



A macro economy as an ecology of plans

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ABSTRACT

Standard macro theories reflect a choice-theoretic orientation wherein aggregate variables are treated as acting directly on one another. Macro phenomena are thus reduced to the same order of simplicity as micro phenomena; macro variables differ from micro variables only by their larger size. In contrast, this paper treats the relationship between micro and macro as non-scalable. Macro phenomena emerge through micro interaction and are of a higher order of complexity than micro phenomena. Rather than reducing macro to micro through scalar multiplication, macro phenomena supervene on micro interaction and are not themselves objects of direct action. A macro economy is treated as a complex ecology of plans that constitute a non-equilibrium process of spontaneous ordering.

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1. Introduction

One notable feature of Snowden and Vane's (2005) "schools of thought" survey of macro theory is that the controversies among the theorists they examine resembles a family feud. Despite numerous particular differences among those theorists, they all operate under the shared presumption that macro phenomena are scaled-up versions of micro phenomena: macro is micro addressed in a loud voice. Where micro theory refers to demand and supply functions for individual services, macro theory refers to demand and supply functions for output as a whole. Just as a firm is characterized by a production function, so too is the aggregate of firms. Where a firm's plan of production can be altered through shocks to supply or demand, so too can aggregate output. Macro theory looks pretty much the same as micro theory, as Leijonhufvud (1973) notes in his comparison of the totems of micro and macro theories.

The distinction between macro and micro theory is generally thought to correspond to the distinction between a whole and its parts. This paper likewise treats the micro–macro relationship as one of parts-to-whole. If macro is just a scaled up version of micro, macro phenomena must be equally simple and apprehensible as micro phenomena. This paper parts company with such macro theorizing by treating the relationship between micro and macro as non-scalable, with this

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Table 1

Contrasting macro-theoretic frameworks.

| Choice theoretic (DSGE) | Emergent theoretic |
|-----------------------------|--------------------------------|
| Equilibrium states | Emergent ecologies |
| Reduction of macro to micro | Supervention of macro on micro |
| Society as placid parade | Society as turbulent crowd |
| Macro as simple phenomena | Macro as complex phenomena |
| Separated political economy | Knotted political economy |
| Prediction/policy advocacy | Understanding/explanation |

alternative treatment bringing several analytical possibilities into play. The relationship between micro and macro is no longer a simple matter of aggregation, recognizing also that aggregation is impossible in the presence of heterogeneity in any case (Stoker, 1993; Hartley, 1997, pp. 132–146). This paper approaches non-scalability by treating a macro economy as an ecology of plans. Micro entities form plans and act on them. A macro economy, however, is not an aggregate of plans but is an ecology of plans.

The difference between an aggregate and an ecology resides in unplanned and unintended interactions among plans that are part of the ecology and which are absent in the aggregate. An aggregate is of the same order of complexity as the entities that comprise the aggregate; an ecology is of a higher order of complexity than the entities that comprise the ecology due to interactions among the elements of the ecology. Within an ecology, the same micro units can generate different macro patterns in response to different patterns of connection among the micro units. With a macro economy as an ecology of plans, the macro characteristics of the ecology emerge through interaction among micro units and their plans of action. Macro phenomena have qualities that are not contained within each of the micro units that comprise the ecology. Read (1958) explains that no single individual knows how even to make a pencil. The ability to produce pencils is a macro-level quality that emerges out of micro-level interaction. The knowledge required to make pencils is distributed among persons and embodied in organizational practices and institutional arrangements.

Within an emergent or ecological orientation, there is no reduction of macro to micro through basing theories on averages or representative agents, thus avoiding the situation identified by Kirman (1992). Outliers have significant analytical work to do when the characteristics of the population of interacting agents cannot be reduced to a typical or representative interaction. As Hoover (2001, p. 74) puts it: “The macroeconomy supervenes on the microeconomy but is not reducible to it.” To theorize about macro phenomena is to theorize about objects that emerge through interaction among entities at the micro level of action. In consequence, the macro level is the arena of spontaneous ordering and unseen hands while the micro level is the locus of intentional planning and action. A macro economy is thus a complex ecology of evolving plans that constitute a non-equilibrium (Katzner, 1998) process of spontaneous ordering.

This paper explores how emergent-style theorizing might be brought to bear on the macro-theoretic concern with an economy in its entirety. The paper starts by contrasting the standard choice-theoretic or Dynamic Stochastic General Equilibrium (DSGE) framework for macro with the emergent-theoretic framework that is adumbrated here. The emergent-theoretic framework replaces the postulate that observations pertain to equilibrium states with the presumption that societal orderliness is always incomplete and is subject continually to evolutionary development through the emergence of new phenomena within a complex ecology of plans. Within this alternative framework, macro phenomena emerge out of or supervene on interactions among micro units within the ecology of plans that constitute an economy. After exploring some methodological matters pertinent to this contrast between macro frameworks, the remainder of the paper proceeds by presenting a set of topics where the emergent framework leads into different analytical territory from where the choice-theoretic framework leads. This perusal of topics bears a family resemblance to Schelling's (1978) treatment of the relation between micro-level actions and macro-level results of interaction and to Young's (1998) examination of how interaction among individuals generates the emergence of institutional arrangements. Indeed, the emergent-theoretic framework pursued here locates institutional arrangements and not resource allocations as the prime objects of macro-theoretic analysis, similar to Rosenberg's (1960) treatment of the *Wealth of Nations* as being centered on institutional arrangements and not on resource allocations.

2. A fork in the theoretical road

The world appears to us as generally but not universally orderly. The reasonableness of that appearance is attested by our ability to pursue deliberate action in the world with reasonable success. Not complete success to be sure, because reality also comes with turbulence that sometimes sinks well laid plans. The perception of orderliness provides the point of departure for social theorizing, for without a sense of societal orderliness there would be no object to theorize about. That point of departure, however, presents a fork in the theoretical road concerning the character of the theoretical relation between micro parts and macro whole.

The relationship between micro and macro is the province of the micro foundations of macro theory (Janssen, 1993; Horwitz, 2000). Table 1 presents a six-point contrast between choice-theoretic and emergent-theoretic frameworks for constructing a macro theory that is based on micro-theoretic foundations. There is, of course, significant variation among proponents of the DSGE framework. Where some proponents of that framework take a suitable micro foundation to be

the theory of perfect competition and its Pareto efficiency, other proponents embrace a micro foundation of imperfect competition and its Pareto inefficiency. Such variation, however, is superficial and resembles a family feud in that the commonalities among the disputants dominate the differences when contrasted against the emergent-theoretic framework.

First, proponents of the choice-theoretic orientation treat macro observations as representing equilibrium states to be analyzed through comparative statics. In contrast, the emergent-theoretic orientation is non-equilibrium in character, as illustrated by [Shackle \(1974\)](#) and [Katzner \(1998\)](#) which, it should be noted, is not a disequilibrium framework. It is rather a framework that starts from the common sense observation that life faces us with both persistence and turbulence. These are both features of an ecology of plans: at any instant many plans are continuing without change while yet other plans are being introduced, and with some of those inducing future changes, including abandonment, of presently continuing plans. Regularity in society does not require equilibrium; it requires only that the social world be intelligible, which is consistent with the continual injection of change into society through the introduction, revision, and abandonment of plans. Within a macro ecology of plans, moreover, there will generally be discernable statistical relationships among macro-level variables that are a facet of the intelligibility of the social world.

Systemic equilibrium portends placidity and not turbulence. To get turbulence from postulated equilibrium requires the insertion of exogenous shocks. Even then, however, the turbulence is purely notional because it is just a place holder within the model to indicate that a new equilibrium will be obtained and can be apprehended via comparative statics. Turbulence is brought in through a *deus ex machina* rather than being treated as an intelligible feature of the ecology of plans that are in play inside a society. In contrast, turbulence is a normal feature of most ecologies, including the ecology of plans that comprises a society ([Louçã, 1997](#); [Potts, 2000](#)). Within a framework of limited and divided knowledge, plans are never formed in full knowledge of all other plans and the implications of those plans for the plan in question. For the plan in question, these other plans will act as exogenous shocks. But they are not truly exogenous shocks because they are a normal feature of the ecology of plans. For an individual the rest of the world presents mostly a parade of exogenous shocks, but for the world as a whole those are not shocks but merely internally generated turbulence through collisions among plans.

To treat both orderliness and turbulence as properties of the life of the ecology of plans that constitutes a macro economy requires that we follow the emergent-theoretic branch of that analytical fork, which seeks to explain the emergence or generation of orderliness instead of postulating it as an analytical point of departure. An emergent analytical framework would seek to explain macro coordination as something that arises through interaction among non-coordinated entities,² and would reflect a bottom-up orientation toward macro theorizing as illustrated by [De Grauwe \(2010\)](#). Coordination would thus be a variable quality of societal processes and not a maintained hypothesis to guide theoretical effort, as illustrated, for instance, in the generative style of theorizing conveyed in [Axtell and Epstein \(1996\)](#) and in the essays collected in [Epstein \(2006\)](#).

Second, the choice-theoretic presumption that observations pertain to equilibrium states allows reduction of macro to micro. As [Hoover \(1998, p. 87\)](#) notes, this reduction allows “the euthanasia of macroeconomics.” Within this analytical framework, the structure of micro relationships has no work to do because the presumption of equilibrium converts that structure into mere background. By contrast, the reduction of macro to micro is impossible within the emergent-theoretic framework. Macro phenomena supervene on and emerge out of micro-level interactions, as [Hoover \(2001\)](#) notes in an economic context and [Kim \(1993\)](#) examines philosophically. In this manner the entire population of micro agents, along with the patterns by which they are connected, and not just some measure of central tendency, is relevant for the macro-level properties of the emergent order. The relation between micro and macro is neither reductionist nor holistic, as [McQuade and Butos \(2009\)](#) explain in their treatment of adaptive systems. Causation runs in both directions, so it is reasonable to speak of macro foundations for micro as well as speaking of micro foundations for macro ([Smithin, 2004](#); [Wagner, 2010](#)). Robinson Crusoe, for instance, has neither property rights nor engages in contractual relationships. Property and contract are macro-level phenomena that emerge through interaction among multiple Crusoes, and at the same time these emergent institutions influence the pattern of micro-level activity.

Central to the supervenience of macro observations on micro interaction is recognition of distinct levels of phenomena as against treating all phenomena as residing on the same theoretical plane. [Resnick's \(1994\)](#) computational analysis of a traffic jam illustrates the analytical distinction nicely. Suppose the cars entering a highway follow the simple rule of driving as fast as they can until they are three car lengths behind the car in front of them, at which time they maintain that distance. If, within this steady stream of traffic, one car slows down momentarily, the following cars will likewise slow down and a traffic jam will form. The traffic jam is an object that is distinct from the individual cars that constitute the jam. A sequence of photographs, moreover, would show the traffic jam to be moving backwards. Yet it would not be accurate to describe the traffic jam as a gigantic car that is moving backward. No car ever moves backward. The traffic jam is a distinct object that supervenes on the cars that constitute the jam. It is this quality of emergence and supervenience that comes into play in treating a macro economy as an ecology of plans. A central feature of that ecology, as any ecology, is the emergence of phenomena with qualities that are not reducible to qualities possessed by the micro units that constitute the ecology.

Third, the difference between the choice-theoretic and emergent-theoretic orientations can be summarized with reference to two distinct types of orderly social configuration: a parade and a crowd of pedestrians passing through a piazza.

² In a related vein, [Latour \(2005\)](#) objects to forms of social theorizing that explain social phenomena in terms of other social phenomena; he argues instead that social phenomena should be explained as emerging out of interaction among non-social phenomena.

Both of these configurations are orderly in that people can act intelligibly within each configuration. The choice-theoretic orientation effectively treats a society as a parade. Parades vary in quality, to be sure, with some parades perhaps coming close to some image of perfection while others seem quite distant from perfection. Regardless of whether a parade is thought to be perfect or imperfect, it is appropriately reducible to a point-mass entity. Whatever number of participants a parade might have, they can be reduced to a point-mass entity that can be described by a direction and speed of movement. If one were asked to explain observed variation in the quality of different parades, the explanation would surely run in terms of such things as the organizational skill of the parade marshal, the musical and marching abilities of the participants, and the amount of time given to rehearsal.

The crowd passing through a piazza constitutes a distinctly different social configuration, one that is still generally orderly but which bears little resemblance to a parade. The pedestrian crowd is not reducible to a point-mass entity. The crowd cannot be described by direction and speed. Following a particular pedestrian through a piazza gives no information about the entirety of pedestrians in the piazza. Where the parade is an organization under the direction of a parade marshal, the people within the piazza constitute an order of organizations, with each organization pursuing its own plan of action. A pedestrian crowd is a form of spontaneously ordered network, as explored in Barabási (2002). The orderly quality of the pedestrian crowd resides in the rules and principles that govern interaction among the participants. It would be ontologically mistaken to treat the pedestrian crowd as an imperfect parade that potentially could be perfected through policy, even though it is conceivable that the orderliness of the crowd could be improved along the lines examined in Schelling (1978). It is a pedestrian crowd and not a parade that is an appropriate analogy to the orderly but turbulent social configuration that is constituted through an ecology of plans.

Fourth, the choice-theoretic framework treats macro phenomena as equally simple as micro phenomena. Treating macro as an equilibrated aggregate of micro actions is equivalent to treating a parade as an aggregation of equilibrated pedestrians. Just as a parade is a scaled-up version of a single pedestrian, a macro economy is a scaled up version of an average or representative micro unit. In contrast, the emergent-theoretic alternative recognizes that the micro–macro relationship is scale free. Within the ecology of plans framework, the move from micro to macro is a move from simple to complex phenomena sketched in Hayek (1967) and extended in new directions by Koppl (2010), Magda (2010), and Rosser (2010). While the DSGE reduction of macro to micro is associated initially with Léon Walras, it is worth noting that Walras (1954, pp. 380–381) raised briefly the possibility of treating the macro level as an ecology of plans, only to turn away due to analytical complexity. He raised this possibility by contrasting his formulation of an annual market of pre-coordinated activity with what he called a continuous market, which he described as resembling a lake where the water is agitated by the wind, in contrast to the placidity of the water in the annual market. Walras's continual market allowed variable turbulence as a systemic feature of micro-level interaction, only he abandoned this insight in favor of the analytical closure that he thought equilibrium modeling offered.

Fifth, one facet of the macro-level complexity that accompanies the emergent-theoretic orientation is a treatment of politics as likewise engulfed in complex processes of interaction. Where political economy within the choice-theoretic framework treats politics as unified entities that intervene into market processes (Drazen, 2000), an emergent-theoretic political economy treats politics as complex processes of competitive interaction among the units that comprise a polity (Wagner, 2007). If the micro–macro distinction were a simple matter of scale, micro and macro phenomenon would be equally capable of guidance by planning. After all, individual action is the province of planning, so by extension the macro level would likewise be the province of planning. Within the ecology of plans that pertains to the emergent-theoretic framework, systemic planning faces limits that do not appear within the choice-theoretic framework. The choice-theoretic framework conceptualizes policy as polity acting on economy, with both entities treated in point-mass fashion as when one billiard ball strikes another. Within the emergent-theoretic framework, neither polity nor economy is reasonably reducible to a point-mass entity; moreover, the relationship among those entities is knotted and not separated.

Sixth, the choice-theoretic framework grounded in simplicity makes policy appear to be a simple matter of selecting among equilibriums through comparative statics. The end of analysis is placed on prediction as the instrument of policy advocacy. Within the emergent-theoretic framework, by contrast, the end of analysis is placed on explanation and understanding. As Kochugovindan and Vriend (1998, p. 64) summarize: "... because emergent phenomena are inherently unpredictable to some extent, the study of complex adaptive systems confirms that the true objective of science is not prediction but understanding." A parade is susceptible directly to control through policy, as a parade marshal can change the direction or pace of march in an instant. Doing this is not possible within a piazza because the people who are passing through it have their own objectives which often will be maintained despite the contrary efforts of policy. Once polity is recognized as an order of competitive organizations, moreover, the problem of policy comes to be recognized as more of an institutional and constitutional matter than a matter of systemic planning and control.

3. Micro and macro: a bi-planar framework for an ecology of plans

This paper pursues a bi-planar framework for exploring the relationship between micro parts and the macro entirety within an ecology of plans. Alternatively, Potts and Morrison (2007) use a tri-planar framework that distinguishes among micro, meso, and macro levels, with the meso-level containing institutions which reside on the macro level in the bi-planar framework. Regardless of the number of planes that might comprise an emergence-based framework, the relation between micro action and the macro resultants of micro action requires explanation in terms of planes where one plane contains

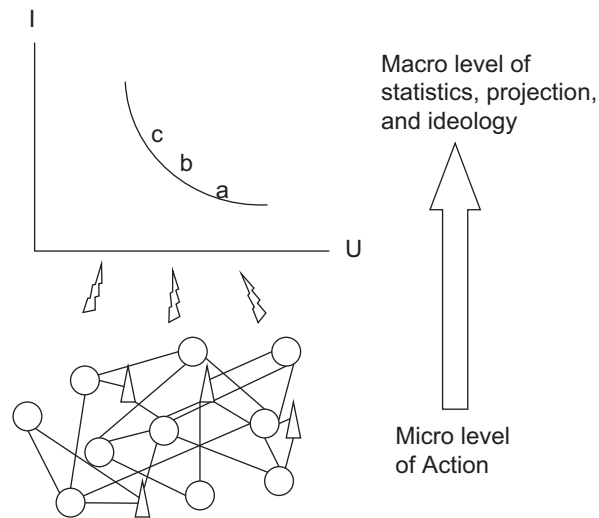


Fig. 1. Micro-macro supervenience.

activities that are projected onto a higher plane through such entities as statistics, expectations, conventions, institutions, and ideologies. There are individuals who act and there are social products of interaction among those acting individuals, and with those products shaping, channeling, and constraining individual action. In this respect, Coleman (1990), in his treatment of theorizing about interdependence among actors in society, distinguishes between the level of action and the level of system. With respect to this framework, he notes that “the only *action* takes place at the level of individual actors, and the ‘system level’ exists solely as emergent properties characterizing the system of action as a whole. It is only in this sense that there is behavior of the system as a whole (p. 28, Coleman’s *italics*).”

Fig. 1 illustrates a bi-planar framework for exploring a macro economy as an ecology of plans that emerges out of interaction at the micro level. The upper part of Fig. 1 illustrates three possible observations in Phillips-curve space to make contact with choice-theoretic macro theorizing. These observations could be thought of as representing three different levels of aggregate demand corresponding to different rates of inflation and output, with *a* and *c* denoting deviations from the natural rate of output represented by *b*. To be sure, the various macro theories differ in how they account for those observations, but the central point in any case is that the object of theoretical attention for choice-theoretic macro theorizing is captured by those macro-level variables. While Fig. 1 uses a Phillips curve portrayal of macro-level theory, such other macro-level portrayals as aggregate supply and demand or money supply and demand could be substituted. Whatever the particular type of macro relationship brought under examination, the emergent framework would treat it as supervening on micro-based network of actions and relationships.

Those micro relationships are portrayed in the lower part of Fig. 1 as a network of acting entities of two types: the circles denote market-based entities and the triangles denote polity-based entities. The lightning bolts pointing from the micro level of action toward the macro level of statistics, projection, and ideology shows that the system level is real but is not the level where action occurs. Action takes place only on the micro level, with macro-level observations supervening on micro-level interaction. The aphorism “think globally but act locally” has the macro-micro relationship almost right. The only emendation required to get the aphorism exactly right is to note that there is no option to local action, for any subsequent global impact is an emergent product of micro-level actions and interactions. This does not mean that the macro level is inert, not by any means. The macro-level is the home of such holistic objects as institutions, statistics, projections of future circumstances, and ideological beliefs and presumptions. Such macro phenomena can influence micro-level action as instances of downward causation, as explored by Lewis (2010) and Pryor (2008). For instance, a prolonged depression might influence beliefs about the stability properties of a market economy, changing in turn the subsequent pattern of micro-level interaction in the direction of greater public involvement in economic activity, especially when, as Kirman (2010) notes, people are to a significant extent influenced by those with whom they associate rather than acting independently of one another. This influence of macro patterns on micro actions is no different from the ability of macro-level projections of an ageing population with much wealth and leisure time inducing micro-level action in the form of enterprises that construct facilities to accommodate the greater use of recreational vehicles that might be thought to be in the offing.

Fig. 1 pertains to a bottom-up formulation of the relationship between micro and macro, similar to De Grauwe (2010). There is, however, a significant difference between these formulations. De Grauwe pursues a bottom-up framework in order to develop an empirically more accurate choice-theoretic model of business cycles, and does so by varying the stock of information that agents possess. De Grauwe thus seeks to construct an alternative path to the construction of direct relationships among macro-level variables as these are reflected in national income accounts. In contrast, the cardinal presumption of the ecology-of-plans framework is that there is no direct causal relationship between micro-level action and macro-level resul-

tants, even though empirical regularities might exist over some temporal interval, because the micro–macro connection is intermediated through societal structure.

Equilibrium-centered macro theory can, of course, give an account of interdependence among economic activities. Indeed, such an account is perhaps the prime virtue of this theoretical framework. What it cannot do, however, is give an account of turbulence that arises through inconsistencies among plans because no action is presumed to take place until all plans are mutually consistent. All plans are pre-reconciled within the equilibrium framework, just as the actions of the members of a parade are pre-reconciled. The alternative to the equilibrium framework is to treat the ecology of plans as an emergent process where macro-level objects supervene on micro-level interaction. Any relation among macro-level variables is thus intermediated through interaction among entities at the micro level.

Any plan has the structure wherein a decision to commit to a course of action is undertaken in advance of the market determination of the value of that action. Cost is borne prior to production, with the receipts generated by that production coming later (Buchanan, 1969). Plans are initiated on the basis of *ex ante* projections or beliefs, with the *ex post* value of those plans ascertained only later and taking the form of windfall gains and losses. Equilibrium theory, however, neuter the distinction between *ex ante* and *ex post*, due to the stipulation that observations pertain to equilibrium states. For the distinction between *ex ante* and *ex post* to have significant analytical work to do, some such analytical framework as an ecology of plans is necessary because the distinction between *ex ante* and *ex post* can appear only in the absence of pre-coordination among plans. People may well lay plans by making efficient use of public information about plans now underway, but there will be much private information pertinent to the formation, revision, and abandonment of plans that will continually enter the ecology, leading to continual divergences between the *ex ante* vision on which a plan was undertaken and the *ex post* reality that subsequently was confronted.

The ecology of plans framework also eliminates the distinction between long run and short run. This venerable distinction is relevant for an individual plan, as it corresponds to the subsequent operation of a plan in the face of some divergence between the long run anticipation on which a plan was based and the short run judgment whether to continue with a plan that presently is not matching that long run anticipation. For an ecology of plans, however, the distinction between short run and long run is irrelevant. Within that ecology, there will be plans that are just getting underway while there are other plans that are in the process of being abandoned. The distinction between long run and short run is pertinent to individual plans but is irrelevant for the ecology of plans, for that ecology is just an arena into which plans are inserted to take wings or not.

What results from this analytical effort is a form of spontaneous order macro theory, as illustrated by Howitt and Clower (2000), Leijonhufvud (1981), Shackle (1974), and Witt (1997). Micro theory would be the domain of intentional action; macro theory would be the domain of emergent phenomena, spontaneous order, and unintended consequences. This line of analysis would reassert the sense of the distinction between what is seen and what is unseen. The micro domain of action pertains to what is seen and intentional. The macro domain of spontaneous order and emergence pertains to what is not part of anyone's direct intention, but rather reflects interaction among participants along with phenomena that emerge through interaction. With respect to micro foundations, this effort points toward emergent-theoretic foundations for macro theory, as distinct from choice-theoretic foundations.

The challenge embraced here is to analyze the generation of orderliness cum turbulence within the ecology of plans that constitute a macro economy and not to compare the properties of some equilibrium arrangement of plans against some postulated Paretian standard. With respect to what is denoted as policy, moreover, the entities of state are likewise members of the crowd and nothing like a parade marshal. Within an ecology of plans, new plans continually are being created while existing plans sometimes are being revised or even allowed to die. The interconnection among plans in this ecology is a source of turbulence, not as an exogenous shock but as a systemic feature of what is a living even if not a sentient organism.

The actors shown in Fig. 1 comprise a network that contains two types of actors and possesses a particular pattern of connection among those actors. With respect to the types of actors, the circles denote market-based entities and the triangles denote polity-based entities. Both types of entity exist and operate on the action plane, for there is nowhere else they can reside and operate. Those entities have somewhat different rules of action, which is significant for some of the turbulence that can emerge within the ecology of plans. While all entities are guided by a search for gain, that search can play out differently as between market-based and polity-based entities. Still, the preference for gain over loss is a universal characteristic of all acting entities, as Buchanan (1969) explains, even though this universal characteristic can be intermediated differently within different types of organizations.

Fig. 1 shows both market-based and polity-based enterprises acting on the same plane, and with each being sources for the generation of macro-level data. It is well recognized that profit motivation differs from bureaucratic motivation, even though both entities pursue gain over loss. For instance, both each party in a dispute between market-based entities has incentive to settle the dispute without going to trial because they are residual claimants on their litigation expenses. It is different for a dispute between a commercial and a political entity because a political entity is not a residual claimant on litigation expenses. Those expenses, however, can serve as a form of investment in seeking higher office if a trial has the ability of trials to attract favorable public attention. The commercial calculus of profit-and-loss would be replaced by an alternative though related calculus of political gain. While an ecology of plans is naturally turbulent due to the operation of *ex ante*–*ex post* divergences, turbulence would also arise through institutional incongruity within the ecology, as noted by Lachmann (1971) in his treatment of Max Weber's institutional economics.

4. Four illustrations of an ecology-of-plans framework

Theoretical frameworks come with cost as well as benefit. The benefit is the ability of a theoretical framework to cast light on the chosen analytical territory. Theories are, of course, products of thought, and choosing one direction of thought requires renouncing some alternative direction. This renunciation of the theoretical products not pursued is the cost of choosing a particular theoretical framework (Buchanan, 1969). To explore those other territories requires construction of different theoretical frameworks. A choice-theoretic macro, for instance, can deepen our understanding of the implications of presuming that the statistical constructs of what are designated as macro variables comprise a systemic equilibrium. It cannot, however, allow a theorist to plumb the implications of presuming that societies are never fully placid and peaceful because they are also arenas of conflict among the plans of the members of a society (Collins, 1994; Coser, 1964; Jacobs, 1992), and where the systemic qualities of a society are emergent features of complex patterns of interaction among the members of society (Aydinonat, 2008). To theorize about such emergent, systemic qualities requires some such alternative conceptual framework as an ecology of plans.

The value of any theoretical framework resides in its ability to illuminate territory that other frameworks could not illuminate or could illuminate only by embracing what are clearly analytical fictions under a presumption that the goodness of fit is sufficient to warrant use of the fiction as a substitute for seeking to penetrate more deeply into reality. This section explores briefly from an emergent-theoretic framework four topics that have currency within the choice-theoretic macro literature. The point of these examinations is not to offer definitive alternative to choice-theoretic formulations but is to illustrate some of the differences that an emergent-theoretic framework can bring to bear on macro-level phenomena. In each of these illustrations, macro or systemic observations emerge through micro-level action and interaction and are not direct products of choice.

4.1. Plan coordination without Say's law

The presumption that macro observations pertain to states of competitive equilibrium brings Say's law in its train. To be sure, Say and the classical economists reasoned plausibly in terms of empirical tendencies and not demonstratively in terms of the logical implications of a set of theoretical presumptions, in keeping with the examination of the distinction and the difference it makes in Clower (1994, 1995). For Say, the law of markets described an empirical tendency that worked with variable speed. In contrast, a theoretical framework that postulates that macro-level observations, which it should be noted are themselves products of theoretical construction, are of states of equilibrium must incorporate Say's law as an implication of competitive markets. When systemic reality is reduced to a representative transaction, the possibility of miscoordination vanishes inside the analytical reduction because miscoordination is meaningless between two rational actors. Miscoordination cannot be explained by starting from a presumption of systemic equilibrium because miscoordination speaks to unexploited gains from trade, which in turn implies false trading in the form of unsuccessful plans. But false trading is rendered illogical by the presumption of systemic equilibrium.

An ecology of plans holds analytical space for miscoordination among the plans of market participants. Indeed, the central analytical task becomes one of explaining the high degree of coordination we observe within societies when there is no parade marshal who organizes market participants. To explain that coordination is, of course, a different task from assuming the existence of such coordination. One reasonable presumption for explaining the generally coordinated quality of economic activity is recognition that people prefer success to failure in pursuing their plans. A second such presumption is recognition that the success of a plan is determined subsequent to making a commitment to pursue a plan. A third reasonable presumption is that the success of a plan is to a considerable extent determined by people other than the creator of the plan because it also involves the willingness of some people to supply inputs and of other people to demand outputs—and both of these in turn depend in other plans that might also be inserted into the economy and which were unknown at the time the plan in question was created.

All plans are set in motion by creating particular combinations of capital goods and capacities to execute the plan. If that plan fails to fulfill the expectations on which it was based, it will be abandoned in some fashion, typically through salvage of assets and not through destruction. Within a setting where plans sometimes fail, market participants will develop institutional arrangements for abandoning plans. Arrangements regarding bankruptcy and business reorganization are emergent phenomena of interactions among participants in a failed plan who are trying to go forward in the face of a failed plan. It is reasonable to presume that those arrangements can vary in their systemic character. For instance, under private ordering the owners of the assets of abandoned plans choose how to dispose of those assets. In the presence of public ordering, however, political agencies are able to shape and channel that disposition. The systemic quality of different institutional arrangements for accommodating the abandonment of plans is a component of a macro ecology of plans.

Leijonhufvud (1981, 1993) advances the claim that economies might be naturally stable within some zone of normalcy but lose those stability properties outside that zone. This is certainly a plausible proposition regarding the applicability of Say's law within an ecology of plans. The historical record shows that depressions occur and are normally short lived, but some of them last for quite some time. Within an ecology, a commercial plan typically ties together numerous people in a web of expectation. The subsequent failure of a plan will thus typically exert negative effects on numerous people. We know

from historical observation that economies recover from such disruption just as we know that forests recover from fires. What we do not know much about, though, is the speed of recovery and the impact of institutional arrangements on that speed. For instance, [Higgs \(1997\)](#) and [Cochran \(2004\)](#) provide grounds for thinking that policies undertaken in the presence of disruption can slow rather than hasten recovery. Regardless of the merits of those claims and the impact of policy actions on the expectational processes through which the restoration of normalcy might be facilitated or impeded, those claims can be examined only within an ecological orientation where macro-level phenomena supervene on micro-level interaction. Whatever might come from such an examination, Say's law would not be a demonstrable quality of a postulated equilibrium but would be a plausible quality of a well-governed ecology of plans.

4.2. Monetary processes and central banking

Within choice-theoretic macro a central bank and a state treasury would be treated as macro-level entities. Within an ecology of plans, however, those entities, like all acting entities, operate on the micro level, with macro level results emerging through networks of micro-level interaction. This alternative assertion does nothing to deny such staple quantity-theoretic claims as the ability of economic interaction to take place equally well under different quantities of money under price flexibility. To be sure, that assertion belongs to the realm of demonstrative reasoning, and does not imply or suggest the empirical irrelevance of monetary variation, for this is the territory of plausible reasoning ([Polya, 1954](#)). It is also the territory of open systems of thought in contrast to closed systems of thought suitable for demonstrative reasoning, as [Dow \(1996\)](#) explains in developing a contrast between Cartesian/Euclidian and Babylonian modes of thought.

The quantity theory is, of course, typically presented in aggregate terms as if it applied to the macro level, just as the equality between saving and investment is typically presented as pertaining to the macro level. Within an ecology of plans, however, macro resultants emerge out of micro-level interaction. In consequence, the interpretation of macro-level observations as involving equality between saving and investment or between money demand and money supply require similar equalities among individuals on the micro level. In the absence of such equalities, interaction on the micro level will generate turbulence at the macro level. How much turbulence will accompany the inconsistencies among plans that those inequalities point toward is a topic to be explored, and with some effort to sketch some of this in a framework of agent-based computational modeling set forth in [Seagren \(2011\)](#).

Within the ecology-of-plans framework, there is no direct relationship between central bank actions and macro aggregates because that relationship is intermediated by structural or connective patterns among the micro units that constitute the macro economy. To the extent those connective patterns are relatively slow to change, there will be persistence across periods in macro-level observations. Still, a statistical relationship is not a theoretical relationship, as illustrated by the effort to develop non-Walrasian approaches to macro theory illustrated by [Gatti et al. \(2008\)](#) and the essays collected in [Colander \(2006\)](#). This is not to deny that purchase of government debt by a central bank can generate changes in such aggregate variables as prices, outputs, and employment. It is only to bring into the analytical foreground the significance of the networked structure of micro-level interaction for understanding both the causes of those central bank actions and their consequences. These phenomena cannot be captured adequately by remaining at the macro level, for a central bank resides at the micro level along with regular banks and other enterprises. A central bank operates within some networked structure of relationships, with different structures having consequences both for central bank activities and the consequences of those activities. This is a general feature of networks where knowledge is local and distributed.

With reference to [Fig. 1](#), a central bank is one of the triangles on the micro level of action. It operates through the connections it has established with other entities in the ecology: it acts as an entity inside the ecology, thereby contributing to the emergence of systemic qualities; it does not act on the ecology as if that ecology were reducible to some point-mass entity. To be sure, a central bank exemplifies what [Koppl \(2002\)](#) calls a Big Player, which is a participant in the economic process that is not subject to the ordinary rules of private property and residual claimancy much as the political plaintiff mentioned above is a Big Player. Big Players act differently from ordinary market participants, which can be a source of uncertainty and turbulence because their actions are less predictable to other participants. Different patterns of interaction are likely to generate different macro observations, and with those observations not the province of the central bank alone because they also depend on patterns of interaction among market participants. Principles of spontaneous order thus play out within the context of macro theory. Indeed, it is at the macro level where principles of spontaneous order would be at work, for spontaneous order and unintended consequences are products of interaction as distinct from action ([Schelling, 1978](#); [Aydinonat, 2008](#)).

The point of this alternative formulation is not to derive some alternative relationship between monetary changes and changes in outputs or prices. It is rather to pursue an alternative program of micro-foundations that reflects emergence and supervenience in micro-macro relationships. Doing this brings into the foreground relationships that are suppressed when macro entities are related directly to one another. When a central bank is conceptualized as acting within a network of connections and relationships, the establishment of those relationships and the work they do become of central analytical interest, whereas they are irrelevant when attention is focused on the macro level. For instance, much central bank activity operates to regulate credit contracting, which in turn presumably modifies the structure of production within a society from what it would otherwise have been, and with macro-level consequences emerging from that change.

4.3. Political economy, public debt, and Ricardian equivalence

Public debt has been mostly examined from the macro level, as illustrated by Barro's (1974) claim that public debt is not a source of wealth to a society. This feature of public debt is an implication of double-entry accounting applied to a closed system treated as a single entity. Within such a single entity, as standard macro theory conceptualizes its object, the replacement of current taxation with public debt must entail future taxation of equal present value. Much of the debate over Ricardian equivalence has concerned the stimulative impact of public debt and fiscal policy, with Ricardian equivalence implying that there would be no such impact.

Within the ecology-of-plans framework, public debt must be an emergent resultant of interaction at the micro level. Once this is recognized, it is possible both to maintain the double-entry truth of Ricardian equivalence and to recognize that public debt can have stimulative properties, only that stimulus will be directed at particular activities within the ecology and not at activity in general. The ability to recognize both properties simultaneously appears as a possibility within the ecology-of-plans framework while it is excluded by the very construction of the choice-theoretic framework. That recognition starts with realization that government is not an indebted entity but is a type of financial intermediary that operates within a transactional nexus that links bondholders and taxpayers. For a closed system, such as described by Fig. 1, public debt is held by a subset of the national citizenry. There are, of course, two possible options to the creation of public debt. One is increased taxation and the other is reduced public expenditure. In comparison with increased taxation, public debt is a means by which those who buy bonds are paying taxes from those who do not buy bonds. At some later date, of course, taxpayers will pay higher taxes to amortize the debt. The government, in any event, is an intermediary in the transactional nexus that connects bondholders and taxpayers. As a matter of double-entry accounting, the sum of the debits must equal the sum of the credits, which is all that is entailed in the Ricardian proposition.

Within the ecology, however, it would be generally mistaken to treat all taxpayers as being in agreement with respect to the transaction. Bondholders, of course, willingly buy the bonds. With respect to taxpayers, some may well support the replacement of current with future taxes but others would surely favor neither debt nor expenditure. The resulting outcome might be advantageous to some while being detrimental to others. Public debt can change net worth at the individual level even if it does not change net worth at the societal level. Furthermore, it is the micro level where action and interaction occurs. To be sure, there is no reason in principle why Ricardian equivalence cannot be brought to the individual level of action. This would result if public debt were assigned to particular individuals in stipulated amounts at the time of its creation, and if that debt were treated legally as ordinary debt, even passing into a decedent's estate. In this case, sentiments about debt-financed spending would surely play out differently than when individual liabilities for public debt are not assigned but are left as a residual to be determined at some later date.

The depiction of the micro level of action in Fig. 1 includes both market-based and polity-based enterprises. Polity is no more treated as a unified entity than are market-based enterprises, as illustrated by Wagner (2007). The ecology of plans entails both cooperation and competition among the enterprises that comprise the ecology. With respect to the stimulative quality of public debt, suppose the distinction between points *a* and *c* in Fig. 1 is a projected outcome of some stimulus program, recognizing that such a projection would follow only from some and not all macro models. A significant implication of that macro projection is indifference about the composition of the added expenditure. Such a claim is clearly unreasonable, as primacy of interest always resides in the composition and not in the simple fact of expenditure. The source of such programs likewise resides at the micro level where action takes place; what is commonly described as macro policy emerges through interaction among entities at the micro level, leaving emergent products to be discerned at the macro level, as illustrated by Wagner (2001).

4.4. Population thinking and efficiency wages

When an entire economy is characterized by a production function that is linear and homogeneous, competitive equilibrium where each input receives the value of its marginal product is accompanied by exact exhaustion of the total product. From this analytical point of departure, a family of efficiency wage ideas has been advanced to give an account of involuntary unemployment, as illustrated by Akerlof (1982) and Shapiro and Stiglitz (1984). While there are several varieties of efficiency wage theory, they all involve claims that firms will be driven by efficiency considerations to pay workers a premium beyond what is thought to be consistent with the marginal productivity theory. For instance, it is costly for a firm to replace a worker, but the usual interpretation is that payment that matches marginal productivity will leave workers indifferent among firms that have the same production function. While a worker who leaves will be replaced by an equally productive worker, the firm will lose because it has to bear the cost of finding a replacement. Some wage premium can this increase the value of the firm by reducing turnover. By paying a wage in excess of marginal productivity, however, total employment by the firm will fall.

Within the choice-theoretic framework that allows reduction of macro to a representative choice or transaction, the efficiency wage theory would seem to give an account of involuntary employment. The ecology-of-plans framework, however, pursues population thinking and not representative or average thinking. Once the claim about wage premiums to reduce turnover is incorporated into a framework based on population thinking, one is led immediately to ask what happens to those workers who are presumed to become involuntarily unemployed. What results is recognition that the condition of being unemployed is a product of the theoretical framework that postulates a given set of firms all of which operate under

a standard form of wage contract. Within a population-based framework, however, the types of firms and the forms of employment contract are themselves variables that emerge out of interaction among market participants.

When society is treated as an ecology of plans, efficiency wages cannot account for involuntary unemployment. They can account for a change in the organizational pattern of activity in society, but that is all. It is reasonable to think that a wage premium will reduce employment by a firm from what it would have been without the premium. It is not reasonable, however, to extend this presumption to the entire population because it is also necessary to ask what happens to the people who do not receive the premium. Those people have options. Self-employment is one option, in which case the share of activity organized in large firms will shrink in the presence of efficiency wages. But self-employment is not the only option. Expansion of employment in relatively small firms is another option, an expansion in the use of various non-wage contracts is still another option, and an expansion in employment in such entities as non-profit firms and cooperatives is a further option. What efficiency wage theory explains, and all that it explains, is why the volume of employment in large organizations is less than what it would be if such wage premiums were not paid. Those premiums prevent some people from securing employment with those organizations, but it does not prevent those people from securing other forms of employment, particularly once it is recognized that the forms of employment is not given but is a emergent quality of interaction on the micro level.

Efficiency wage theory is really a theory about the limit on the size of large firms and not a theory of involuntary unemployment, under the presumption that large firms have to pay a premium to secure some semblance of loyalty that small firms can obtain in other ways. The organizational pattern of activity within the ecology of plans will depend on the costs and gains of putting together and maintaining different organizational frameworks. This is a quite unexceptional proposition once viewed ecologically. A further ecological insight the postulated advantages to large firms might not be as strong as efficiency wage proponents seem to think, and for reasons relating to emergent phenomena and spontaneous ordering. The efficiency wage premium works because of the presumption that employees can be terminated at will. Once upon a time this was true, but it no longer is as termination, especially in larger firms and bureaucracies has become a difficult, procedurally heavy process. Such changes to the operation of contractual relationships, moreover, should be expected to lead to such further changes within the ecology of plans as increased subcontracting and temporary employment, all of which would represent emergent, systemic qualities of micro-level action and interaction.

5. A closing note

To treat macro phenomena as emergent products of spontaneous ordering processes, and with the standard organizations associated with “policy” likewise operating on the micro and not the macro plane, is to assert neither the impotence of policy nor the universal beneficence of spontaneous ordering. Actions by political agencies can exert macro-level effects, as can actions by market-based organizations. Spontaneous ordering is not universally beneficial, as illustrated with especial cogency by Schelling (1978). Spontaneously generated orders, however, are not subject to direct and immediate control through policy, and for two reasons: (1) political policies themselves arise through competitive processes within a setting of specialized and divided knowledge where there is no such thing as a God’s-eye view and (2) people will speak back, as it were, to policy efforts, and the effects of that speaking back can play out differently depending on whether those policy efforts seem to facilitate what people are seeking otherwise to accomplish or to direct people into channels or paths they desire not to travel.

The spontaneous order orientation toward macro phenomena that has been adumbrated here connects directly with the concerns of constitutional and institutional economics by probing how different constitutive frameworks at the micro level can influence the macro level patterns we observe, perceive, or experience, as noted in Foster (1987) and Oprea and Wagner (2003). The concern with emergence and turbulence also points toward a non-equilibrium style of theorizing that avoids grounding systemic theories in a presumption of harmony represented by an equilibrium set of market-clearing prices. In this respect, conflict is an on-going feature of life in society, as a feature of natural turbulence that is mostly confined and rarely widespread, though not always, and which can have salutary macro consequences as noted by Coser (1964). Whether policy action within a particular constitutional framework acts to mitigate or intensify conflict and turbulence would be a question of central interest within a theory concerned with the properties of social life within an emergent ecology of plans. In any case, conflict and its governance and not a presumption of harmony would come to occupy the theoretical foreground, as illustrated by Bowles and Gintis (1993) and Hirshleifer (2001) and also Collins’s (1994) treatment of the conflict tradition within sociology.

A theoretical framework is an organon of complementary pieces of thought that work together. The choice-theoretic framework is one such organon, the emergent-theoretic framework is another. It sometimes happens that a piece that is suitable for one theoretical framework is introduced into a different theoretical framework, and often found wanting. The framework for macro theory associated with Robert Clower and Axel Leijonhufvud across many works, both individually and separately—for instance Leijonhufvud (1993) and Clower and Leijonhufvud (1975), in addition to other works cited below and many others not cited—have often been interpreted as contributions to choice-theoretic macro. It seems eminently plausible that this mis-interpretation has set back significantly the development of an ecological framework for macro theorizing, for it is clear that the questions they address and the manner in which they sought to address them were suitable for an ecological framework. In this respect, Shackle (1974) notes the unsuitability of applying an equilibrium method to a framework that is concerned with expectation and the *ex ante*–*ex post* gap this entails. In other words, the value of any

theoretical construction depends on the available of complementary pieces of intellectual capital, and the line of theorizing set forth by Clower and Leijonhufvud provide many pieces of thought that have value for bring ideas of emergence to bear on the ecology of plans that comprise the macro level of economic interaction.

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References

- Akerlof, G.A., 1982. Labor contracts as partial gift exchange. *Quarterly Journal of Economics* 97, 543–569.
- Axtell, R., Epstein, J.M., 1996. *Growing Artificial Societies*. Brookings Press, Washington.
- Aydinonat, N.E., 2008. *The Invisible Hand in Economics*. Routledge, London.
- Barabási, A.-L., 2002. *Linked: The New Science of Networks*. Perseus, Cambridge, MA.
- Barro, R.J., 1974. Are government bonds net worth? *Journal of Political Economy* 82, 1095–1118.
- Bowles, S., Gintis, H., 1993. The revenge of home economics: contested exchange and the revival of political economy. *Journal of Economic Perspectives* 7, 83–102.
- Buchanan, J.M., 1969. *Cost and Choice*. Markham, Chicago.
- Clower, R.W., 1994. Economics as an inductive science. *Southern Economic Journal* 60, 805–814.
- Clower, R.W., 1995. Axiomatics in economics. *Southern Economic Journal* 62, 307–319.
- Clower, R.W., Leijonhufvud, A., 1975. The coordination of economic activities: a Keynesian perspective. *American Economic Review* 65, 182–188.
- Cochran, J., 2004. Of contracts and the Katallaxy: measuring the extent of the market, 1919–1939. *Review of Austrian Economics* 17, 407–446.
- Colander, D. (Ed.), 2006. *Post Walrasian Macroeconomics*. Cambridge University Press, Cambridge.
- Coleman, J., 1990. *Foundations of Social Theory*. Harvard University Press, Cambridge, MA.
- Collins, R., 1994. *Four Sociological Traditions*. Oxford University Press, New York.
- Coser, L., 1964. *The Functions of Social Conflict*. Free Press, New York.
- De Grauwe, P., 2010. Top-down versus bottom-up macroeconomics. *CESifo Economic Studies* 56, 465–497.
- Dow, S.C., 1996. *The Methodology of Macroeconomic Thought*. Edward Elgar, Cheltenham, UK.
- Drazen, A., 2000. *Political Economy in Macroeconomics*. Princeton University Press, Princeton, NJ.
- Epstein, J.M. (Ed.), 2006. *Generative Social Science: Studies in Agent-Based Computational Modeling*. Princeton University Press, Princeton, NJ.
- Foster, J., 1987. *Evolutionary Macroeconomics*. Allen & Unwin, London.
- Gatti, D., et al., 2008. *Emergent Macroeconomics: An Agent-Based Approach to Business Fluctuations*. Springer, Heidelberg.
- Hartley, J.E., 1997. *The Representative Agent in Macroeconomics*. Routledge, London.
- Hayek, F.A., 1967. The theory of complex phenomena. In: *Idem, Studies in Philosophy, Politics, and Economics*. University of Chicago Press, Chicago, pp. 22–42.
- Higgs, R., 1997. Regime uncertainty: why the great depression lasted so long and why prosperity resumed after the war. *Independent Review* 1, 561–590.
- Hirshleifer, J., 2001. *The Dark Side of the Force: Economic Foundations of Conflict Theory*. Cambridge University Press, Cambridge.
- Hoover, K.D., 1998. *New Classical Macroeconomics*. Basil Blackwell, Oxford.
- Hoover, K.D., 2001. *The Methodology of Empirical Macroeconomics*. Cambridge University Press, Cambridge.
- Horwitz, S., 2000. *Microfoundations and Macroeconomics*. Routledge, London.
- Howitt, P., Clower, R., 2000. The emergence of economic organization. *Journal of Economic Behavior and Organization* 41, 55–84.
- Jacobs, J., 1992. *Systems of Survival*. Random House, New York.
- Janssen, M.C.W., 1993. *Microfoundations: A Critical Inquiry*. Routledge, London.
- Katzner, D., 1998. Time, Ignorance, and Uncertainty in Economic Models. University of Michigan Press, Ann Arbor.
- Kim, J., 1993. *Supervenience and Mind*. Cambridge University Press, Cambridge.
- Kirman, A.P., 1992. Whom or what does the representative individual represent? *Journal of Economic Perspectives* 6, 117–136.
- Kirman, A., 2010. The economic crisis is a crisis for economic theory. *CESifo Economic Studies* 56, 498–535.
- Kochugovindan, S., Vriend, N.J., 1998. Is the study of complex adaptive systems going to solve the mystery of Adam Smith's "invisible hand"? *Independent Review* 3, 53–66.
- Koppl, R., 2002. *Big Players and the Economic Theory of Expectations*. Palgrave Macmillan, New York.
- Koppl, R., 2010. Some epistemological implications of economic complexity. *Journal of Economic Behavior and Organization* 76, 859–872.
- Lachmann, L., 1971. *The Legacy of Max Weber*. Glendessary Press, Berkeley, CA.
- Latour, B., 2005. *Reassembling the Social: An Introduction to Actor-Network Theory*. Oxford University Press, Oxford.
- Leijonhufvud, A., 1973. Life among the econ. *Economic Inquiry* 11, 327–337.
- Leijonhufvud, A., 1981. *Information and Coordination*. Oxford Press, New York.
- Leijonhufvud, A., 1993. Towards a not-too-rational macroeconomics. *Southern Economic Journal* 60, 1–13.
- Lewis, P., 2010. *Emergent Properties in the Work of Friedrich Hayek*. Working Paper, King's College.
- Louçã, G., 1997. *Turbulence in Economics*. Edward Elgar, Cheltenham, UK.
- Magda, F., 2010. Can neoclassical economics handle complexity? The fallacy of the oil spot dynamic. *Journal of Economic Behavior and Organization* 76, 584–596.
- McQuade, T.J., Buto, W.N., 2009. The adaptive systems theory of social orders. *Studies in Emergent Order* 2, 76–108.
- Oprea, R.D., Wagner, R.E., 2003. Institutions, emergence, and macro theorizing. *Review of Austrian Economics* 16, 97–109.
- Polya, G., 1954. *Mathematics and Plausible Reasoning*, 2 vols. Princeton University Press, Princeton, NJ.
- Potts, J., 2000. *The New Evolutionary Microeconomics*. Edward Elgar, Cheltenham, UK.
- Potts, J., Morrison, K., 2007. Meso comes to markets. *Journal of Economic Behavior and Organization* 63, 307–312.
- Pryor, F.L., 2008. System as a causal force. *Journal of Economic Behavior and Organization* 67, 545–559.
- Read, L., 1958. I, Pencil. *Foundation for Economic Education*, Irvington-on-Hudson, NY.
- Resnick, M., 1994. *Turtles, Termites, and Traffic Jams: Explorations in Massively Parallel Microworlds*. MIT Press, Cambridge.
- Rosenberg, N., 1960. Some institutional aspects of the *Wealth of Nations*. *Journal of Political Economy* 68, 557–570.
- Rosser Jr., J.B., 2010. *Emergence and Complexity in Austrian Economics*. Working Paper, James Madison University.
- Schelling, T.C., 1978. *Micromotives and Macrobehavior*. Norton, New York.
- Seagren, C., 2011. Examining social processes with agent-based models. *Review of Austrian Economics* 24, 1–17.
- Shackle, G.L.S., 1974. *Keynesian Kaleidics*. Edinburgh University Press, Edinburgh.

- Shapiro, C., Stiglitz, J.E., 1984. Equilibrium unemployment as a worker discipline device. *American Economic Review* 74, 433–444.
- Smithin, J., 2004. Macroeconomic theory, (critical) realism and capitalism. In: Lewis, P. (Ed.), *Transforming Economics*. Routledge, London, pp. 55–75.
- Snowden, B., Vane, H.R., 2005. *Modern Macroeconomics*. Edward Elgar, Cheltenham, UK.
- Stoker, T.M., 1993. Empirical approaches to the problem of aggregation over individuals. *Journal of Economic Literature* 21, 1827–1874.
- Wagner, R.E., 2001. Politics and the macro economy. In: Shugart II, W.F., Razzolini, L. (Eds.), *The Elgar Companion to Public Choice*. Edward Elgar, Cheltenham, UK, pp. 422–439.
- Wagner, R.E., 2007. *Fiscal Sociology and the Theory of Public Finance*. Edward Elgar, Cheltenham, UK.
- Wagner, R.E., 2010. *Mind, Society, and Human Action: Time and Knowledge in a Theory of Social Economy*. Routledge, London.
- Walras, L., 1954. *Elements of Pure Economics*. Richard D. Irwin, Homewood, IL.
- Witt, U., 1997. The Hayekian puzzle: spontaneous order and the business cycle. *Scottish Journal of Political Economy* 44, 44–58.
- Young, H.P., 1998. *Individual Strategy and Social Order: An Evolutionary Theory of Institutions*. Princeton University Press, Princeton.