problems arising for this measure in a world of heterogeneous capital, with some of these problems foreshadowing the later critiques made during the Cambridge controversies in the theory of capital (Harcourt, 1972), with Garrison (2001) following up on these issues within an Austrian framework. [↑](#footnote-ref-16)
17. This essay was only published in Hayek (1948). [↑](#footnote-ref-17)