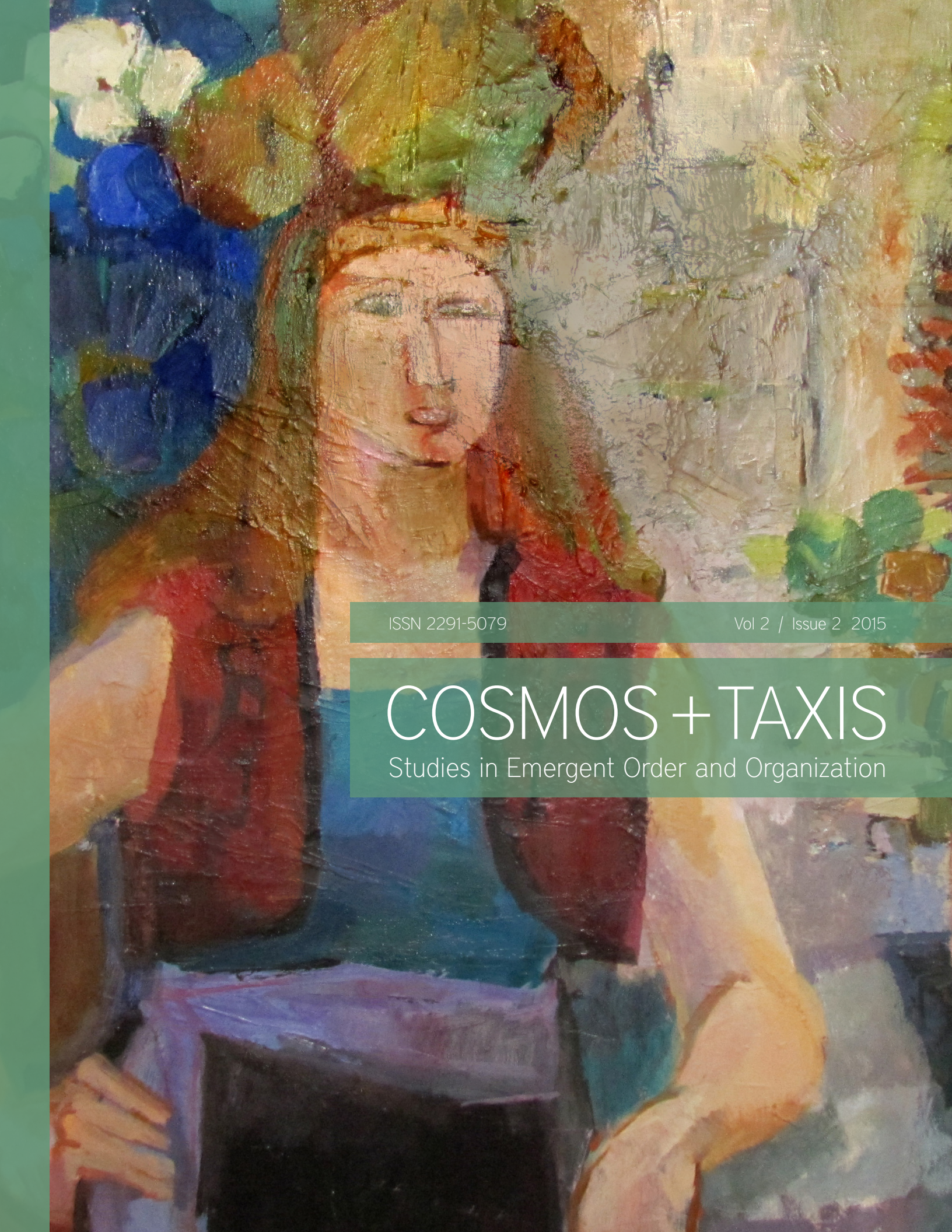


An abstract painting featuring a central figure of a woman's face, rendered with visible brushstrokes in shades of pink, orange, and brown. The background is a complex mix of colors including blue, green, yellow, and red, creating a textured, layered effect. The overall style is expressive and painterly.

ISSN 2291-5079

Vol 2 / Issue 2 2015

COSMOS+TAXIS

Studies in Emergent Order and Organization

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Studies in Emergent Order and Organization

VOLUME 2 / ISSUE 2 2015



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Orders, Orders, Everywhere ...

On Hayek's *The Market and other Orders*

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Abstract: This review essay of *The Market and Other Orders* (volume 15 of the *Collected Works of F. A. Hayek*) uses the essays collected in the volume as a vehicle to discuss certain key issues raised by Hayek's work, including that the knowledge required for plan coordination is provided not only by prices but also by formal and informal social rules; that the capacity of the price mechanism to coordinate people's plans is best viewed as an emergent property of the market system; that this emergent coordinative power also forms the basis for the process of group-selection in Hayek's theory of cultural evolution; that the nature of the interaction between the overall order of actions and the causal powers of other emergent entities is shaped by social structures; that Hayek's notion of 'order' is different from the economist's notion of 'general equilibrium'; and that Hayek's ideas anticipate those of modern complexity theory.

Keywords: Hayek, complexity, emergent properties, systems, evolution, group selection, rules, order.

1 INTRODUCTION

Friedrich Hayek was a scholar of uncommon breadth and depth whose work will be a source of insight for many years to come. Over his long career his interests spanned a wide range of subjects including psychology, economics, political philosophy, the philosophy of (social) science, and intellectual history. It is perhaps, therefore, something of a surprise to find an extraordinary consistency and unity in his thought running through time and subject matter. In volume 15 of the *Collected Works of F. A. Hayek* (Hayek 2014), entitled 'The Market and other Orders', editor Bruce Caldwell has selected papers that range in date of publication from Hayek's pivotal 1937 paper on 'Economics and Knowledge' ([1937] 2014) to his 1975 Nobel Memorial prize lecture on 'The

Pretence of Knowledge' ([1975] 2014). The selected papers illustrate this unity in a very instructive way. Throughout his professional career Hayek wrestled with issues related to the coordination of interrelated human actions, positing from early on that there was some kind of 'ordering' or 'coordinating' set of properties to the market process. This theme of 'spontaneous order' is the connecting thread that runs through all of his work, not just in economics but also in theoretical psychology and political philosophy. In this volume we can trace the development of Hayek's ideas on this topic through his career, relating it in particular to his emerging view of the economy as a complex system.

We begin in the next section with a discussion of Hayek's crucial 'early years' (the 1930s and 1940s at the London School of Economics). The articles published in this peri-

od—still frequently cited today—contain penetrating analyses of the nature of equilibrium, knowledge and the market process. In writing these early papers, Hayek was coming to grips with the themes that were to define the rest of his long career. In the third section of the paper, we discuss Hayek's treatment of complexity in the social world. We bring out in particular the fact, often unappreciated, that on Hayek's account the coordinative power of the market is an emergent property of the free market system that is formed when people's interactions are structured by certain kinds of formal and informal rules. We also highlight the point, also insufficiently widely acknowledged, that Hayek provides a satisfactory explanation of how order is possible in decentralized market economies only in his later work, which is ostensibly on political philosophy rather than economics. In the fourth section we discuss Hayek's vision of the world as consisting of many different (hierarchically organized) complex orders, of which the market is only one. Far from being an ontological reductionist, as he is sometimes (mis-)portrayed, Hayek subscribes to a view of the world as consisting of a series of ontologically distinct, and irreducible, layers of phenomena. We explore this further in the fifth section, examining the implications of Hayek's views for the possibility of multi-level interaction, arguing—contrary to some readings of his work—that Hayek's approach admits the possibility that emergent properties possessed by social systems include the capacity to shape, via downward causation, human agency. In the sixth section we turn to the question of how different societies come to be characterized by different sets of orders and thus different levels of economic success. Hayek posited a group selection evolutionary process that has been the subject of some criticism. We examine this and find Hayek's story to be more plausible than the critics have suggested. In the seventh and eighth sections we examine Hayek's perception of the market as a dynamic process occurring in real time. We focus on two questions in particular: how do real-world economic actors cope with radical uncertainty; and what is the nature of any tendency towards plan coordination? We argue in particular that Hayek's analysis implies that, even in the absence of external shocks, the question of whether the market system tends to produce greater plan coordination cannot be answered on the basis of *a priori* arguments alone. The final section concludes with an examination of Hayek's ideas in relation to modern complexity theory.

2 EQUILIBRIUM, PRICES, RULES AND SOCIAL ORDER

It was in a lecture delivered in 1936 to the London Economics Club that Hayek first grappled with some of the enduring themes that were to shape the remainder of his career. This paper is clearly a major departure for him:

It was really the beginning of my looking at things in a new light. If you asked me, I would say that up until that moment I was developing conventional ideas. With the '37 lecture ... I started my own way of thinking. (Hayek 1983, quoted by Caldwell 2014: 3)

In this lecture Hayek explored for the first time the concept of equilibrium from a subjectivist perspective, a route which took him immediately to questions about action, time, knowledge and expectations. Hayek realized that, unlike its counterpart in the physical world, the notion of equilibrium in economics must refer to the views of individuals as they act in the social world. Hence Hayek defined equilibrium as a situation in which 'the different plans which the individuals composing [a society] have made for action in time are mutually compatible' (Hayek [1937] 2014: 64). Equilibrium is here conceived as a situation in which individual knowledge and expectations, and the actions based on them, are compatible with the 'data,' where the 'data' for one individual include the plans and actions of other individuals. Hayek wonders how people's plans are in fact synchronized and coordinated. All successful human action is based on perceived and reliable causal connections between those actions and their effects. Disparate expectations, implying the inevitability of widespread errors and plan failures, would appear to preclude successful action. Having been pushed by the logic of equilibrium in a changing world to consider this question, it became a preoccupation of Hayek's throughout his career, even as he moved beyond economics narrowly understood. But it was also the beginning of his penetrating critique of some aspects of accepted theory and practice, most notably the meaning of competition and the market process, that are the themes of the other three articles that comprise Part 1 of the volume under review, entitled *The Early Years*. In retrospect, these papers can be seen to have laid the basis for his later work on the nature of the rules and practices that facilitate successful human action in dynamically changing societies, societies that are essentially complex phenomena.

In what is his most cited article, Hayek ([1945] 2014) posits that the high degree of coordination observed in economic life reflects the pivotal role of prices as both signals and incentives. Price movements signal changes to which individuals are motivated to adapt even in the absence of any knowledge as to their causes. His example of a sudden scarcity in the supply of tin, which results in a rise in its price that provokes individuals to economize on it, and to seek to produce substitutes, is justly famous as a canonical statement on the role of prices as ‘knowledge surrogates’ that communicate much of the information people need in order to coordinate their plans. As Hayek noted in ‘Economics and Knowledge’, in an economy characterized by an elaborate division of labour, knowledge—about people’s tastes, about the availability of resources, about the technology that might be employed to produce goods—is inevitably dispersed throughout the population ([1937] 2014: 72). However, as he went on to argue in ‘The Use of Knowledge in Society,’ when one set of individuals implements plans formulated on the basis of their local (dispersed and also often tacit) knowledge¹, their actions generate changes in relative prices which summarize in a publicly available form the significance of that knowledge for the scarcity of various resources.² And those price changes both enable and encourage other people to adjust their own plans so as to dovetail with those of the first group, without the former in fact knowing anything about the details of the local knowledge that informed the latter’s actions ([1945] 2014: 99–100).³

This is the second of the two famous ‘knowledge’ articles—published eight years apart (1937 and 1945)—that set the tone for so much that was to follow. Interestingly, there is potentially a tension between them. In ‘Economics and Knowledge’ Hayek emphasizes the subjective nature of knowledge and expectations ([1937] 2014: 60). The ‘data’ upon which we base our actions are to a large extent composed of our expectations of the actions of others upon whom we depend in order to bring our plans to fruition. More generally, as Hayek shows beautifully in an article written just a few years later, the very ‘facts’ of any given social situation are themselves really the interpretations we make of events and things in order to classify them by analogy to what we already know into categories useful for action and understanding (Hayek [1943] 2014). Thus, any social event, including a price change, must be interpreted if it is to be of any use. Yet, in ‘The Use of Knowledge in Society’ Hayek seems to come close to attributing an ‘objective’ status to price changes in the sense that, at times, he seems almost

to suggest that they provide unambiguous signals to people about what needs to be done.

One way of resolving this tension is to interpret the later article as taking the success of the market process as a given, as confirmed by our shared experience, and proceeding then to describe the implications of this success, and the pitfalls of failing to understand it. This leaves aside the question of how, and under what circumstances, people are able to extract from price signals knowledge that is accurate enough to permit the system to function as we know it can and does. But for sure this is not a question that Hayek ignored in any way. Hayek hints at an answer in ‘The Use of Knowledge in Society,’ when he refers to the way in which people ‘make constant use of formulas, symbols and rules whose meaning we do not understand and through the use of which we avail ourselves of the assistance of knowledge which individually we do not possess’ ([1945] 2014: 101). But a fuller answer came only later, in Hayek’s later writings on political philosophy and the law, where he argued systematically and explicitly that the dissemination of knowledge required for plan coordination is facilitated not only by price signals but also by a set of intersubjectively shared rules and norms, including both formal legal rules and also informal norms of honesty and promise-keeping. The fact that people act in accordance with the same general guidelines about how to interpret and act in various kinds of situation makes it possible for them to form reasonably accurate expectations of each other’s future conduct, thereby enabling them to formulate plans that have a reasonable chance of coming to fruition (Fleetwood 1995; Lewin 1997; Vaughn 1999a). As Hayek puts it:

What makes men members of the same civilization and enables them to live and work together in peace is that in the pursuit of their individual ends the particular monetary impulses which impel their efforts towards concrete results are guided and restrained by the same abstract rules. If emotion or impulse tells them what they want, the conventional rules tell them how they will be able and be allowed to achieve it. (Hayek 1976: 12)

Perhaps most notably, by facilitating enforceable contracts, the set of rules in question enables people to formulate and embark upon plans of action in the confident expectation that the contributions from their fellow men required to implement those plans will actually be forthcoming.⁴ In the

present volume, one can see early formulations of this idea in Hayek's Cairo Lectures on 'The Political Ideal of the Rule of Law' where Hayek states that 'if a multitude of individual elements obey certain general laws, this may ... produce a definite order of the whole mass without the interference of an outside force' (Hayek [1955a] 2014: 160). This possibility 'applies to the laws obeyed by men no less than to the laws of nature.' It is, Hayek tells us, an example of 'what Michael Polanyi has described as the spontaneous formation of a polycentric order; an order which is not the result of all factors being taken into account by a single centre, but which is produced by the responses of the individual elements to their respective surroundings' ([1955a] 2014: 160-61).⁵

The outcome that is generated when people's (inter)actions are structured by an appropriate set of rules is orderly in the following sense:

By 'order' we shall ... describe a state of affairs in which a multiplicity of elements of various kinds are so related to each other that we may learn from our acquaintance with some spatial or temporal part of the whole to form correct expectations concerning the rest, or at least expectations which have a good chance of proving correct. (Hayek 1973: 36; emphasis removed)

The orderliness of free market activity manifests itself in the fact that people can usually predict the behaviour of their fellows well enough to implement successfully the plans they make in the course of going about their daily lives and meeting their most basic needs (Hayek 1973: 36). As we shall see in section 7 below, this notion of 'order' differs in significant ways from the standard notion of general equilibrium.

What all this suggests, as Caldwell (2014: 12-14) notes in his 'Introduction', is that Hayek's post-1937 research in economics and his later investigations in social theory and political philosophy form a more coherent body of work than might at first glance appear to be the case.⁶ That is so not simply because, as is widely recognized, Hayek's insight that the problem of order is primarily an epistemic one informed his writings on political philosophy and social theory. The coherence also reflects the fact, less commonly acknowledged, that it was only in this later work, ostensibly on political philosophy, that Hayek was finally able to provide a convincing answer to the question, first posed in his narrow technical work on economics, of how socio-economic order is possible in decentralized market economies. As Hayek himself put it, in retrospective reflections on the development of his research penned in his essay on 'Kinds of Rationalism':

[T]hough at one time a very pure and narrow economic theorist, I was led from technical economics into all kinds of questions usually regarded as philosophical. When I look back, it seems all to have begun, nearly thirty years ago, with an essay on 'Economics and Knowledge' in which I examined what seemed to me some of the central difficulties of pure economic theory. Its main conclusion was that the task of economic theory was to explain how an overall order of economic activity was achieved which utilized a large amount of knowledge which was not concentrated in any one mind but existed only as the separate knowledge of thousands or millions of different individuals. But it was still a long way from this to an adequate insight into the relations between the abstract rules which the individual follows in his actions, and the abstract overall order which is formed as a result of his responding, within the limits imposed upon him by those abstract rules, to the concrete particular circumstances which he encounters. It was only through a re-examination of the age-old concept of freedom under the law, the basic conception of traditional liberalism, and of the problems of the philosophy of the law which this raises, that I have reached what now seems to me a tolerably clear picture of the nature of the spontaneous order of which liberal economists have so long been talking. (Hayek [1965] 2014: 49-50)

In emphasising the importance of rules as well as prices, Hayek can in his later work be thought of as attempting to devise an interdisciplinary, social-theoretic—as opposed to narrowly economic—approach to the explanation of plan coordination (Fleetwood 1995; Vaughn 1999a). We can elaborate on the nature of this account by exploring another development in Hayek's post-war thinking that is apparent in the essays collected in this volume, namely his increasing emphasis on viewing society as a complex system.

3 COMPLEXITY AND THE COORDINATING POWER OF THE MARKET AS AN EMERGENT PROPERTY

Responding to criticisms of his efforts in *The Counter-Revolution of Science* (Hayek [1952] 2010) to draw a sharp distinction between the methods of the natural and the social sciences made, amongst others, by the philosopher Ernst Nagel and the mathematician Warren Weaver, Hayek began

from the mid-1950s to distinguish between those sciences that study relatively simple phenomena and those whose subject matter is relatively complex (Hayek [1955b] 2014; see Caldwell 2014: 14-15). For Hayek, a complex system consists of a set of parts or elements which are related to each another, and so interact with one another, in a particular way. The set of relations that must obtain between a set of elements if they are to constitute a particular kind of complex system is the system's structure. As Hayek writes in an unpublished paper that complements those reprinted in this collection, '[t]he term system will ... be used here in the sense in which it is used in von Bertalanffy's "General System Theory," that is 'in the sense of a coherent structure of causally connected physical parts' (Hayek n.d.: 4).

While not completely pellucid (Fiori 2009, Rosser 2010), Hayek's explicit account of complexity appears to suggest that it has two defining features. The first is that complexity involves 'structures whose characteristic properties can be exhibited only by models made up of relatively large numbers of variables' (Hayek [1975] 2014: 365; see also Hayek [1955] 2014: 195-96, 200 and Hayek [1964] 2014: 260-61). The second is that complex systems display what are known as emergent properties. The term 'emergence' refers to situations where, when certain elements stand in particular relations to one another, the system that is formed has properties that are not possessed by its constituent parts taken in isolation or as an unstructured aggregate. As Hayek puts it in his essay on 'The Theory of Complex Phenomena,' the hallmark of emergence is that 'a certain combination of ... structures produces an overall structure possessing distinct characteristic properties':

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 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 (as described, e.g., by an algebraic equation) is preserved. Such "wholes", defined in terms of certain general properties of their structure, will constitute distinctive objects of explanation for a theory, even though such a theory may be merely a particular way of fitting together statements about the relations between individual elements. (Hayek [1964] 2014: 261-62)

Emergent properties are structural or relational in the sense that their existence depends not only on the presence

of their ('lower-level') constituent parts but also on those parts being organized into a particular ('higher-level') structure that involves them standing in specific relations to one another. More specifically, emergent properties arise in systems that are characterized by what Hayek terms *organized complexity*:

Organised complexity here means that the character of the structures showing it depends not only on the properties of the individual elements of which they are composed, and the relative frequency with which they occur but also on the manner in which the individual elements are connected with each other. (Hayek [1975] 2014: 365)

Emergent properties are ontologically and causally irreducible to the properties of the lower-level elements of which the emergent or higher-level whole is formed. Where emergent properties arise, therefore, there is not merely a quantitative but a qualitative difference made to the world. New categories, irreducible to those required to understand the lower-level elements, are needed in order to conceptualize adequately the nature and causal impact of the emergent whole (Lewin 2014: 179-82; Lewis 2012, 2015a; Turner 2014).

For Hayek, one notable example of a complex system is, of course, the market economy. In particular, as Hayek came to see it, the ability of the price mechanism to coordinate people's plans is an emergent property of the complex (market) system that is formed when people's (inter)actions are governed both by the formal rules of contract, property and tort law, and also by informal moral norms of honesty and promise-keeping. In an essay entitled *Notes on the Evolution of Systems of Rules of Conduct*, Hayek christens the coordinative power in question as 'the overall order of actions' (Hayek [1967] 2014: 282). It is an emergent property because it is possessed only by a particular whole, namely the free market system that is constituted by a group of people whose interactions are structured by a set of rules like that mentioned above. In Hayek's words, it is 'more than the totality of regularities observable in the actions of the individuals and cannot be reduced to them ... It is more than the mere sum of its parts but presupposes also that those elements are related to each other in a particular manner' (Hayek [1967a] 2014: 282).⁷

The epistemological implication of complexity is that the outcomes that result from the operation of complex systems do not lend themselves to precise quantitative predictions.

Instead, they are intelligible in that we are able to understand the *kinds* of outcomes—defined in terms of their general attributes rather than in terms of the properties of any individual component—that are possible. Thus *patterns* rather than point values are what can be predicted. Of course, the inability to make specific predictions makes it harder to falsify theories (Hayek [1955] 2014: 207, 210; Hayek [1964] 2014: 264). However, as Hayek is anxious to point out, this does not preclude altogether the possibility of an important type of (Popperian) falsification or refutation. Certain resulting patterns are ruled out by this type of investigation; the observation of a pattern of results outside the range predicted by a model of some complex phenomenon would refute that model. For example, confirmed observations of inherited traits acquired in a Lamarckian manner would refute the Darwinian version of evolution (Hayek [1964] 2014: 259-60, 263-71; Hayek [1975] 2014: 365-71). Moreover, as we shall see below, pattern prediction is not the sole preserve of (social) scientists; it is also something that businesspeople must rely on in attempting to navigate their way through a complex economic system.

4 HAYEK, OTHER 'ORDERS' AND THE STRATIFIED NATURE OF REALITY

As Caldwell (2014: 24-25) notes in his excellent 'Introduction' to the volume, Hayek contends that the notion of 'order'—understood as referring to a situation in which the actions of various members of a group are coordinated or brought into mutual adjustment, so that they stand in certain relations to one another—is applicable not only to the market economy but also to other natural and social phenomena. While it is possible for some simple kinds of order to be created through the deliberate arrangement of the relevant parts, Hayek's main focus is, of course, on those complex orders which—like the market order or catallaxy—arise spontaneously (that is, as the unintended consequence of the rule-guided behaviour of their individual parts, without any conscious direction) (Hayek [1967b] 2014). Prominent amongst such orders is the human mind, and it will be helpful for drawing out some important aspects of Hayek's thought to explore in more detail his account of the mind as a spontaneous, rule-governed order.

Hayek's theoretical psychology is set out in full in his 1952 book *The Sensory Order* (Hayek 1952). The volume under review here contains two essays in particular that draw on and develop some of the ideas advanced in that work, namely

'Rules, Perception and Intelligibility' and 'The Primacy of the Abstract.' Hayek views the mind as consisting of a structured hierarchy of interconnected nerve fibres, which acts as a rule-governed system of classification that discriminates between different physical stimuli in such a way as to give rise to the pattern of sensations—the sensory order, in Hayek's terminology—that people actually experience. 'What we call "mind"', Hayek (1952: 16) writes, 'is thus a particular order of a set of events taking place in some organism and in some manner related to but not identical with the physical order of events in the environment.' The neuronal structures in question are—as we shall elaborate in the next section of this paper—the material embodiment of a set of abstract social rules that not only govern perception but also regulate all of the other activities of our minds and indeed much of human action. As Hayek puts it, '[w]e ought to regard what we call mind as a system of abstract rules' (Hayek [1969] 2014: 43). These rule-governed neural structures create in people dispositions both to perceive certain classes of external stimuli as constituting particular types of situation, and also ultimately to respond to those circumstances in certain ways. On Hayek's account, therefore, there is no orchestrating Cartesian 'self' that oversees and directs the function of the neurons in the brain. Rather, our mental life is a spontaneous order, the unintended (emergent) outcome of the rule-governed interactions of a myriad of neurons (Hayek [1962] 2014: 232-36; Hayek [1969] 2014: 317-21, 326-27; see also Dempsey 1996: 25-27, 33).

As Hayek's use of the term 'order' suggests, he views the human mind as relational in nature. The capacity of the human mind to generate the phenomenal world of sense experience, and also to imbue events with meaning and to initiate purposeful action, is possessed only by a particular whole—namely the structured arrangement of neurons found in the human brain—and not by those neurons taken in isolation (Hayek [1967] 2014: 284-85; Hayek 1952: 35, 46-47, 53). In other words, those capacities are emergent properties of the structured array of neurons found in the human brain and central nervous system (Butois and Koppl 2006: 40-43; McQuade 2006: 59; Lewis 2012: 370-73). Their bearer is the higher-level or emergent entity, namely the human mind, which is formed when nerve fibres are arranged into the type of structure required to facilitate the classification of external stimuli and to respond to those stimuli in the complex, rule-governed way described by Hayek. On this emergent causal powers materialist account, the mind is viewed, not as consisting of distinctive 'mental stuff' that exists independently of the physical and biological world, but rather as

an emergent property of the structured array of neurons that is found in the human brain (Hayek 1952: 177-79; also see Bunge 1980: 6-9, 21-25; Lewis 2014).

For Hayek, then, both the mind and the market are complex systems. In both cases, they consist of parts (neurons and people respectively) whose behaviour, when their interactions are structured by an appropriate set of rules, generates emergent properties (such as, respectively, the capacity to generate the sensory qualities we experience and the capacity to coordinate people's plans). More generally, the picture to which this kind of emergentist position gives rise is one that portrays the world as stratified in the sense that there is a hierarchical structure of ontologically distinct 'levels' of emergent entities, each of which has its own distinctive and irreducible properties. These range from the physical, chemical, and biological to the mental (psychological), individual, and social. The existence of entities in the higher strata always depends upon their constituent lower-level components; people could not exist without lower-level physical and biological processes, and society would not exist in the absence of human action. However, at the higher levels there are emergent properties—such as the meaning associated with human action and the increased productivity associated with an elaborate division of labour—that arise only as a result of the relations that obtain between lower-level entities and which are qualitatively novel in the sense of being irreducible to the properties of those lower-level entities taken in isolation (Blitz 1992).

Two other pieces of evidence can be adduced in support of the claim that Hayek subscribed to such a layered ontology. The first comes in the form of teaching notes Hayek produced for a seminar class entitled 'Scientific Method and the Study of Society', held at the University of Chicago in late 1952. The notes include a chart listing phenomena at different 'levels of organization', ranging from the gene to the cell to individuals to society, along with the corresponding fields of study (genetics, physiology, etc.) (Caldwell 2004: 298-99). As used in the notes, the term 'organization' refers here to the way in which emergent properties arise only when certain (lower-level) parts or elements are arranged—'organized'—so as to form particular kinds of (higher-level) structure (Hayek 1952: 46-47; Hayek 1973: 27, 37; also see Lewis 2014).⁸ The reference to 'levels of organization' can be taken, therefore, to indicate that Hayek views the world as consisting of a nested set of emergent entities, with lower-level entities existing within the context of higher-level ones in a hierarchy of organizational levels. Hence Hayek's remark that '[s]ocieties differ from simpler complex structures by

the fact that their elements are themselves complex structures' (Hayek [1967] 2014: 288). This interpretation receives additional support from a second piece of evidence, namely the way in which, in some of the essays collected in the volume under review, Hayek describes phenomena such as the coordinative powers of the market as 'higher level regularities' or 'higher level generalities' (Hayek [1961] 2014: 381-82; also see Hayek [1964] 2014: 264). The higher-level regularities are 'wholly different ... [from any] regularity in the behaviour of the elements,' and 'cannot be wholly reduced to the regularities of the parts,' indicating once more Hayek's commitment to the notion of emergence and a layered ontology (Hayek [1967] 2014: 289, 286).⁹

We move on now to consider two important implications of Hayek's emphasis on emergent properties and a layered ontology: the first concerns the nature of the interaction between entities located at different levels; the second relates to the possibility of group selection on the basis of the emergent property that is the overall order of actions.

5 INTERACTION BETWEEN LEVELS

One question to which this stratified account of reality gives rise concerns how entities at different levels interact with one another. So far as this issue is concerned, as was hinted above, Hayek's theory implies that the social rules structuring people's interaction so that they form a functioning market system can quite literally get inside people's heads and shape the dispositions governing their actions. The process through which the internalization of social rules happens centres on the way in which repeated action in conformity with a social rule can—via social-psychological processes of habituation, imitation, and conformism—cause neurological changes that lead to the formation of new neural structures and, therefore, to people having new dispositions to conceptualize and respond to their circumstances in certain ways. Consider, for example, how new drivers learn the rules of the highway code. Those rules set out how people who drive cars on the public highway should interact with each another. Novice drivers have to make a conscious effort to learn the rules, so that the act of following them involves impulses travelling along nerve fibres in parts of the brain associated with higher-order thought. Over time, however, as the external stimulus provided, say, by a red traffic light becomes associated with a particular type of action—namely, bringing the car to a halt—connections form between the neurons stimulated by that external event and the motor fi-

bres that fire when the appropriate response is taken, so that the neurons that previously had taken the stimulus into the higher-order nerve centres need not fire for the appropriate action to be forthcoming. In the case of an experienced driver, therefore, the impulses emanating from the receptors stimulated by the red light simply cause the motor neurons associated with the act of stopping the car to fire, without the fibres associated with conscious thought coming into play. The upshot is that the appropriate action will be taken ‘automatically,’ so that the rule will no longer be followed consciously (Hayek [1967] 2014: 285-86; Hayek [1969] 2014: 317-21, 326-27).

In this way, the alteration in the neural structures of the brain leads to the formation of a new disposition—or ‘abstraction,’ as Hayek also terms it—for the person to interpret and respond appropriately to an aspect of their social environment without having to make a conscious decision to do so on each separate occasion. As Hayek puts it:

[T]he formation of abstractions ought to be regarded not as actions of the human mind but rather as something which happens to the mind, or that alters the structure of relationships which we call the mind, and which consists of the system of abstract rules which govern its operation. In other words we ought to regard what we call mind as a system of abstract rules of action (each ‘rule’ defining a class of actions) which determines each action by a combination of several such rules; while every appearance of a new rule constitutes a change in that system, something which its own operations cannot produce but which is brought about by extraneous forces. (Hayek [1969] 2014: 322)

Because the neuro-physiological structure of the human brain is sensitive to people’s experiences, and because those experiences are shaped by the social rules that structure how people interact with each other, the human mind must also be sensitive to, and causally influenced by, those social rules and relations. In Hayek’s words, ‘[i]ndividual reason is the product of inter-individual relationships’ (Hayek 1952: 160). For Hayek, therefore, social rules can—quite literally—become physically embodied in people’s brains. And by moulding people’s neural networks, social rules also shape the dispositions that govern how people perceive, think and act. In short, social rules, and the systems to which they give rise, possess the emergent causal power to shape human agency (Lewis 2012: 374-76).¹⁰ One important implication of this view, as we shall see, is that it will help us to mount a

defence of Hayek’s much-maligned theory of cultural evolution, to which we now turn.

6 GROUP SELECTION AND CULTURAL EVOLUTION

One question raised by Hayek’s emergentist perspective on the market concerns the origin of the rules that shape people’s interactions so as to give rise to the overall order of action (Potts 2013: 35-36; Lewis 2015a: section 3.3). One answer is provided by Hayek’s controversial theory of cultural evolution and group selection, which is most clearly outlined in this collection in his essay ‘Notes on the Evolution of Systems of Rules of Conduct’ (Hayek [1967a] 2014). While undoubtedly controversial and problematic, recent developments in social theory have shown that Hayek’s account is perhaps not as flawed as some of his critics have argued.

Hayek’s reference to the importance of ‘the twin ideas of evolution and spontaneous order’ is telling in this regard (Hayek [1967] 2014: 289; see also Chaumont-Chancelier 1999; Gauss 2006). For in Hayek’s view, it is through an evolutionary process that the set of rules required to generate the overall order of actions comes to be established.¹¹ According to Hayek’s theory, human societies develop through a process of competition between groups of people, where the groups in question are defined by reference to the sets of rules to which their members subscribe. The trait that forms the basis for the competition between those groups is in fact an emergent property, namely the ability of the sets of rules in question to generate the overall order of actions: ‘what may be called the natural *selection* of rules,’ Hayek ([1967] 2014: 279) avers, ‘will operate on the basis of the greater or lesser efficiency of the resulting *order of the group*’:

It is the resulting overall order of actions but not the regularity of the actions of the separate individuals as such which is important for the preservation of the group ... [and] the selection process of evolution will operate on the order as a whole. (Hayek [1967] 2014: 280, 283)

Those groups whose activities were structured by a set of rules that gives rise to the relevant emergent property were able to generate the wealth required to sustain higher populations, while those groups that did not adhere to such rules declined in size and ultimately were eliminated, leading eventually to an outcome in which groups that exhibit

the emergent power in question came to predominate. In Hayek's scheme of thought, therefore, the notions of emergence, spontaneous order and evolution are intimately bound together, because it is in virtue of their capacity to generate the emergent causal power to coordinate people's actions without centralized direction that groups—and, more specifically, the sets of rules that characterize them—are selected in the process of social evolution (Gaus 2006; Lewis 2015a).¹²

A noteworthy feature of Hayek's account of cultural evolution is that the emergent property upon which the process of group selection acts is the outcome of the interplay between several different rules rather than being simply the aggregation of their separate effects. Hence Hayek's remark that 'systems of rules of conduct will develop as wholes' (Hayek [1967] 2014: 283):

The evolutionary selection of different rules of individual conduct operates through the viability of the order it will produce, and any given rules of individual conduct may prove beneficial as part of one set of such rules, or in one set of external circumstances, and harmful as part of another set of rules or in another set of external circumstances. (Hayek [1967] 2014: 280)

There is, in other words, an intricate institutional structure, whereby certain rules complement each other in the sense that, taken together, they give rise to capacities that are not possessed by any of them taken alone. For example, as Hayek makes abundantly clear, the existence of the emergent causal power to coordinate people's actions requires not only formal legal rules but also informal moral rules of promise-keeping and truth-telling. One of those types of rules alone will not suffice to generate the overall order of actions (Hayek 1960: 36, 62, 158).

Group-selection arguments of the kind advanced by Hayek have been criticized on the grounds that they depend on the members of the group in question following the relevant set of rules, not because doing so benefits the individuals themselves, but because it is advantageous for the group as a whole. The problem with such self-sacrificing behaviour, the critics argue, is that such groups will be undermined by the growing presence amongst their membership of free-riders who benefit from being part of the group without incurring the costs of conforming to the rules in question. While such groups might enjoy a 'between-group advantage' in the process of competition with other collections of people, the critics contend that they will ultimately be undermined from

within, because the selfish free-riders will enjoy the benefits of group membership without incurring any of the costs of sustaining it. As a result, they will enjoy a 'within-group advantage' over the more altruistic group members who adhere to the relevant rules, being able to out-compete the latter and eventually coming to dominate the group (Vanberg 1986: 85-89).

However, the interpretation of Hayek's work provided above, taken together with recent developments in experimental economics and behavioural game theory, suggests that such criticisms need not be fatal for group-selection arguments of the kind advanced by Hayek. The evidence collected by experimental economists and behavioural game theorists suggests that people often possess so-called *pro-social preferences*. The latter encourage people both to cooperate even with anonymous others with whom it is known that there will be no future interaction and also to punish people who violate social rules even though doing so involves the person carrying out the punishment incurring a personal cost. Such behaviour is said to involve people exhibiting *strong reciprocity* or acting as *rule-following punishers* (Gintis *et al.* 2005; Henrich *et al.* [eds.] 2004; Gintis and Bowles 2014).

The punishment meted out by rule-following altruists is important because it indicates how group selection arguments of the kind postulated by Hayek can be defended against their critics. The presence within a group of even a small minority of altruistic punishers means that other members of the group face a realistic prospect of being penalized if they fail to follow the relevant social rules. The prospect of such punishment can ensure that it is in the interest even of those group members who are not naturally inclined to adhere to the rules in question actually to do so, thereby deterring free-riding and ensuring that the rules that underpin the group's 'between-group advantage' are followed. On this view, altruistic punishment (also known as *second-order cooperation* and involving people enforcing rules) can help to ensure that behaviour in conformity with group-benefitting rules (so-called *first-order cooperation*) is also in the individual's own self-interest. And the realization that a second-order disposition altruistically to enforce the social rules that underpin cooperative group behaviour can help to sustain the set of rules that defines the group and underwrites its emergent causal power to coordinate its members' actions shows how group-selection arguments of the kind advanced by Hayek can be rescued from their critics (Zywicki 2000; Gaus and Thrasher 2013: 645, 652-53).

This argument is strengthened by the possibility, noted in the previous section, that people's dispositions can be shaped by the social rules governing the society in which they live. If we include within the category of 'dispositions' people's preferences—which seems reasonable, because preferences dispose people to behave in certain ways—then what Hayek's theoretical psychology offers is an account of the cognitive processes through which people's preferences are shaped by the rules that characterize the group of which they are a member. The point is that repeated action in conformity with the rules that underpin the social order of actions may ultimately cause people to internalize those rules, so that they acquire a pro-social preference or disposition for adhering to them. And if people come to value intrinsically behaviour that is in conformity with those rules, then they will be less likely to engage in opportunistic free-riding of the kind that might undermine the emergent properties that give their group its 'between-group advantage' (Gaus 2006: 242).

7 NOVELTY, UNCERTAINTY AND ORDER VERSUS EQUILIBRIUM

It is worth reflecting on how variety is introduced in the evolutionary process. Hayek focuses on two possibilities: accident and purposeful rule-breaking. New rules may arise for 'purely accidental reasons' (Hayek 1979: 155), the accidents in question being concerned with the way in which knowledge, skills, attitudes and habits are combined (Hayek 1960: 29-33). In that case the variation that is introduced into the evolutionary process is random. Second, however, and more significantly for Hayek, new rules can arise because there are times when, in the light of their personal circumstances and views, an individual makes a conscious decision to 'brave general opinion and to disregard a particular rule which he regards as wrong' (Hayek 1979: 171). While in his explicit comments on these matters, Hayek typically focuses on moral rules, the scope for introducing variety into social systems also encompasses the rules governing how work is organized and how physical and human capital are combined in the course of producing goods and services. Thinking about this aspect of novelty is useful because it will enable us to connect our discussion of the introduction of variety to our earlier accounts of the notions of emergence and order in Hayek's work.

Evolutionary and Austrian economists such as Hodgson (1997, 2000), Dosi *et al.* (2003), Dopfer and Potts (2004, 2008), and Harper and Endres (2012) have argued that when

entrepreneurs combine human capital, physical capital, and social rules in novel ways, they give rise to emergent properties. New combinations of the intra-organizational rules that govern production can give rise to new, emergent properties at the level of the firm, such as cheaper production processes and an enhanced capacity to innovate (Potts 2000). New combinations of capital goods generate emergent capacities absent from any of the individual components taken in isolation, as for instance when the correct assembly of the parts of an iPhone yields a product that has *sui generis* communicative and data-transmitting capabilities (Harper and Endres 2012). The idea that new combinations of capital goods can give rise to emergent properties, and thereby introduce novelty into the economic system, is of course central to the Hayekian account of capital and, in particular, the idea that there exists complementarities between different kinds of capital goods (Lachmann 1956; Lewin 2011; Harper and Endres 2012).

Significantly, while these new combinations of capital and rules are composed of familiar elements, the emergent properties to which they give rise typically cannot be deduced from, and so cannot be predicted on the basis of, a priori knowledge of their individual component parts. The properties exhibited by such systems are novel in the sense that it is hard, if not impossible, to predict them from our prior knowledge of the elements. In such cases, decision-makers must deal with radical uncertainty; they are unable to assign sharp numerical probabilities to the consequences of their actions and so cannot act in the expected-utility maximizing fashion postulated by rational choice theory (Shackle 1972; Lachmann 1976; Arthur 2013). The answer to how people cope with such uncertainty is found, once again, in social rules. Perhaps most notably, the long-term contracts facilitated by the rules of the legal system enable people to secure a degree of control over their future income and expenditure (in the case of households) and revenues and costs (in the case of firms). Such contracts do not tie down the future completely (unforeseen events may arise, which are not covered by the contract, and one or more parties may unexpectedly renege on their contractual commitments). But they do circumscribe the range of possible outcomes sufficiently for people to be able to orient themselves towards the future in a sensible way. In a complex world, the rules of the legal system play a similar role to that which Hayek attributes to scientific theories in the case of the natural world. While such rules 'do[.] not tell us precisely what to expect, [they] will still make the world around us a more familiar world in which we can move with greater confidence that we shall

not be disappointed because we can at least exclude certain eventualities':

It makes it a more orderly world in which ... we can at least say in general terms how [events] hang together ... Though not in a position to specify precisely what to expect, or even to list all possibilities ... it limits the possibilities of what else may occur ... [thereby] help[ing] us to make our action more effective. (Hayek [1955] 2014: 209-10; also see Hayek 1976: 130).

In this way, such rules enable people to act in a purposeful, goal-driven fashion.¹³

This returns us to the conception of order to which Hayek subscribes. As noted in section 2 above, Hayek defines 'order' as a situation in which a multiplicity of elements are related to one other in such a way that it is possible to learn from an acquaintance of part of the whole to form correct expectations concerning the rest. Over the course of his career, Hayek gradually came to believe that this notion of order was more suitable than the traditional notion of equilibrium for conceptualizing the outcomes produced by the market process, writing in 'Competition as a Discovery procedure' that '[e]conomists usually ascribe the order which competition produces as an equilibrium—a somewhat unfortunate term, because such an equilibrium presupposes that the facts have already been discovered and competition has therefore ceased'. Hayek ultimately rejects the notion of equilibrium on the grounds that it cannot capture the dynamic, open-ended, evolutionary, novelty-generating features of the market process. The advantage possessed by the notion of order is that 'we can meaningfully speak of an order being approached to various degrees, and that order can be preserved throughout a process of change' (Hayek [1968] 2014: 184).¹⁴ For Hayek, therefore, the notion of order is better able to do justice to the nature of the market as an open-ended, evolutionary process of discovery in which, notwithstanding the emergence of novel goods and methods of production, people are still usually able to predict the behaviour of others well enough to devise plans that have a decent chance of coming to fruition.

Hayek advances a *transformational conception of socio-economic order* (Fleetwood 1995: 135-55; Lewis 2015a).¹⁵ For Hayek the continued existence of the inherited stock of social rules that facilitate purposeful, coordinated human agency at any given point in time depends on current human action (Hayek [1967] 2014: 284-89). In drawing upon the inherited rules in order to act, people reproduce—or, if

individuals transgress and engage in new forms of conduct which others subsequently imitate, transform—those rules. What this suggests is that social rules may be seen at one point in time as relatively stable points while at others as features of the economic systems that are subject to change. Commercial law is necessary for the conduct of economic life and indeed facilitates the emergence of unpredictable novelty in economic life, but economic and technological changes of certain types put a strain on aspects of the law that prompt it to change. For example, the emergence of electronic communications has suggested the acceptance of facsimile signatures and has raised difficult legal questions relating to copyright and privacy on the internet. However, so long as the extant set of rules continues to generate the emergent causal power to coordinate people's plans, an outcome that is orderly in the sense defined above will still be generated. On this view, social order is the (continual, never-ending) process whereby people draw on (pre-existing, historically given) social rules and norms in order to act and, in so doing, subsequently either reproduce or transform the rules in question.

8 THE NATURE OF THE TENDENCY TOWARDS PLAN COORDINATION

It was argued above that, for Hayek, the capacity of the market to coordinate people's plans is an emergent property of the set of rules that characterises the liberal market system. Put slightly differently, those rules constitute a generative mechanism that, when set in motion by the behaviour of the people whose (inter)actions they shape and structure, gives rise to the emergent causal power to coordinate people's plans even in the absence of centralized direction. The fact that the mechanism underpinning the overall order of action is animated only by human agency is significant because it implies that outcomes in the market are the product of the interplay between two ontologically distinct and relatively autonomous causal powers, namely the overall order of actions and the power of people to engage in purposeful, creative decision-making. It is for this reason, of course, that Hayek describes the working of the market system as involving the interplay of causal powers—or 'regularities', as Hayek terms them—'on ... two levels' and involving the 'interaction between the regularity of the conduct of the elements [people] and the regularity of the resulting structure' (Hayek [1967] 2014: 286, 288-89; also see Hayek 1979: 158).

On this view, the actual outcome produced by the market is the result of the interplay between two ontologically distinct, and relatively autonomous, levels, ‘the individual and the social,’ each of which possesses its own distinct (emergent) causal powers. But then there arises the possibility that the capacity of the market to bring people’s plans into conformity with one another might be offset by the capacity of human agents to respond so autonomously, so creatively—and, therefore, so unexpectedly—to their circumstances that they surprise one another and as a result develop plans that are less, not more, compatible. The creative powers of human agents may be such that, to use the terminology employed by subsequent generations of Austrian economists, dis-coordinating forces are generated endogenously, as part of the market process. Moreover, the tendency to endogenous dis-coordination produced by creative human agency may even outweigh the capacity of the liberal market economy to bring plans into greater conformity with each other, so that the operation of the market process leads to less, not more, plan coordination (Lachmann 1976: 129; Rizzo 1996: xvii-xxi; cf. Beinhocker 2006: 109-14; Arthur 2013).¹⁶

Ultimately, therefore, as Hayek himself clearly recognized, even in the absence of external disturbances the question of whether the market system tends to produce greater plan coordination cannot be answered on the basis of a *a priori* argument alone. As Hayek remarked in 1983, ‘while the analysis of individual planning is in a way an *a priori* system of logic, the empirical element enters in people learning about what other people do ... [Y]ou can’t claim, as Mises does, that the whole theory of the market is an *a priori* system, because of the empirical factor which comes in that one person learns about what another person does’ (Hayek, quoted in Caldwell 2004: 221; also see Hayek [1937] 2014: 68-70). Of course, the evidence indicates *ex posteriori* that the coordinative powers tend to prevail. However, as Hayek himself clearly recognized, there are no guarantees that they will always and invariably do so.

9 CONCLUSION: HAYEK AND COMPLEXITY THEORY

We end by considering the extent to which Hayek’s ideas anticipate the work of modern complexity theorists (Vaughn 1999b; Vriend 2002; Rosser 2010). While there are many different definitions of complexity, none of which command universal ascent (Horgan 1997), complex systems are commonly said to possess the following attributes.

- First, they are composed of a set of elements which are related to one another in a particular way, forming a structure that governs how they interact and that displays emergent properties (Holland 1998: 2-6, 14, 225; Miller and Page 2007: 9-10, 48-50; Page 2011: 25-26).
- Second, they are hierarchical, in the sense that systems obtaining at one level of organization (the physical, say, or the individual) form the building blocks (sub-systems) out of which systems obtaining at higher levels (the chemical or the social respectively) are composed (Holland 1988: 6-9; Miller and Page 2007: 40-42, 50-51).
- Third, the emergent properties that obtain at each level of the system are the product of a process of self-organization, arising as a result of the rule-guided responses of the individual elements to their local environment (rather than from directions issued by a central controller possessing an over-arching, synoptic view of the entire situation) (Holland 1998: 141-42; Beinhocker 2006: 167-68).
- Fourth, these properties are often novel in the sense that it is hard, if not impossible, to predict them from our prior knowledge of the elements. On this view, novelty is generated endogenously, via the operation of the system itself, as well as through exogenous shocks (Holland 1998: 4, 229-30; Beinhocker 2006: 97; Arthur 2013).
- Fifth, the systems obtaining at each level are adaptive in the sense that they adjust to the broader environment in which they are situated via an evolutionary process involving variation, selection, and (differential rates of) reproduction (Beinhocker 2006: 18-19; Page 2011: 25).
- Sixth, the outcomes produced by such systems do not lend themselves to being understood using standard notions of (economic) equilibrium, but rather in terms of alternative notions of ‘order’ (Beinhocker 2006: 17-19, 76-75; Miller and Page 2007: 222; Page 2011: 27; Arthur 2013).

Hayek’s explicit definition of complexity tends—as we have seen—to focus on the number of variables required to represent a system and on the presence of emergent properties (section 3 above). However, Hayek’s writings, as showcased in the volume under review here, also refer to most if not all of the other aspects of complexity listed above, so that his own use of what would now be regarded as complexity-related ideas often outstrips his explicit definitions of complex systems. For, as we have seen, Hayek attributes to mind, and to society, many of the other features commonly said to be hallmarks of complex systems: in each case, order arises spontaneously as a result of rule-governed interactions between the system’s parts rather than through conscious con-

trol (see the second and fourth sections above); both systems are adaptive, evolving so as to become better fitted to their environment via a process of group selection (see the sixth section); the two systems form part of a larger hierarchy of structures (see the fourth and fifth sections); while the patterns produced in such systems are best conceptualized not in terms of 'equilibrium' but of 'order' (see the seventh section).

It is important not to exaggerate the extent to which Hayek anticipated modern complexity theory. His understanding of some of the concepts listed above was of course different in certain key respects from that of modern complexity theorists. For instance, it is hard to argue convincingly that in his notion of 'order' Hayek had an (implicit) understanding of technical concepts in modern complexity theory such as 'basins of attraction' and 'strange attractors'. Moreover, there are also important respects in which Hayek's account of complex systems diverges notably from modern complexity theory. For instance, Hayek's account of the economy as a complex system tends to emphasize negative rather than positive feedback (Hayek [1968] 2014: 309), whereas contemporary complexity theory sets great store by increasing returns to scale and positive feedback (Miller and Page 2007: 50-52; Witt 2013: 123; Arthur 2013). Also, Hayek's ideas about complexity tend to be presented discursively, in marked contrast to the present-day emphasis on mathematical and computer modelling. However, it seems safe to conclude, following Rosser (1999: 185-86), Caldwell (2004: 363) and Gaus (2006: 254 n. 5), that, while Hayek never developed what contemporary complexity theorists would regard as a fully-fledged theory of complexity (in the sense of articulating a completely integrated, formal account of all the features listed above), his writings display many of the ideas that were later crystallized into complexity theory.¹⁷

What is clear enough, though, as this essay has hopefully demonstrated, is 'the gradual emergence of and, indeed, the underlying *order* to be discovered in Hayek's ideas' (Caldwell 2014: 1). As editor Bruce Caldwell (2014: 35) writes: 'The title of this volume is *The Market and Other Orders*. The title is meant to highlight Hayek's own path: he began with the market order, then became aware of the existence of orders in many other areas.' Caldwell has succeeded admirably in his aim of bringing out the unity in Hayek's thinking across a wide range of topics that might appear at first glance to be rather disparate. Scholars have reason to be grateful for the care and good judgment with which he has curated this volume.

NOTES

- 1 By 'dispersed knowledge' Hayek ([1945] 2014: 95) means, in his famous phrase, 'the particular circumstances of time and place.' This encompasses knowledge of 'local conditions and of special circumstances' rather than of 'general rules.' Examples include knowledge of 'a machine not fully employed, or [of] somebody's skills which could be better utilised, or ... of a surplus stock [of some good].' As these examples attest, local knowledge is often explicit, propositional knowledge (that is, knowledge that such-and-such is the case). In the case of 'tacit knowledge', however, people have the capacity to act according to (general) rules without necessarily being able to state those rules explicitly (Hayek [1962] 233; [1969] 2014: 317-18). An example of such 'know-how' is provided by a person's ability to speak and write grammatically correct English without being able to articulate the rules of English grammar. Herein then lies the distinction between these two kinds of knowledge: dispersed knowledge is explicit and has as its object particular facts; tacit knowledge is not propositional and has as its object general rules. Of course, notwithstanding the possibility of drawing such analytical distinctions, Hayek also notes that in practice two forms of knowledge may come into contact with each other. For example, in 'Competition as a Discovery Procedure,' Hayek argues that one example of tacit knowledge is provided by an entrepreneur's 'capacity to find out particular circumstances.' That is to say, according to Hayek, while entrepreneurs possess the capacity to discover local, propositional knowledge, they may be unable to 'list the principles that underlie their ability to do so' ([1968] 2014: 306).
- 2 As Caldwell rightly notes in his Introduction, Hayek's emphasis is on the role of disequilibrium, as distinct from equilibrium, prices (2014: 9-11; also see Thomsen 1992 and Kirzner 1997).
- 3 In a series of lectures delivered at the University of Virginia in 1961, entitled 'A New Look at Economic Theory' and published for the first time as Appendix A of this volume, Hayek offers a similar account of 'The Communication Function of the Market,' couched not in terms of tin but of sisal and jute (Hayek [1961] 2014: 415-22).
- 4 As Hayek puts it elsewhere, the information provided by market prices enables people to form reasonably accu-

rate expectations of one another's plans only if it arises against 'a fairly constant framework of known facts,' as provided by social rules and norms (Hayek 1976: 125). Thus, stability and predictability in one sphere, namely that of institutions, is a necessary ingredient for coping with its absence (unpredictable novelty) in another sphere (Lewin 2014: 187-88).

- 5 In addition to being the first place where Hayek used the term 'spontaneous order,' the Cairo lectures also saw him elaborate on several issues in political theory, the history of political thought, and jurisprudence—such as the notions of 'equality before the law' and the 'rule of law,' as well as the history of liberalism—that would form part of the core of *The Constitution of Liberty* (Hayek 1960; see Caldwell 2014: 12-14).
- 6 The reason why the claim about coherence concerns Hayek's post-1937 work in economics is that, as Hayek notes in the long passage from 'Kinds of Rationalism' quoted in the main text, and as Caldwell (2014: 3-5) explains in his Introduction, Hayek's 1937 paper on 'Economics and Knowledge' marks a major shift in his approach to economic analysis. Prior to that paper, Hayek was an exponent of the standard approach to economics, namely equilibrium analysis. Indeed, before 1937, Hayek virtually defined economics as equilibrium analysis, maintaining that any legitimate *economic* explanation must employ some notion of equilibrium. However, due principally to the experience of participating in the socialist calculation debate of the 1930s, Hayek came to question the merits of the equilibrium concept. The use of general equilibrium theory to justify market socialism led Hayek to revise his understanding of his own approach to economics and to begin to distance himself from that mode of analysis. For in responding to the arguments of the market socialists—arguments that were couched in terms of the equilibrium framework by which he himself had set such store in the past—Hayek came to realize that his emergent understanding of the market as a dynamic process of adjustment was one to which equilibrium analysis could not do justice. The reason, of course, is that by confining itself to situations in which people's plans are already coordinated, equilibrium analysis ignores the most important question that must be answered both in explaining how market economies work, and also in evaluating the feasibility of central planning, namely that of how (if at all) people acquire the information they need to coordinate their plans and thereby achieve an orderly

allocation of resources (Kirzner ([1988] 1992; Caldwell 2004: 155-62, 209-220, 409-22).

- 7 Hayek makes a similar point in *The Errors of Constructivism*, writing that '[t]he order of society is therefore a factual state of affairs which must be distinguished from the regularity of the conduct of individuals' (Hayek [1970] 2014: 344).
- 8 Hayek was of course aware of the fact that the 'organized' wholes to which he referred were not consciously designed. In this context, the term 'organization' was, of course, being used in a sense different to that intended by Hayek in his criticisms of constructive rationalism. As Hayek put it in the first volume of *Law, Legislation and Liberty*, '[t]he biologist will generally speak without hesitation of "organization" without implying design ... [B]iology has from its beginnings been concerned with that special kind of spontaneous order which we call an organism' (Hayek 1973: 27, 37).
- 9 Given that, on Hayek's account, both the mind and the market—and, indeed, other facets of social life, such as the law—are complex systems in which order arises spontaneously, the question arises of whether there is a common, underlying account of 'system' and of 'spontaneous order.' It is noteworthy in this regard that the theoretical biologist Ludwig von Bertalanffy, upon whose notion of 'system' Hayek draws (see Hayek n.d.: 4; Hayek [1961] 2014: 381-82), sought to develop a trans-disciplinary framework—couched in terms of concepts such as 'organization,' 'level,' and 'emergence'—that was applicable to all phenomena of organized complexity, independent of their substance or spatio-temporal sphere of existence (Bertalanffy 1950: 164-65; Bertalanffy 1952: 11). Bertalanffy termed his framework general system theory and it would seem to be one candidate for the unifying account in question. For more on Bertalanffy's influence on Hayek's thinking, see Lewis (2014, 2015c). And for interesting efforts to find an abstract account of 'spontaneous order' common to all the particular examples considered by Hayek, see Bernstein (2008) and diZerega (2013).
- 10 In this regard, Hayek's work is compatible with the ideas of various evolutionary, old institutionalist, and modern complexity economists, all of whom emphasize the scope for social rules to help constitute human agents and, therefore, human agency (Hodgson 2004: 184-86, 2007; Gintis and Bowles 2014; Gintis and Helbing 2015; Harper and Lewis 2012: 1-3; Lewis 2015b).

- 11 The foil against which Hayek develops his evolutionary account of the emergence of the set of rules in question is provided by those approaches, such as contractarian political philosophy and legal positivism, which portray rules as the deliberate creation of conscious reason. Hayek contends that, while the roots of this ‘constructivist rationalist’ approach are ultimately to be found in Greek philosophy, its modern influence begins in the sixteenth and seventeenth centuries with the works of Francis Bacon, Thomas Hobbes, and in particular René Descartes. Hayek traces the influence of their ideas through the works of French thinkers such as Rousseau and Comte and of English legal positivists such as Bentham and Austin, via Hegel and Marx, and ultimately to the market socialists and Fabian reformers of the twentieth century. From the current collection, see in particular the essays entitled ‘Kinds of Rationalism’ (Hayek [1965] 2014), ‘The Results of Human Action but not of Human Design’ (Hayek [1967] 2014), and ‘The Errors of Constructivism’ (Hayek [1970] 2014). These essays also contain Hayek’s account of the evolutionary tradition of thought to whose revival he saw himself as contributing, and whose leading exponents included the Scottish Enlightenment thinkers Hume, Smith, and Ferguson, the Spanish Schoolmen, the conservative political philosopher Edmund Burke, and the founder of the Austrian school of economics Carl Menger.
- 12 It is also worth noting in this context that, according to Hayek, the mind develops via a process of selection through which neural structures are reinforced or whither, according to how successful they are in promoting behaviour that is well adapted to the prevailing context in the sense of enabling a person to achieve his or her goals. Hayek’s account is one in which structured groups of neurons are selected by virtue of their emergent capacity to classify the world in a way that enables people successfully to navigate their environment (Hayek 1952: 74). This process of neuronal group selection on the basis of the emergent properties of the group of neurons is, of course, analogous to the process of group selection that Hayek believes accounts for the development of rule-governed social systems such as the market economy.
- 13 What this suggests, of course, is that it is not only social scientists who engage in pattern prediction; the occupants of complex systems also have to rely on pattern prediction in attempting to devise plans that have a decent chance of being brought to a successful conclusion. For more on the nature of plan coordination, and on different kinds of knowledge that can sustain it (including the kinds of knowledge possible in complex systems), see Lewin (1997: 251-53; 2011: chapter 3).
- 14 As Caldwell notes elsewhere, in a lecture delivered in 1981 Hayek was unequivocal in his dissatisfaction with the equilibrium concept as a means of capturing the market process. Using the metaphor of a stream to articulate his ideas about the way in which the price mechanism coordinates the capital stock to continuously changing economic conditions, Hayek comments as follows: ‘It is tempting to describe as 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 the process and its various later stages, the achievement of an equilibrium is strictly impossible. Indeed, in a literal sense, a stream can never be in equilibrium, because it is disequilibrium which keeps it flowing and determining its direction’ (Hayek, quoted in Caldwell 2004: 226-27).
- 15 The same is arguably also true of another Austrian economist, Ludwig Lachmann. See Lachmann (1970), Lewis and Runde (2007), Lewis (2011) and Lewin (2014).
- 16 On this view, the emergent causal power of the market to coordinate people’s actions is best viewed as giving rise to a non-empirical or transfactual tendency towards the dovetailing of people’s plans, whose impact on the outcomes that actually arise may be offset by the impact of other, countervailing tendencies, most notably those produced by creative human agency (Lewis 2011).
- 17 This is unsurprising once it is remembered that Hayek was developing his ideas at a time when the scientific problems and concepts that were the precursors to modern complexity theory were being discussed and developed (Vaughn 1999b; Lewis 2014). If it is indeed the case, as Colander and Kupers (2014) argue, that there is no unified theory of complexity that incorporates all of the features of complex system listed in the main text, then Hayek’s ‘failure’ to develop such a theory looks like less of a shortcoming than it otherwise might.

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General Disequilibrium: the Hidden Conflict between Fractional Reserve Banking and Economic Theory

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Abstract: Banking systems based on ledger entries, held against fractional reserves of physical currency, using double-entry book-keeping have played a key role in Western monetary systems for several centuries. Over this period economic analysis has wrestled with both the esoteric treatment of the daily and familiar form of money within the banking system, and with understanding the economic role of the monetary system itself. A complex emergent system based on statistical multiplexing techniques introduced many centuries before they were developed in other fields, the banking system has consequently both influenced economic analysis, and been subject to it, as repeated attempts have been made to regulate its behaviour. Unfortunately, a long history of thought stretching from Hume to the current day repeatedly demonstrates that no economic theory of money has ever survived contact with the indignities that the daily operation of the banking system inflicts on the unit of economic measurement. We will argue that by introducing perturbations into the monetary system over time scales that were effectively invisible in day-to-day economic activity, the banking system has been a major obstacle preventing the development of a complete and causally based understanding of the monetary and financial framework underlying modern economies.

Keywords: banking, emergent systems, cash-liability money dichotomy.

1 INTRODUCTION

The complex arrangement of double-entry book-keeping ledgers, bank notes, loans, reserves and capital that slowly developed into today's banking system has always occupied a precarious economic niche. Too convenient to be abandoned, and too unstable to be left alone, it has been the subject of political discussion and repeated attempts at regulation for over three centuries. Our understanding of the monetary system it facilitates has developed in tandem, an intricate dance of theoretically based arguments on the role of the monetary system within the economy and the causes of its financial crises, resulting in regulatory frameworks that attempted to impose economic order on the banking system's behaviour. As theorists attempted to impose on the

banking system their views of its proper behaviour, banking systems have imposed on the economy the results of their misconceptions. The consequences of continuous and subtle mutations in the regulation of the supply of money and credit to the economy, and the distortions caused from the use of money as a unit of measurement without recognition of its abnormal behaviour as a measure, are clearly visible in economic theory today. Uniquely, of all the sciences, economics has arrived in the 21st century without a clear consensus on its fundamental components, and indeed without even an uncontested definition of its fundamental unit of measurement—money.

What exactly do economists mean when they use the word money? Historically, the liability bank deposit used for the vast majority of financial transactions today was either

ignored by economic theorists, or treated as an inconvenient or even fraudulent complication. However, from the point of fractional reserve banking's introduction, money consisted of two separate entities. A payment made into a bank, created an asset deposit of the money being paid in, and a liability deposit, representing the customer's claim on that asset. Two very different entities, both commonly referred to under the general rubric of 'money' by the economic literature, with critically different roles and behaviours within the financial system.

A 21st century perspective of long-term money supply series clearly shows that a 'background noise' of continuous increases in the quantity of both money represented in liability bank deposits, along with occasional sharp contractions, has played out ever since the introduction of fractional reserve banking. This increase occurred at varying rates depending on time and country. While the causes and effects of this behaviour have received considerable attention, a similarly long perspective on economic theory also shows that this feature of the monetary system has never been fully integrated into economic or social analysis. Greenlaw (1958), commenting on France in the 1780s, aptly illustrates the entire problem:

An infallible sign that the wealth of the country was increasing was that the population was growing rapidly and the prices of commodities, land and houses were steadily rising. ... while later we are informed that the number of banks had also increased greatly under Louis XVI.

The most likely of several interpretations of this information is that the introduction of fractional reserve banking was rapidly inflating the money supply. What actual increase in possessions and living standards might have been occurring is impossible to deduce, but the subsequent French Revolution in 1789 is a less than compelling argument for an era of general prosperity. (Greenlaw 1958)

The definitions of money used today in economics are more complex, but they are also more confused. The official monetary measurements of many countries typically include a mixture of both asset and liability banking deposits. In some cases forms of debt under the label of 'near-money' are also included. There are many incongruities, a distinct lack of standardization, and even what appears to be occasional double counting. For example, banks classify money that is deposited with them as an asset, and simultaneously create a matching liability—the bank deposit. Consequently, add-

ing the total of the banking system's asset cash deposits (base money, or M0 in the United States), to the total of its liability deposit accounts (M1 and M2), will effectively count physical deposits twice. Similar issues occur with money market funds, which are mainly held in short-term commercial paper (debt), but can also include deposits in the banking system.

Do these obscure technicalities matter? We are talking about the unit of measurement for the entire economy. Even within the limited domain of pure monetary analysis, it is easy to show that as a direct consequence confusion abounds. For example, in a recent paper by Koo (2011), the M4 measure in the United Kingdom is used in comparison with the M2 measure in the United States to support the claim that neither country's money supply has increased, despite quantitative easing. By virtue of their very different compositions, the American M2 and the British M4 measure are not directly comparable, and in fact the American M2 measure has increased from \$8 trillion to \$11 trillion over the period reported by Koo, reflecting a slightly over \$1 trillion increase in asset money attributable to the TARP program, and a \$2 trillion increase in liability bank deposits.¹ Meanwhile, in the United Kingdom the M2 measure, which is similar if not identical to the American M2², shows an 18-month contraction which was masked in the M4 measure by the latter's inclusion of debt and the asset-money deposits in large part created by quantitative easing. Koo's claim that the 'loans and leases in bank credit' component of the Federal Reserve H.8 release has dropped is correct, but in the same table government treasuries (a form of debt) have increased, and net bank lending has of course increased, matching the increase in the money supply.

These kinds of distinctions are rarely drawn in general discussions of economic theory and policy, where the specifics of banking system operations are usually abstracted or overlooked. Be that as it may, only if it can be formally demonstrated that these distinctions are immaterial can the specifics of money within the banking system be legitimately ignored, and as the previous paragraph demonstrates, this is not the case. Since the banking system itself consists of a complicated set of book-keeping rules, which vary over time, and sometimes, as is the case currently in the Eurozone, within it: the problems of an already complex discussion have now been considerably multiplied.

How far though would chemistry or physics have advanced, if scientists still believed that the sole components of matter were earth, water, fire and air?

Even the most fundamental relationship of money to the economy through its influence on the price level still lies open to question. As Knut Wicksell (1898) illustrated early in the 20th century, there are very real problems with the quantity theory of money in economics, which attempts to establish the relationship between money, prices and economic transactions in the economy, one of which he illustrated as follows:

Let us suppose that several individuals, A, B, C, D, etc., have been given credit (e.g. merchandise credit) by one another, so that A owes money to B, B to C, C to D, etc. The repayment of these debts requires that a certain sum of money shall pass from A to B, from B to C, etc. If all the promissory notes fall due on the same date and involve equal sums, then repayment can be accomplished in a very short space of time and with the aid of the same pieces of money. (Wicksell 1898)

Since this observation is equally applicable to direct exchanges of money between A, B, C and D for goods of equivalent price, it provides, if not justification for economists to abstract money out of their equations, certainly some sympathy. Price provides no information about supply in this situation, in direct contradiction to the quantity theory. Masked by the continual expansion of its supply since the introduction of fractional reserve banking, is an underlying reality that money simply does not behave like other units of measurement and this is not only due to variations over time in its quantity.

Awareness of this type of problem required knowledge of some of the more interesting features of the banking system, and in particular acceptance of its now notorious propensity to ‘manufacture money out of thin air,’ and this was slow to develop. Eighteenth and Nineteenth century writers focused on the ability of individual banks to vary the quantity of their physically issued banknotes, and issues arising from trade and accompanying international gold exchanges, which interfered with the gold-based regulatory mechanisms of the banking system. Bank deposits were not generally included in the definition of money, and so their gradual expansion was ignored. While we can assume—simply from the term ‘fractional reserve’—that the importance of limiting the expansion of liability-deposit entries against holdings of physical currency had been recognized at least by those controlling the banks, attempts to formalize the calculation of the accompanying multiplier effect do not appear in the literature until the early 20th century. The first appearance of

the flawed description of this process found in today’s entry-level textbooks appears to be the 1931 Macmillan Report to the British Parliament. Authored by John Maynard Keynes, it predicted a bounded monetary stability that was subject to central bank control. It was a theory even the limited evidence of its time did not support.

Something unusual in the twists and turns of the development of scientific knowledge occurred between that description, and the current day. Rather than developing a deeper and more complete understanding of the operation of the banking system, general knowledge of the complexities surrounding the banking system regressed. Knowledge of the double-entry book-keeping aspects of the system are evident in Keynes’ description, and indeed were required to fully appreciate it. That there were important structural and potentially systemic differences between banking systems was also acknowledged; both Lawrence’s (1928) attempts to characterize the deposit expansion rate of the US banking system and Watkins’ (1938) of the English system include these factors in their analysis, while Keynes (1929) also commented on significant differences within the US system in his *Treatise on Money*.

British contemporaries of Keynes had reason to believe that their system was stable, since as Laidler (2003) describes, after an extraordinarily periodic series of banking crises in the 19th century, the British system had settled into a period of seeming stability after 1870. The ‘British monetary orthodoxy,’ as Fetter (1965) described it, would consequently become the template for banking systems worldwide. It relied on a lender of last resort to rescue temporarily illiquid banks, mandatory reserves, convertibility with gold to regulate its lending and resulting monetary expansion, and the productive forces of an empire to sustain it. It lasted forty years.

Economic stability can be a slippery term. The stable feature of the late 19th century British economy was mild price deflation. Similar to today, there were dramatic increases in production from technological development and population growth, as well as a slow but steady increase in the money supply as measured by liability bank deposits, accompanied by a punctuated equilibrium of periodic credit crises. The contemporary perception of its stability owed more to the relative instability being then experienced in mainland Europe and America, whose origins lay partly in bimetallism—a now obscure detail of financial systems where silver occupied a similar role to gold; and in the case of the United States a free-wheeling approach to banking practices in an as yet largely unregulated system.³

Price stability however does not imply monetary stability, which is one of the several distinctions between money as a unit of price measurement and as physical units of measurement. Price changes in a market-based economy can have several causes, including increases or decreases in production, increases or decreases in the supply of money, and changes in the supply of credit. It is consequently not possible to know, purely from price measurements, what is actually changing within the economy. Perceived price stability can occur at the same time as monetary expansion as long as it is matched by productive expansion. Indeed economists frequently state that as long as productive expansion matches monetary expansion the latter is unimportant. A convenient argument given the general uncertainty surrounding the subject. Was the British banking system of this period then truly stable, or was it simply collapsing over a longer period than previously due to the extraordinary increases in production created by the Industrial Revolution?

The perception of stability, but the reality of something else, was to prove a dangerous combination, not only because it led to an unwarranted faith in central bank control of the banking system, but also in gold standard regulation, and in particular in fixed exchange rates between countries. It is in the subsequent attempts in the 20th century to impose international fixed exchange rate monetary systems that we can see some of the large-scale ramifications of the failure by economic theorists to develop their understanding of the banking system. On two separate occasions in the last 60 years, international treaties have been based on assumptions about the behaviour of the system that were not only incorrect, but also guaranteed their eventual failure. The treaties of Bretton Woods in 1944 and of Maastricht in 1992 made commitments to fixed-rate exchange systems between countries with widely different expansion rates in their underlying monetary systems. No explanation appears to ever have been provided as to how such an arrangement could be expected to endure, as the monetary and accompanying credit expansion influenced local price levels at varying rates as a result of the systems expanding out of step with one another. Nor has the presumption that the national central banks had sufficient control over their banking systems prevented this differential expansion from slowly tearing the fabric of the resulting interlinked economies apart.

The subsequent history is either well known or soon will be. Following a period of initial adjustments that were excused as adaptations to the new monetary system, major revaluations within the Bretton Woods agreement occurred with increasingly frequency. Canada devalued in 1962, the

United Kingdom and Denmark in 1967, France in 1969, Germany re-valued in 1961 and 1969, Holland in 1961, and Austria and Switzerland in 1971. The absence of any monetary analysis concentrating on the actual mechanics of the system by economists of the period is notable. Katz (1971), writing shortly before the Bretton Woods breakup in 1971, concentrates primarily on observed measurements, in particular variations in rates of inflation and balance-of-payments imbalances as the source of the issues afflicting the agreement: effectively treating these empirical factors as a cause rather than an effect. The same process is now occurring in the Eurozone, where monetary expansion rates in its various national banking systems have ranged from 1.3 in Germany to 3.0 in Spain over its first decade. However, there is no mechanism within the euro for the exchange rate readjustments that prolonged the Bretton Woods agreement. Calls for a banking union to deal with the symptoms of variable monetary expansions ignore the need for the far deeper exploration of its mechanical causes that might still provide practical solutions.

To discuss these issues we must confront their principle cause: the absence of a clear and correct description of the banking system in economics textbooks. In the rest of this paper we will first provide a more detailed description of some simple banking system operations that may provide some clarity to readers unfamiliar with the subject, before proceeding to a detailed review of the flawed descriptions of the operation of the banking system that is found in economics textbooks. We will show how detailed knowledge of the operation of the system is surprisingly critical even at the macroeconomic level, and explore some of the analytical problems that fractional reserve banking has created for economic analysis. We will suggest that a critical and fundamental failing in economic theory to date is the failure to develop an atomic theory of money with concrete definitions of the two different forms of money and their role in the banking system, as well as of their role in a complex network of long-term monetary flows. It is the absence of such definitions that is the root cause of much of the confusion that macroeconomics in particular currently finds itself in. Indeed, only by focusing once again, as researchers did in the 1920s, on the detailed operations of banking, and by developing an atomic theory of money, can we reconstruct an economically relevant theory of monetary and financial operations for 21st-century society.

2 MONEY, CREDIT AND THE FRACTIONAL RESERVE BANKING SYSTEM

Fractional reserve banking practices introduced a new form of money within the economy, an entry on a deposit ledger within the accounting framework provided by double-entry bookkeeping. Although the status of bank deposits as equivalent to physical currency was first recognised in the 1820s by Pennington and others⁴, the subsequent debate on whether this accounting entry enjoyed the same status as physical tokens of money lasted well into the 20th century. Traces of it can still be found in claims that ‘money is debt,’ with continuing confusion arising from its presence on both sides of the balance sheet: as an asset in the form of physical money and regulatory reserve requirements, and as a liability in the form of a customer’s deposit, and in some forms of equity. By the end of the 19th century though, Dunbar (1887) was reporting that over 90 per cent of all financial transactions were being performed within the banking system. In today’s largely computerized systems, it is probably the status of physical cash as fully equivalent to bank deposits that should be questioned.

The existence of two separate but equal forms of money within the same system suggests a more fundamental definition might be useful, if only to avoid the somewhat tedious debates on the validity of these different forms of money. For the purposes of this paper we will borrow a definition from complex systems, namely that each unit of money at the smallest subdivision for its currency, is a discrete bit of information. Information, in the sense that Shannon (1949) defined, has the specific meaning of a single, indivisible and unique piece of information, and is a foundational construct of data communications and networking theory.⁵ Using this definition we can unify the concept of money under a single general description, whilst still being able to discriminate between its different forms in the monetary systems by being specific about the type of money in question and its position in the banking ledgers—for example liability money (customer bank deposits) or asset money, which can be either physical deposits of cash or electronic equivalents, while the reserve account represents a liability deposit at the central bank. Even with a unified definition, we still have to carefully distinguish the different types of monetary information being used, as they are not necessarily interchangeable—for example, there is no direct way to transfer a unit of asset money from a bank’s balance sheet to a liability money de-

posit at the same bank; the rules of double-entry bookkeeping explicitly forbid this operation.⁶

More importantly, we sidestep the discussion of whether physical, fiat, or deposit money is truly money. They are all forms of money in its definition as information, and we can concern ourselves with the more important issue of the systemic behaviours that result from the operations performed on these different forms of money. This also leads us to a convenient definition of debt as a contractually committed flow of money over time, and by extension the treatment of the larger credit system as a networked system of debt relationships through which monetary flows are conducted. This not only develops naturally from the role money plays within society as a unit of communication, but also allows us to integrate money within the framework offered by complex systems, and in particular, real time network systems analysis, from which the definition of information originates.

3 EMERGENCE

Double-entry bookkeeping processes and procedures were originally introduced at the end of the 13th century as described by Lee (1977). They are a sophisticated technology in their own right, as well as being an early example of a forward error-correction algorithm.⁷ Double entry bookkeeping required that each individual financial transaction be simultaneously recorded as two separate actions, a (debit, credit) tuple on two separate ledger accounts. These transactions were based on the accounting equation:

$$\text{Assets} = \text{Liabilities} + \text{Equity}; \quad (1)$$

or, in its longer form:

$$\text{Assets} = \text{Liabilities} + \text{Equity} + (\text{Income} - \text{Expenses} - \text{Dividends}). \quad (2)$$

It is worth observing that neither of these equations can be regarded as mathematical identities, since the units of their components do not match; there are also order of evaluation issues in (2) if bracketing is not strictly observed.

The single bookkeeping operation, which effectively created the banking system, is the record of the deposit of physical money, leading to the creation of a corresponding liability entry in the ledger, representing the deposit thus:

[Debit Cash (asset), Credit Customer Account (liability)]

This simple operation would eventually pave the way for a complete disassociation between the physical money deposited and the ledger entry acknowledging the deposit.

Initially it simply allowed physical gold to be deposited at the early goldsmith bankers for storage. The customer received a receipt; the goldsmith provided safe storage for his or her gold.⁸ Significantly though, individual gold deposits were regarded as interchangeable. The customer received a receipt for an equivalent amount of gold, rather than the actual pieces of gold that they deposited.

From this first step of fiscal separation, all that was required for a modern banking system to develop were three additional developments, each of which can be seen as a natural emergent step from the facilities that double-entry bookkeeping provided. On the customer side, the receipt for a fixed amount of gold at a reputable storage location was used in lieu of the gold itself—thereby avoiding the hazards of carrying precious metals to and from a known location in an era before the introduction of police forces. As goldsmiths then became aware of the relative permanence of their physical holdings, they began to provide short term loans of gold, effectively introducing statistical multiplexing between their gold holdings and their customer deposits. The final step needed for the banking system we recognize today was a development of the use of simple instructions as a substitute for actual gold exchanges which would allowed direct transfers between customer accounts—cheques.

Technology would replace hand-written receipts with recognizable bank notes, and eventually restrictions on their issuance. A centralized meeting place, originally a convenient tavern⁹, would develop into intricate clearing algorithms to manage the exchange of cheques between banks, as illustrated by Campbell-Kelly (2010). Short-term shortages of physical money caused by a variety of systemic problems, but visibly taking the form of bank runs, would lead to central banks and their role as the lender of last resort. As the system in Britain began to stabilize, or at least experience longer periods between crises, a belief grew in the ability of central banks to control the entire system. The army of clerks employed in 19th century cities to manage the day-to-day bookkeeping surrounding banking gave way in the 20th century to the computer and network technology which provides the pervasive electronic monetary systems in use today.¹⁰ What though of the nature of money?

4 MONETARY PAYMENTS

The immediate consequence of fractional reserve banking practices were that transfers of money between two parties could now be conducted in three different ways. Physical tokens of money could be exchanged directly between individ-

uals; but there were now also two ways to perform a ledger exchange between two bank deposits, either by direct ledger operations for customers of the same bank, or critically using an accompanying exchange of asset money for customers at different banks.¹¹ When customer deposits were transferred between banks with cheques or other financial instruments, physical money was used as an intermediary. This introduced a dependency within the banking system on physical money—to perform exchanges with other banks—that was critically important for the stable operation of the banking system, but effectively removed asset money from contributing materially to the price level.¹² The book keeping operations¹³ were:

<i>Originating Bank</i>	<i>Receiving Bank</i>
(Credit cash, Debit customer account)	(Debit cash, Credit customer account)

However, if the originating bank did not have enough asset money to make the transfer, then it was illiquid. This could create short-term flow issues, even when the bank could predict that there was sufficient future income from its loan book to cover its obligations. While in principle a bank can completely predict its future status this way, the technology and mathematical support for this would not be developed until the 20th century, and only in the early 21st century would Taufemback and Da Silva (2011) first consider applying Erlang queueing theory, which was originally developed in the 1920s for engineering telephone exchange capacity, to the problem of bank reserve management.

There were now significant differences between the treatment of physical money and its virtual counterpart on the deposit ledger, but all might still have been well for economic theory had operations involving physical cash been the only way that liability deposits could be created within the banking system. However, the accounting framework also allowed lending instruments to be created, and this was accounted similarly to cash deposits. Loans were entered identically to a cash deposit at the receiving bank:

[Debit loan, Credit customer account]

Repayment involved two separate operations—payment of principal was simply removed from both sides:

[Credit loan principal, Debit customer account]

whilst interest payments took place entirely on the liability/equity side, as the customer's account was debited, and the bank's interest income account was credited:

[Debit Customer Account,
Credit bank interest income account]

This last operation provides a very simple answer to the question of the direct effect changes in interest rates have on the supply of money and credit from the banking system, and that is in most banking systems, none. Interest payments are simply a flow of money between a bank's customers and the bank. If the bank maintains the same spread between its saving and lending rates, then there is also no effect on the bank's total income. However, there can be second-order effects from interest rates if bank profitability, or the loan default rate, are impacted.

Control of the amount of lending performed by banks depended on practices developed by the goldsmiths, and these were primarily empirical, derived from observation of the day-to-day demands for money on the asset side of the balance sheet (physical cash and gold), and the need to ensure

that these did not exceed the bank's actual holdings. Several centuries before the technique would be introduced to solve bandwidth contention in radio communications, the banking system was using statistical multiplexing, balancing the use of a small amount of physical money that was nominally the bank's asset against a much larger amount of liability money that represented their customer's deposits.

The result—as shown in Figure 1—was a system facilitating monetary exchanges that effectively operated through two independent circulating systems comprising two different forms of money, with a poorly understood interchange mechanism connecting them.

Bank loans thus created 'money out of thin air'—in the form of bank deposits—by adding to the quantity of money held in deposit ledgers at banks. However, recognition of the significance of this depended on the definition of money, and in the 19th century money was the physical medium, not its virtual equivalent. While the steady increase in bank deposits did not escape attention, especially after the 1844 Act in Britain mandated regular reports by banks on their holdings, it does not appear to have been correctly attributed. Dun (1876) for example, comments on the London joint

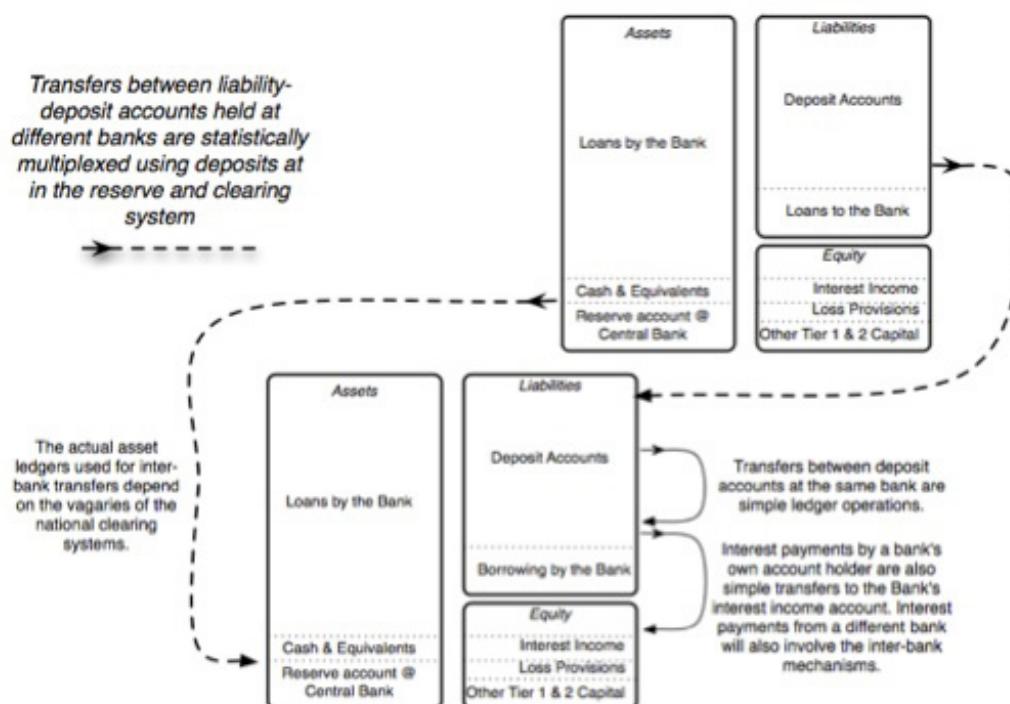


Figure 1: Monetary transfers within the banking system.

stock banks 1844-1847 that '[t]he increase of money lodged here shown is no less than 1010 per cent; an enormous augmentation, even if allowance be made for the absorption of several large private banks,'¹⁴ but ascribes this to the physical deposit of cash money 'lodged,' rather than making the causal link to lending activities.

As economists did become more aware of the internal dynamics of the banking system, theories of credit began to be developed, and the origins of the unfortunate idea that 'money is debt' can be traced to Macleod (1889). The complication that money in the form of a customer's liability deposit is created at the same time as a debt instrument (a loan), does not imply an absolute identity in the scientific context, nor should it. A loan represents a contractual commitment by the borrower to provide a flow of monetary payments over time: hence money is not debt—debt is a flow of money.

If the originating bank for any reason was unable to satisfy a demand for a withdrawal against an account in good standing a bank run could be triggered. This could occur from requests for physical withdrawal, but also from a larger flow of direct transfers to another bank from its deposit accounts—since this relied on matching transfers of asset-money between banks.¹⁵ Since there was no such danger with direct transfers between a bank's own customers, a slow process of consolidation began to occur, favouring banks which were either sensitive enough to these network effects to organize their customers activities to favour deposit transfers conducted entirely within their own ledgers, or geographically isolated enough from other banks for this not to be an issue. These direct ledger transfers also discretely added to the supply of money, and consequently there was an accompanying, but all but invisible influence on the price level from that source, which when it acted on the price of gold also influenced one of the regulatory elements of the entire system.

5 BANK LENDING

Intertwined with the new form of money, was a new form of lending, the bank loan, which was also subtly but significantly different from other forms of lending within the economy. Distinct from other lending, when a bank loan was created, money was created in the form of a bank deposit, and when it was repaid this money was destroyed. It is the regulation of these two processes on a day-to-day basis, across the entire banking system, that determines whether the part of the money supply being lent is expanding or contracting.¹⁶ From the privileged perspective of 21st century access to

long-term time series we know that the alternately expanding and contracting 'equilibrium' portrayed by Keynes and others was simply not there. The part of the money supply represented by bank deposits was, with rare exceptions, continuously expanding. Even under gold standard regulation, bank loans carried the significant side effect of deposit growth. Meanwhile, the occasional contractions which could be caused either by inter-bank flow issues or by high loan default levels caused considerable economic dislocation, as the delicate network of loans and monetary flows that economic activity increasingly relied on was disrupted, not only by reduced quantities of money in the economy, but also by liquidity issues in the interchange/bank-clearing mechanisms.

This problem was introduced by another significant difference between bank lending and loans made elsewhere, in the form of the relationship between interest payments and loan-default handling. Interest payments on normal loans are direct transfers of money between two parties. When interest on a bank loan is paid, a similar transfer occurs, but from the customer's deposit account into the bank's interest income liability account. Losses on loans are then first treated as an expense, and deducted from interest income, before the bank's interest income is recognized and paid out to meet bank expenses or as dividends. The consequence is that when either form of loan goes into default, the lender loses money; when non-bank loans go into default, the money their capital represents is still circulating in the economy somewhere, and thus there are no risks of larger side-effects due to monetary contraction. Bank loans behave a little differently. There is a limited zone where money can be destroyed, and then re-created through lending, effectively substituting new lending for bank profits. Within this 'quantum zone' banks and the larger monetary system are immune to the effects of loan losses. Indeed, compared to a bank with no defaults, a bank experiencing a manageable default rate would support a slightly higher rate of new lending, at the price of somewhat reduced profits.

If a bank's profit or loss provisions are not sufficient to cover losses though, then the bank must deduct the loss from its capital holdings. Capital accounts are classified as equity, but although treated identically to liabilities by the accounting equations relied on for economic analysis, they can comprise a mixture of liability money in ledger accounts (retained interest income for example), and financial instruments such as preferred stock that represent asset money deposits. There can also be regulatory requirements for capital holdings and loss provisions that must be maintained by banks. If bank

loan defaults exceed that which can be covered from loss provisions and profits, then the regulatory mechanisms force the bank to restrict or contract its lending, and as a consequence contract its contribution to the liability money supply. In the limit, loan losses that exceed the various forms of loss provisions that are made on the right hand (equity and liability) side of the ledger can only be made up over time from interest income flows. As these flows are money-supply neutral, external intervention is then required to maintain the level of money in the economy.¹⁷ The practical realities of individual bank stability are far more interesting than the simplistic description of depositor-initiated bank runs that typically occupy introductory texts in economics.

Less visible is the problem of changes to the regulatory structure, for example mandated increases in loss provisions or capital holdings. This is currently occurring as part of the Basel 3 adjustments, and it can also impact the bank's short term ability to lend, again with potential long-term macro-economic impact as well as considerable confusion in the resulting economic analysis. The recent contraction in the British money supply, for example, appears to be caused by the combination of a high default rate and the Basel 3 requirement for the banks to increase their capital holdings, temporarily inhibiting their ability to increase lending.

Table 1: Amount of new lending from loan repayment vs. monetary expansion with \$1,000,000 total

<i>Loan Duration</i>	<i>New Lending originating from Capital Repayment</i>	<i>Monetary Expansion to create equivalent lending</i>
<i>10 years</i>	100,000	10%
<i>25 years</i>	40,000	4%
<i>40 years</i>	25,000	2.5%
<i>100 years</i>	1,000	1%

Within a hypothetically stable banking system where loan securitization is not allowed¹⁸—maintaining a constant supply of money and credit—the amount of new lending or investment provided by the banking system would depend entirely on the amount of capital repayment on existing loans, as well as the ‘quantum buffer’ offered by loss provisions and income, and loan defaults. Unless loan securitization is involved, if the total quantity of bank-originated lending is increasing, there is necessarily an accompanying

increase in the liability deposit money supply. It is instructive to consider the quantities involved. Table 1 shows the amount of annual new lending from loan repayment versus the monetary expansion required for the same amount of new loans, assuming loan repayment is evenly distributed and all loans within the banking system are made for the same duration. By comparison, the annual expansion of the US M2 monetary measurement was 7 per cent between March 2012 and 2013. Even with relatively low rates of monetary expansion, new lending created by monetary expansion of liability deposits dominates over that made available from loan repayment.

The economic conundrum is that the two are intertwined. Whatever role credit creation plays in the economy, when it originates in the banking system it is necessarily accompanied by monetary creation.¹⁹ When it comes from elsewhere, for example from government borrowing, then there is no accompanying money creation. There is consequently a significant difference between the monetary impact of increased government borrowing directly from its citizens, versus increased borrowing from/lending by commercial banks, a difference that seems to have escaped many economists, including Keynes.

6 FAILURE MODES

As is not uncommon with complex systems, there can be far more causes of failure than there are symptoms. While the bank run receives the most attention in the literature, banking failure can have multiple causes. Even a well-run bank is at the mercy of long-term monetary flows within the system, and a pattern of asymmetric lending from one region to another can easily set up unbalanced monetary flows that will over decades cause bank failure due to liquidity failure as it loses asset money to another bank. Rules surrounding non-performing loans are also critical: a bank may appear to be solvent, and indeed be able to cover its day-to-day expenses from a small amount of interest income, but no longer be able to supply new loans, as capital is no longer being repaid—the ‘zombie bank’ phenomenon.

Lending effects within the banking system are however not confined to the liability side of the banking sheet. Short-term loans of asset money are also made between banks to cover day-to-day reserve fluctuations, and these create the possibility of systemic cascade failures in the event of bank failure, requiring government intervention to prevent monetary collapse. In the modern banking system, the relatively clean divide between asset lending and liability money on

19th century balance sheets has been broken down by the extension of these originally short-term measures to longer duration loans within the ‘capital markets’ of asset money which banks then re-lend. Not only does this increase the system’s intrinsic instability, but it has increased the need for government intervention to prevent a collapse of the entire system, as the asset side of the bank’s balance sheet, which is considerably leveraged, is far more vulnerable to individual loan defaults than the liability side.²⁰

7 ECONOMIC THEORIES OF THE BANKING SYSTEM

The parallel development of the banking system and modern economic theory has meant that the former has been subjected to several divergent evolutionary forces. Initially the most critical was the ability of individual banks to learn to manage the complex set of relationships described above, and to prevent failure from short-term liquidity failures if more physical cash or gold was demanded than they could satisfy. This led to the empirical discovery, and later to the requirement for minimum reserve requirements, typically 25 per cent or more in the 19th century.²¹ It also introduced the role of the central bank as the lender of last resort so as to backstop short-term shortages of asset money (liquidity), which could be expected to be resolved over time as the bank received more funds from its existing loan portfolio, as compared with actual insolvency issues which could not.

An understandable desire by society to prevent bank failures from causing economy-wide cascade failures through their impact on commerce, and also to prevent use of these mechanisms for deliberate fraud, led to demands for regulation and reform throughout the 19th century. Successful regulation of the banking system would however have required a systemic and complete understanding of its operations, and as we will see this was not available. Rather each participant in the system argued for their perceived local interests. While banks do not profit directly from the creation of money involved in lending, they ‘grow’ as a result, and over time receive more total interest income from the increased loan book: while banks may make money, they earn income. Inevitably there was and is an intrinsic conflict between the banking sector’s objective in fulfilling its capitalist role to earn money, and society’s desire for a stable monetary system, which requires control over the actual process of manufacturing it.

The full implications of double-entry bookkeeping operations within a system of banks—in conjunction with the dif-

ferent regulatory frameworks in use—never appear to have been fully integrated into economic theory. As present discussions of ‘money is debt’ and ‘credit theories of money’ show and multiple definitions of key financial terms such as ‘capital’ make clear that—uniquely among the sciences—economics never developed an atomic theory consolidating and clearly defining the operations embedded in one of its fundamental systems. While the deposit creation process was clarified by Keynes and others, other critical operations in the banking system such as loan default and interest repayment, and the problem of positive and negative feedback loops within the regulatory mechanisms, were left largely unexamined. Economic reasoning proceeded on statements made about the behaviour of high-level abstract concepts, such as investment, liquidity and so on, without any detailed description of the precise mechanics involved in these mechanisms. Equally overlooked was the vital question of whether a distinction needed to be made between lending originating from within the banking system and outside it.

As a consequence, economic analysis continued without detailed consideration of the banking system, even as the banking system was modified, in no small part due to the influence of economic analysis. In considering Keynesian and other economic theories, we have to not only consider that they were based on an incorrect understanding of their own period’s banking system, but also that the banking systems of that time behaved differently from their counterparts today.

8 THE STANDARD TEXTBOOK DESCRIPTION

The origin of the description of the banking system found in economics textbooks appears to be the Macmillan Report to the British Parliament (1931), in all probability written by John Maynard Keynes as reported by Stamp (1931). Taken in its entirety, the Macmillan Report is an interesting and comprehensive review of the banking and economic issues of its time and place. It provides detailed descriptions of the operations of the banking system, the structure of the central bank’s balance sheet, and other details that demonstrate an intimate understanding of the finer details of banking mechanics. However, its contents also reflect an unwarranted confidence by at least one of its authors²² in their understanding of the long-term behaviour of the system for which no strong theoretical basis could be extracted from the academic debates of the period.

It is on page 34 (ibid.) that we find the paragraph that would inadvertently do such lasting damage to economic understanding of the practices of banking:

A simple illustration, in which it will be convenient to assume that all banking is concentrated *in one bank*²³, will make this clear. Let us suppose that a customer has paid into the bank £1,000 in cash and that it is judged from experience that only the equivalent of 10 per cent of the bank deposit need be held actually in cash to meet the demands of customers; then the £1,000 cash received will obviously support deposits amount to £10,000. Suppose that the bank then grants a loan of £900; it will open a credit of £900 for its customer, and when the customer draws a cheque for £900 upon the credit so opened that cheque will, on our hypothesis, be paid into the account of another of the bank's customers. The bank now holds both the original deposit of £1,000 and the £900 paid in by the second customer. Deposits have thus increased to £1,900 and the bank holds against its liability to pay out this sum (a) the original £1,000 of cash deposit and (b) the obligation of a customer to repay the loan of £900. The same result follows if the bank, instead of lending £900 to a customer, purchases an investment of that amount. The cheque which it draws upon itself in payment for the investment is paid into the seller's bank account and creates a deposit of that amount in his name. The bank, in this latter case, holds against its total liability for £1,900 (a) the original £1,000 of cash and (b) the investment which it has purchased. The bank can carry on the process of lending, or purchasing investments, until such time as the credits created or investments purchased, represent nine times the amount of the original deposit of £1,000 in cash. (Macmillan Report to the British Parliament, 1931: 34)

In its precise details, this description is entirely correct. However, the details must be carefully observed. In particular, all actions must occur in one bank, avoiding the critical complications that arise from the transfer of money from one bank to another. It is equally critical to maintain the difference between the physical deposit of cash (listed on the balance sheet as an asset), and the liability deposit entered against it. What is particularly problematic about this description, in both its original and later forms, is the implied convergence to stability under conditions of sufficient loan demand, which not inconsequentially also provided support for Keynes' more elaborate theories of macroeconomic control. This was not supported even by the data provided in the Macmillan report itself; tables on pages 35 and 37 showed, respectively, a small but steady decline in the English clear-

ing banks' reserve accounts at the Bank of England and cash in hand, against a steadily increasing amount of total deposits in the banking system between 1919 and 1930.

The 1844 Bank Charter Act had required British banks to publish their deposit and reserve information on a weekly basis in national newspapers between 1844 until its partial repeal in 1928. Consequently, 19th century Britain enjoyed a level of transparency about the weekly flows within its banking system that is not available today. As Higonnet (1957) shows, this data demonstrated that there was a continuous expansion in the amount on deposit in the English banking system in the 19th century. This took place against a backdrop of prices that were perceived to cyclically increase and decrease over long periods, a temporal pattern that gained the label of the business cycle. A question that formed part of the difference between the Austrian and Keynesian schools, not apparently recognized at the time, was the nature of the variation of the money and the corresponding loan supply from the banking sector. An assumption that it was naturally increasing and decreasing in response to loan demand is quite different from an assumption that its normal state was continuously increasing, with variations in the rate of expansion, and occasional sharp contractions triggered by cascade failures, which is what the long time series statistics available today clearly show, as illustrated by Laidler (2003).

This is a sensitive question. The co-dependent relationship between new money and debt has wide-reaching implications, both for the control of the system and for its economic influence. Intervening to prevent monetary contraction is a quite different proposition from intervening to support a continued expansion whose immediate benefits are increasingly unevenly distributed in the economy as a direct result of the long-term dynamic process that is thereby triggered. The implication that the source of debt would matter, and that indeed bank lending might well enjoy a subtle long-term advantage over other forms of lending, was also a difficult one to address. Indeed without a clear description of the detailed mechanisms of the banking system at any given time and place, it is impossible to answer these kinds of questions. For example, was the 19th century money supply increase due to a slow increase in gold asset deposits, a faster increase in deposit liability money, or a subtle interaction between the price of gold, used as a regulatory control, and the growth in bank deposits? Each of these might cause similar macroeconomic affects on the price level, but require very different policy interventions to correct adverse consequences.

If we compare and contrast with the description typically found in popular US undergraduate textbooks (e.g. Mankiw 1997), which is shown here as Table 2, we can see that several changes have crept in, presumably in an attempt to clarify the original example. The example given no longer restricts the process to a single bank. Rather a sequence of operations is shown, where loans are being re-deposited between banks, and the important distinction between the physical cash as an asset and the customer's liability deposit has been lost.

Table 2: Textbook description of deposit expansion with a 10% reserve requirement

Bank	Amount Deposited	Loans	Reserves
A	100	90	10
B	90	81	9
C	81	72.9	8.1
D	72.9	65.6	7.29
etc.			

Source: Mankiw (1997)

Consequently, this example no longer represents the actual process that occurs within the banking system, and indeed is also internally inconsistent. For example, if we assume that the amount deposited is cash, which is a necessary assumption since a reserve from cash is clearly being withheld, then double-entry bookkeeping defines physical cash as an asset, a loan as an asset, and a central bank reserve account (or a reserve of physical cash) also as an asset, thus breaking the fundamental accounting equation in Equation 1. This assumption would then lead to the loan creating a cash deposit, which is equally incorrect. But then the first amount deposited cannot be a liability deposit, without an accompanying asset deposit, and so while classifying 'Amount deposited' as a liability would maintain the accounting equation, with the amounts and reserve requirement stated, it would not in fact be possible for bank A to make any more loans, as it would already be at its 10 per cent reserve ratio limit.

Alternately we have this passage in a popular European textbook, the 6th edition of Burda and Wyplosz (2013):

An even more interesting and less well-understood fact about banks is that they actually create money

when they grant loans—when they create credit. To see why, consider the case of Ms A who receives €1,000 in cash from abroad and deposits it in her bank. Bank No. 1 lends this money as soon as possible to Mr B, another trustworthy customer. Mr B needs the money to buy a sofa. Soon enough, the €1,000, initially deposited by Ms A will be handed over to the store that sold the sofa to Mr B. The shopkeeper now owns this €1,000. Ms A too owns €1,000. As far as she is concerned, her money is in the bank. In fact, she owns a deposit in her bank which is backed by a loan in the amount of €1,000, but the €1,000 in currency is long gone. (Borda and Wyplosz 2013) Precisely for this reason, modern banking is often called a 'fractional reserve banking system.' If the bank figures out that, say, only 10 per cent of the sums that will be deposited will be withdrawn at any point in time, all it needs to do is keep 10 per cent of its deposits in reserves, and it can then lend out the rest. In the case of Ms A's deposit, the bank will keep €100 in cash and lend the remaining €900. In that case, the initial amount of money created is only €900. After it is deposited in Bank No. 2, a new loan of €810 (this is €900 less 10%), will be arranged, and the process will go on as shown.

This restatement of Keynes' description is truer to the original, and clearer in terms of the cash-deposit difference. In one important respect it is erroneous, though. It is incorrect regarding the loan of money to another bank's customer. As with Mankiw's example, as soon as loan repayments begin, Bank B and any other banks involved in the "process" will become illiquid. Keynes pointed out part of the problem in the next paragraph in the Macmillan Report:

There is however, a limitation on this process. A bank which is actively creating deposits in this way will naturally find that a considerable part of the cheques drawn against them will be in favour of other banks. It will thus lose part of its cash reserve to those banks and must proceed to limit its loan operations if its normal cash ratio is to be maintained. (Macmillan Report, 1931: 34)

Interestingly, while this is a correct description of a short-term problem that can occur when the loan is made, a larger issue is that exactly the opposite occurs over the long term. Over the entire period of the loan, more money in interest and capital repayments will be received by the originating

bank than it originally lends. If it comes from other banks then its reserves will grow at their expense, providing one explanation for why over time banking systems with large numbers of small banks become systems with small numbers of large banks.

We can only speculate why economic theory took the path it did, and increasingly ignored these fine points of the intricate machinery that is modern banking. It is clear that the description in the Macmillan report could have provided the basis for the development of a far deeper and more complete understanding of its operation, paralleling the contemporary developments in physical science. This might have led to a science of economic systems that rested on solid and demonstrable causal foundations, albeit rather complex ones, rather than a series of assumptions derived from purely empirical observations of a complex system being continuously modified by its own intrinsic behaviour, and that of its observers.

One of many instances where such clarification would have avoided considerable debate can be found in Keynes' and other authors' writings on the 'liquidity preference,' a preference for holding money over other forms of investment. Here once again, the definition of money is important—in a gold standard system, with strict relationships between physical bank notes, bank deposits, and gold holdings, a preference for holding physical cash could indeed alter the behaviour of the banking system, particularly given the multiplier relationships involved. Cash withdrawals and flows of gold in international trade not only affect a bank's asset liquidity, but also its ability to lend. In modern banking systems this explicit tie between physical cash and banking system operation has been largely severed, primarily by the reduction in the general use of physical cash. Bank runs in the era of digital transactions are conducted through electronic transfers. The 'liquidity preference' stays in the banking system; it is simply moved to another bank. There is thus no change in the total quantity on deposit in the entire banking system.

What though did the originator of this term actually mean? According to Keynes:

The primary effect of a change in the quantity of money on the quantity of effective demand is through its influence on the rate of interest. If this were the only reaction, the quantitative effect could be derived from three elements—(a) the schedule of liquidity-preference, which tells us by how much the rate of interest will have to fall in order that the new money may be absorbed by willing holders, (b) the schedule of mar-

ginal efficiencies which tells us by how much a given fall in the rate of interest will increase investment, and (c) the investment multiplier which tells us by how much a given increase in investment will increase effective demand as a whole. (Keynes, 1936: 298)

This passage is hard to interpret without a clear description of the banking operations involved, and clarification of the definition of money being used. A change in the quantity of money originating from the banking system must perforce derive from an increase in lending, so the borrower has already been sourced when this occurs. An increase in the quantity of money and credit from the banking system can also be presumed to affect the price level—so the claim that interest rates 'will have to fall' rests on a hidden assumption of price stability. Credit bubbles have demonstrated repeatedly that price rises can have the opposite effect when there is a general perception of more to come. An increase in asset money on the other hand, as a result of government printing, will trigger an expansion in money and lending, but as many governments have discovered to their cost, the resulting multiplier expansion of deposits within the banking system rapidly overwhelms the monetary system, leading to hyperinflation.

In addition, if a regulatory limit on loan supply has already been reached within the banking system, supply side restrictions will determine new lending, not demand. It is the rate of excess lending over repayment that causes monetary expansion from the banking system, not the interest rate *per se*.²⁵

If Keynes meant that—contrary to his description—loan demand could influence the monetary expansion rate of the banking system, then there is a secondary issue with these assumptions that relates to the composition of bank lending. The British banking system relies on variable rate lending, which is linked to the interest rate of the Bank of England. Changes in that rate affect interest payments across the entire country within weeks. The US Banking system developed differently, with a preference for fixed rate loans over long periods—in the low interest rate environment of 2013 30-year mortgage loans were available at under 4 per cent per year. Iceland's attempt to deal with hyperinflation caused by government seignorage uses loans whose outstanding capital is indexed-linked (see Mallett [2013] for details on the rather unusual arrangements of the Icelandic monetary system). There are significant and systemic differences in the behaviour of these banking systems, and by extension the larger economy, arising from these differences in the fi-

nancial instruments being used for ‘investment.’ A general theory that makes claims about the monetary effects of interest rate manipulation without accounting for these structural differences is necessarily at best a general theory of the British monetary economy, not of monetary systems in general.

Had Keynes provided us with specific mechanisms to back up his argument, we would be far better able to judge what he was saying. We would for example know what type of money he was referring to, and we would also be able to judge the applicability of his mechanisms to today’s quite different banking and monetary systems. He did not, his field did not, and we are left dealing with the complex behaviours of a 21st century financial system with the help of 19th century analytical techniques.

9 CONCLUSION

Objectively, analysis of the complex of operations and side effects at the core of the monetary system has always posed considerable challenges, especially at the macroeconomic level of analysis. It is formally and mathematically incorrect to equate like with unlike, and yet this is what economists have been forced to do when trying to develop mathematical descriptions of high level abstractions such as investment or capital, or even lower ones such as interest, if they ignore the presence of significant side effects, depending on whether or not the accompanying monetary operations are performed by an institution performing fractional reserve lending.

Economic understanding in the 21st century monetary system consequently rests on a vacuum, lacking the solid foundation of structural understanding that underpins other fields. The problem is not that there is an absence of economic theories about the monetary system, quite the contrary. Rather the problem is determining which of the many are correct, and to which of the equally large number of different banking systems they apply. As is common with many complex systems, empirical data and even mathematical reasoning can be used to support many differing explanations of a system’s observed behaviour.

On the other hand we have the banking system itself, a complex and extraordinarily advanced distributed system. It is a moving target for analysis, and it is one that has simultaneously influenced both economic development and the development of economics. Added to this is the problem of what the banking system does to money, which is that it causes its quantity to continuously expand. Consequently measurements made with money are seen to behave like

other physical measurements. Government expenditures ‘grow’ over time, health costs ‘rise,’ GDP ‘grows.’ However, the units of other measurements are constant: a centimetre today is the same length as that of a centimetre in 1799. How much of economically measured ‘growth’ is a result of increased production as opposed to increases in the money supply cannot be determined purely from price data, even if inflation compensations are included. Nor can we say with any certainty that any of the purely theoretical economic arguments—such as general equilibrium theory that implicitly assume a constant money supply—are also applicable to a system where the money supply is continuously increasing. The real world as it appears to economics is very much a special case.

The complexity of these issues has been acknowledged before, if not necessarily in the context of the micro-structure of the banking system. Keynes freely acknowledged the presence of multiple complicating and inter-related factors as supply and demand factors play out in his General Theory, but expressed a faith in simultaneous equations to solve them that experience with the mathematics of non-linear dynamic systems would have quickly disabused him from. But with this problem we can only sympathize; economics has long laboured under significant analytical difficulties, stemming from the absence of formal methods for treating the inherently recursive nature of the relationships that the banking system and the larger economy embody. Recursion, and many of the other techniques used to analyse complex distributed systems, would not be developed until the second half of the 20th century. They came far too late to assist the theories of banking system behaviour that are currently in use.

Ultimately there is only one way out of this collision of impasses: it is to return to the fundamentals of the monetary system and the banking system, armed finally with a 21st century appreciation of complex distributed systems. Only by reassessing what we believe we know about the monetary system, in the context of a far more detailed and thoroughly grounded understanding of the short and long-term influences of the banking system on the economy, can we resolve the long-standing question of which, if any, of the theoretical constructs we have of the monetary system, and its accompanying assumptions, are grounded in reality.

NOTES

- 1 USA Federal Reserve Statistics Series H.6 Money Stock Measures
- 2 Bank of England Statistical series LPQVWYH (UK estimate of EMU M2) shows M2 as 2,100,420 in June 2010, falling to 2,021,130 in June 2012 and recovering to 2,091,037 in June 2013.
- 3 Wicksell (1935) provides an overview of some of these issues in his *Lectures on Political Economy*, Volume II, Chapter 2, and Klebaner (1990) provides a useful overview of the situation in the United States.
- 4 Referenced by Arnon (2011: 178) as a memorandum in 1836 and an addendum to Tooke in 1829.
- 5 See Arndt (2004) for a detailed discussion of information and its measurement within computer science.
- 6 Strictly, this would require performing a credit to the asset account, and a credit to the deposit account, and all double-entry bookkeeping operations must be performed as a [credit, debit] tuple.
- 7 Forward error correction techniques introduce extra information into a message that allow a limited number of errors to be detected and corrected without retransmission of the original data.
- 8 See Quinn (1994) for an excellent overview of the pre-banking goldsmith arrangements.
- 9 *The Five Bells in Lombard Street, London* (Nevin and Davis, 1970).
- 10 The banking industry was an important source of finance for both the early computing and networking industries, with mainframe computers being developed for processing their daily accounting transactions, and X.25 networks in particular developed for inter-bank payments and financial handling. As a result its operations also played a role in the development of computer science, with the development of real-time systems, network and database theory all being heavily influenced by its requirements.
- 11 Illustrated examples of all double entry bookkeeping operations used in this paper can be found in Mallett (2012).
- 12 Mechanical issues arising from asset money shortages within banking literature are usually referred to as 'liquidity'; the complication is that these balances can also play a regulatory role on deposit expansion.
- 13 In double entry bookkeeping, the arithmetic operations accompanying credit and debit depend on the status of the ledger they are applied to. Operations on the right hand side of the ledger (liabilities and equity) follow their English usage; operations on the asset side are opposite. For example, a credit to an asset account reduces its total, and a credit to a liability or equity account increases it.
- 14 Deposits for the 10 banks are shown increasing from £7,984,000 in 1844 to £88,604,000 in 1874. This is an approximately 30% annual growth rate.
- 15 Equally, unscrupulous competitors could start rumours of liquidity issues that were liable to rapidly become self-fulfilling—see Sykes (1867) and Klebaner (1990) for an overview of the far more interesting, and considerably less stable, banking environment that developed in the 19th century United States.
- 16 Although this process is typically described with respect to the expansion of liability deposits, the potential exists for a more limited form to occur through interbank lending on the asset side of the bank's balance sheet.
- 17 At this point a bank's situation as a day-to-day manager of funds is typically no longer tenable without outside intervention. Over time though as income continues to be received on its remaining assets it will usually be capable of being wound up with relatively small absolute losses. Nor is intervention always as straightforward as it might appear, replacing non-performing loans as assets for example risks interfering with long term reserve regulation mechanisms if they exist.
- 18 Loan securitization by banks increases the amount of bank-sourced lending, but does not increase the deposit money supply, unlike normal bank lending.
- 19 Unless the loan is securitized.
- 20 See Shin (2009) for a description of the Northern Rock failure due to this cause.
- 21 Nineteenth century banking systems appear to have been just as unstable with 25% reserve requirements, as 21st century ones with 2% reserve requirements or less.
- 22 Pages 239-281 of the report consist of reservations on its contents expressed by five of its authors.
- 23 Author's emphasis.
- 24 Keynes (1936: 298).
- 25 Under Basel capital regulations, interest rates may have a second-order effect on the behaviour of the system, in that bank capital is now a regulatory control over lending limits, and can generally only be increased from profits. However, this relationship is the inverse to that which Keynes is referring to, i.e. if increasing interest rates positively impacts bank profitability, it would

increase lending expansion rates through increased supply, although this would also depend on the bank's management of the difference between the interest rate paid to savers as opposed to that received from borrowers. Interestingly, Wicksell (1898) also comments that it is a matter of record that price increases are greater with higher interest rates than lower ones.

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Currency Emergence in Absence of State Influence: The Case of Diablo II

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Abstract: This paper presents a case study of the emergence of currency from a barter economy, a process discussed theoretically by Menger (1892). In particular, we use this case study to attempt to adjudicate between chartalist and emergent theories of currency formation. Using the records of an online message board dedicated to facilitating trades within the game, we document the emergence of currency and its stability over time, and note that the environment lacks the sort of agent required to cause a currency to emerge in the chartalist theory.

Keywords: Chartalist, medium of exchange, Menger, money emergence, online societies, state theory of money

1 INTRODUCTION¹

The theory of money as an emergent phenomenon arising from market interactions is widely accepted. However, because of the remote historical nature of most barter economies, examples of the evolutionary process at work are generally exclusive to circumstances of extreme duress (Radford 1945) and/or state failure (Selgin 2008). In addition, the emergent theory of money is not unchallenged. Some theorists hold that it is the fiat of powerful elites, rather than market processes, that deserve the credit for the creation of money as a social institution. The increase in popularity over the last 15 years in online communities and games provides a fruitful, if simplified, environment for observing in real time which of these theories has greater explanatory power. We discuss the online community in the game Diablo II² and argue it provides an excellent example of the money emergence process. Importantly, the Diablo II environment

has nothing in it resembling a state—involuntary transfer of resources between players is ruled out completely—so our narrative speaks to the literature on emergent vs. state theories of money (discussed further below).

Our contribution engages the literature on the emergence of money, and in particular which theory regarding the historical emergence of money is most accurate. Many, if not most, economists accept Menger's (1892) formulation. Menger held that a monetary system was an example of an emergent order, brought about by economic actors pursuing their own interests. The actions of these actors resulted in an invisible-hand process wherein a small number of commodities, or even a single commodity, with certain desirable properties eventually came to be accepted as the economy's medium of exchange. Opposed to this is the chartalist, or state, theory of money. These theories will be described in more detail in the following section, but the common theme running throughout is that the imposition of liabilities

on weak groups by strong groups is the source of money.³ The quintessential modern example is fiat money, whose value according to this school derives from its ability to discharge obligations to the state.

Our work engages this debate by providing an account of monetary emergence which lies squarely within the Mengerian paradigm. In the environment we examine, there is no state in the sense of the state/chartalist theory, meaning there are no agents with the ability to impose obligations on others. The eventual emergence of a stable monetary order suggests that, while “strong” agents imposing obligations on “weak” agents may contribute to the demand to hold a particular commodity as a means of payment, it is not a necessary condition for the establishment of a commodity or commodities as money (Salter and Luther 2014).⁴

The environment which we examine is admittedly a simplification of reality, but the agents operating in this environment are purposeful human actors; as such, we believe the insights gained from examining this virtual economy validly illustrate the operation of universal economic phenomena. In addition, the case we present offers the rare opportunity to capture the emergent process almost in its entirety. In the real world, the Mengerian process can take thousands of years, depending on exactly where and when one decides money has “fully” emerged. In our account, economizing action on the part of goal-oriented individuals leads to a mature commodity-money system in just a few years. This offers an exciting opportunity for the examination of anthropologic-economic phenomena as yet unexplored.

Castronova (2006) details the use of other large-scale multiplayer game communities as tests of macro-level coordination effects. In the formation of currency, we see Diablo’s online community as a similar natural experiment of this particular large-scale coordination problem. While the size of the video game industry and the increasing prevalence of virtual goods commanding real money⁵ along with the difficulties of properly creating a virtual currency have led to those aspects of virtual worlds to have increasing relevance among economists⁶ the value of understanding the economics internal to these game environments has been somewhat overlooked, serving as a useful complement to our understanding of how these games interact with the “real world” economy.

The remainder of the paper will proceed as follows: Section 2 presents the existing literature on currency formation. Section 3 presents an overview of Diablo II’s exchange environment. Section 4 demonstrates the formation and de-

velopment of money within the forum over time. Section 5 concludes.

2 STATE VS. EMERGENT THEORIES OF MONEY

Our contribution engages the literature on the emergence of money, and in particular which theory regarding the historical emergence of money is most accurate. Many, if not most, economists accept Menger’s (1892) formulation. Menger portrays the monetary system as a spontaneous order –a system which nobody intended to create, but arose as a result of a multitude of purposefully-acting individuals pursuing their own self-interest. In Menger’s account, the motivation for a common medium exchange results naturally from the double coincidence of wants problem first articulated by Jevons (1885). The process by which a single (or small number) of commodities evolves into a common medium of exchange hinges on the concept of *saleability* –the ease with which that commodity can be traded for others. Saleability is important because of the epistemic limits of the individual actors –exchange ratios are not constant but always in flux, but it is beyond the cognitive capacity of individuals to keep track of all these data (Menger 1892: 242). The conditions which make a commodity more or less saleable include the number of actors within the sphere of exchange, their excess supplies (or demands) for the commodity relative to other goods and services, and the divisibility of the commodity. Spatial and temporal considerations, such as the geographical extent of the market and the cost of storing the commodity, are also of obvious importance.

As Luther (2013) notes, the modern literature on search and matching models has formalized Menger’s insight, and it now forms the core of the paradigm that money is the emergent result of market interaction. The archetypal paper, which predates the modern search-theoretic literature, is Niehans (1971); The search-theoretic literature itself begins with Kiyotaki and Wright (1989, 1991, 1993).⁷ The most relevant branch of this literature for our purposes include Aiyigari and Wallace (1997), Li and Wright (1998), and Hogan and Luther (2014), which explore the role of government in securing a monetary equilibrium, i.e. an equilibrium in which monetary exchange exists. Our work can be considered complementary to these, in that we show empirically that while the state can anchor beliefs to create monetary equilibria, it is neither necessary nor sufficient.

Opposed to this is the chartalist, or state, theory of money. Building on the works of Georg Knapp (1924) and further

popularized by Abba Lerner (1947), this theory holds that money, to the extent it exists as a social phenomenon, cannot be conceptually divorced from its social context (Bell 2001). Adherents point to the historical record, which they believe shows money arose not spontaneously, but as a system of clearing debts between parties. Accordingly, the ability of one party to impose obligations on another, including the requirement as to what sort of payment can discharge the obligation, is regarded as the founding characteristic of money (Wray 2004). A modern-day interpretation holds that governments can determine the economy's medium of exchange by imposing tax liability on its citizens—literally, a state theory of money (Goodhart 1998; see Starr 1974, 2003 and Goldberg 2010 for formalizations).

Our work engages this debate by providing an account of monetary emergence which lies squarely within the Mengerian paradigm. In case under consideration, there is no state in the sense of the state/chartalist theory, meaning there are no agents with the ability to impose obligations on others. The eventual emergence of a stable monetary order suggests that, while “strong” agents imposing obligations on “weak” agents may contribute to the demand to hold a particular commodity as a means of payment, it is not a necessary condition for the establishment of a commodity or commodities as money (Salter and Luther 2014).⁸ The environment which we examine is admittedly a simplification of reality, but the agents operating in this environment are purposeful human actors; as such, we believe the insights gained from examining this virtual economy validly illustrate the operation of universal economic phenomena. In addition, the case we present offers the rare opportunity to capture the emergent process almost in its entirety. In the real world, the Mengerian process can take thousands of years, depending on exactly where and when one decides money has “fully” emerged. In our account, economizing action on the part of goal-oriented individuals leads to a mature commodity-money system in just a few years. This offers an exciting opportunity for the examination of anthropologic-economic phenomena as yet unexplored.

3 DIABLO II AS AN EXCHANGE ENVIRONMENT⁹

This section presents evidence that the exchange environment of Diablo II was such that there were significant gains to be secured through players coordinating their exchanges through a medium of exchange. Importantly, there is no

mechanism or institution in the game environment by which obligations to pay in material resources can be forced on players. As such, there is no state in the sense used by the chartalists.

Gameplay in Diablo II began with choosing one of seven character types (known as classes) each with different strengths and weaknesses at overcoming the computer-controlled monsters that populate the game world. Players venture into the game world and defeat monsters, becoming gradually stronger and acquiring items and equipment¹⁰ from slain monsters. Improved character ability and improving the quality of equipment being used by a character allow that character to defeat stronger monsters, earning rewards of a higher quality. Monster difficulty and corresponding reward continue to increase over the course of gameplay, eventually ending in the “end-game” containing the maximally difficult monsters, who have a chance to drop the rarest (and most powerful) items and equipment.

Equipment properties, while highly variable, are perfectly observable (they are displayed in the in-game description of the equipment itself). The algorithm that governs the obtained rewards from killing monsters does not take into account which items would be most beneficial for the player. As such, the large majority of acquired items and equipment, even if they would be useful for some other character or build, would probably be of no use to the character that obtained them. Items, while having comparatively little heterogeneity¹¹, still had significant variation. Finding a trading partner with whom a player had a mutual coincidence of wants thus became a paramount element of participation in the exchange environment.

Object storage during the interim between acquisition and trade was also highly costly: characters had access to a limited amount of storage measured in indivisible ‘squares’ arranged in a set of grids of particular dimensions.¹² Objects themselves took up a variable number of squares, with a minimum size of 1 square, up to a maximum for the largest equipment of a 4x2 area. Additional storage required the creation of additional characters to serve only as warehouses, referred to in-game as “mules.” Inventory management between characters used by the player to actually engage in gameplay and these storage characters carried with it significant opportunity costs. Time spent engaging in inventory management meant forgoing engaging in actual gameplay, and mitigating the risks involved in transferring items¹³ often required involving other players, or access to a second copy of the game software and a second computer. In addition, newly created characters needed to spend a minimum

of several hours actually in games in order to not be deleted by the server. For players without access to a second copy of the game software and a second computer, “parking” each mule was an additional period during which no other gameplay could be conducted. Storage space on characters used to actually conduct gameplay was made additionally costly due to the existence of “charms”, a type of equipment which provided beneficial effects in exchange for directly occupying space in a character’s inventory. Non-mule characters thus faced a trade-off between power and extent of storage space.

The primacy of solving the double coincidence of wants problem to acquire useful items or equipment, along with the costly nature of inventory management and storage, meant that gems and runes, items that were highly saleable (desirable across many classes and builds), had minimal storage costs (occupied the minimum 1 square of inventory space), and relatively homogenous¹⁴ were well-positioned to be settled on as a focal money. As Section IV will show, gems and runes did in fact emerge as the monetary units within the Diablo II economy.

Exchange Institutions within Diablo II

That there would be significant gains to finding exchange partners during online gameplay was one of the elements built into the design of Diablo II, and the game developers did include some game functions meant to facilitate player-to-player exchange. One significant improvement over its predecessor, the original Diablo, was the introduction of a trading interface, by which two characters in a safe area (one in which there could be no hostile activity) could open an interface to exchange items where the actual transfer between inventories would be conducted by the server. This interface covered the game screen and allowed each player to display items in a 4x10 grid: after any negotiations, both parties could indicate that they wanted to conduct a trade by clicking a check marker. When both sides had indicated they consented to a trade, the contents of each player’s grid would be transferred to the other’s inventory (provided they had room to hold those). In contrast to more modern games which often have sophisticated exchange institutions to allow exchange between all members of a given game server, or allow trades to be conducted without needing a direct bilateral exchange, this trade interface is the only element of the in-game interface focused on exchange. While property rights over one’s own inventory was protected by the rules of the game environment no other property rights between players existed or were enforced¹⁵.

No in-game circumstance could cause you to involuntarily relinquish objects from your own storage. Of particular note for our argument is the complete absence of the sort of debt clearing or state obligations described as necessary to money creation in the chartalist framework. *Since there exists no mechanism by which any player could compel by force the transfer of items from one player’s storage to another, no mechanism exists for the chartalist account of currency formation to take place.* Other accounts based on the compulsion of payment of tax revenue similarly lack an analog in the Diablo II environment, since there is no person or group in a position to issue tax burdens or collect them.¹⁶

Using the available trade interface still required finding other players interested in trading, as opposed to game instances meant for cooperative gameplay: to that end, certain types of communication became focal to find potential exchange partners. One of the most common methods of communication was to title the instance of the game one was creating with a title that potential entrants would see indicated it as a space for exchange. Depending on the sort of exchange one wanted to conduct, these names could take one of two forms. For exchanges where the relative values of each item were relatively settled and only a currently interested counterparty was required, names would take the form of the desired exchange: X for Y, where (in general) one was in possession of object X and wanted to exchange it for object Y. However, game names were limited to only a certain number of alpha-numeric characters, so if one desired to create or join a game for more general exchanges or ones with more complicated terms, often the solution was to name the game in such a way as to indicate the game’s purpose was for trades. Over time, “trade” became the focal name for the first such game to be formed at any given time. However, if there were already the maximal number of characters in the game ‘trade’, a hierarchy of alternative game names could be created or joined.^{17,18}

Anecdotal Evidence on the Diablo II economy before 2004

The dataset that we examine to detail the emergence of currency begins in early 2004, but the state of the economy from the date of release until then is still anecdotally well known. Early on, the primary monetary unit was a unique ring, the “Stone of Jordan”.¹⁹ Along with its marketability, early versions of Diablo II unintentionally allowed for a much larger supply of this particular object than was intended. Even when these initial technical problems were fixed by Blizzard issuing game patches, other exploits present in

the code allowed for persistent counterfeiting of the existing supply of Stones of Jordan, leading to a significant inflation. Prices eventually stabilized during this period of the game's history, with the price level of the most desirable items often somewhere between twenty to forty Stones of Jordan.²⁰

The game environment remained relatively stable after the initial period of patching with the release of Patch 1.09 in August, 2001, until the release of Patch 1.10 on October 28, 2003. Meant as a way to revitalize interest in the game for longtime players, the patch drastically revised the difficulty of areas of the game, changed various areas of the skill system, and added new items and equipment. An effort was also made to create a new economic system, rather than introduce all of these additional features into the current system dominated by these prior counterfeit items.²¹ Rather than undo all of the effort expended by players to acquire the items and characters prior to the patch, Blizzard chose instead to create a new type of character, known as a "Ladder" character.²² Ladder characters had access to all of the new item combinations, and additional endgame monster encounters with powerful equipment rewards, but had to start from the beginning of character development again and were unable to interact with characters from the old (Non-Ladder) economy.²³ With these fundamental changes in the underlying variables that determined the demand for any particular good and the complete reset of the wealth level, the Ladder economy thus presents a clean slate from which to examine the emergence of the new monetary system.^{24,25}

4 CURRENCY FORMATION: EVIDENCE FROM FORUM BEHAVIOR²⁶

The limitations of the in-game exchange environment led many players to move to out-of-game institutions in order to better facilitate trade. One of the most durable types of out-of-game institutions were message boards (normally attached to fan websites), where one could post a message detailing one's current inventory and desires. These forum posts could be seen by (given sufficient participation) far more people than any in-game advertisement, remained visible and could be replied to even when a player was not actively engaged in trading. Along with these reductions in transaction costs, participation in a forum provided an opportunity to develop a durable reputation and, in line with the predictions of the money-as-memory literature, provides publicly visible knowledge regarding the desires and exchange-values of other players.²⁷

The particular message board we use for our dataset is the records of the trading forum for the USEast Realm during the period 2004-2008, beginning a few months into the new economic environment of Patch 1.10.²⁸ A typical forum post consists of a list of goods which represents the wants of the player posting the message,²⁹ and a list of one's current inventory of objects for trade.³⁰ These lists could range in sophistication and scope from simple requests for barter,³¹ all the way to extensive inventories of hundreds of items.³² Although there is no formal currency, even the earliest messages have a notion of differential salability of goods. Most commonly, this is noted by the inclusion of catch-all phrases into the list of wants. Along with indication that a trader would accept runes as a class of item, forum users in the early Patch 1.10 environment refer to a separate class of objects, "tradeables" which contains a variety of items with high salability and lower storage costs.³³ Most lists in this early period focus on searching for a few specific wants, with both runes as a class and tradeables as a class serving as backup wants.³⁴ The term "currency" is also in use contemporaneously during the early period, but is used almost exclusively to refer to non-ladder exchange. From the beginning of the data until the first ladder reset on July 7, 2004,³⁵ fewer than 20% of references to "tradeables" are in the context of objects in the non-ladder economy, while the opposite is true of references to "currency".³⁶ Over time, "currency" becomes standard in the ladder economy as well.

Along with the transition between the early idea of a class of highly marketable items and later ideas of a developed system of currency, the complexity of the terms of exchange offered would slowly increase over time. One such element of the advanced use of currency is the use of explicit pricing in terms of currency units. Often early on, these explicit prices are used when a player is trying to sell some inventory of low-to-moderate value items in exchange for bulk materials for crafting.³⁷ Explicit numerical reservation prices are a rarity early on; most lists give no indication of reservation price, or do so with less precision, generally by placing the items for sale into tiers based on the quality of rune the item could be expected to trade for.³⁸

Attempts to codify the general trend of exchanges on the forum and provide some of the memory functions of money exchanges are occasionally attempted by members of the forum and to varying degrees maintained over time.³⁹ Because of the tendency for queries regarding the relative exchange-values to push messages conducting actual exchange activity off of the front page of the message board, such requests were consolidated into a separate board, the Trade Values fo-

rum,⁴⁰ a location which also contained various price guides. These price guides, often meant to serve as an introduction to exchange on the forum, serve as some of the best indicators of the nature of the currency in use on the forum at any given time.⁴¹ These threads would generally contain a primer on the basics of the economy, a rough value (denominated often in runes or in 'points' where rune values were the benchmark⁴²) of much of the equipment in the game, and warnings against various common in-game fraud attempts and an injunction to beware of rampant counterfeiting, especially in non-ladder play. While these guides are far from definitive, they did serve as a reasonable reflection of trade values and practices of the time of their writing, especially exchange rates between currency items,⁴³ and statements, especially by infrequent traders, to the effect that the price guide served as a focal point for their expectations of exchange-values, are common.⁴⁴

Players who took it upon themselves to maintain the price guides often explain their methods in the introductory post, and their explanations support the view of the currency system in Diablo II as an emergent process, because their maintenance was primarily based on observation of the trades actually conducted on the forum itself and other similar forums.⁴⁵ Price lists updated based on trying to codify the exchange behavior that was already taking place, and chose to do so in terms of gems and runes because those were the benchmark, both as a medium of exchange and as the unit of account. Much as no in-game actor had the capacity to dictate a currency *ex nihilo*, price lists were meant only to document values that were being created through the trading process. Over the course of the dataset, the system of trade values became relatively stable,⁴⁶ although new patches added a few additional valuable objects to the economic system, their relative value was also established over time.⁴⁷ By 2007-2008, the use of explicit reservation prices had become commonplace, to the extent that a guide for new traders on the message board recommended the practice as central to quick trading.⁴⁸ Normally, these prices were expressed by some numerical value, with the correspondence between items considered part of the currency system and the numerical values listed as well.^{49,50} While the sophistication of the near-retail system of reservation prices described above is far from universal, it does reflect well the climate of exchange during the middle of a ladder season, where a stable currency of highly saleable items facilitates complicated exchange. The documentation of this system on the message board reflects the sort of economic environment that would have been accessible in-game, albeit with greater difficulty

owing to the limited in-game exchange institutions. By this period in 2007-2008 we argue that the evolution of the currency system itself is complete.

5 CONCLUSION

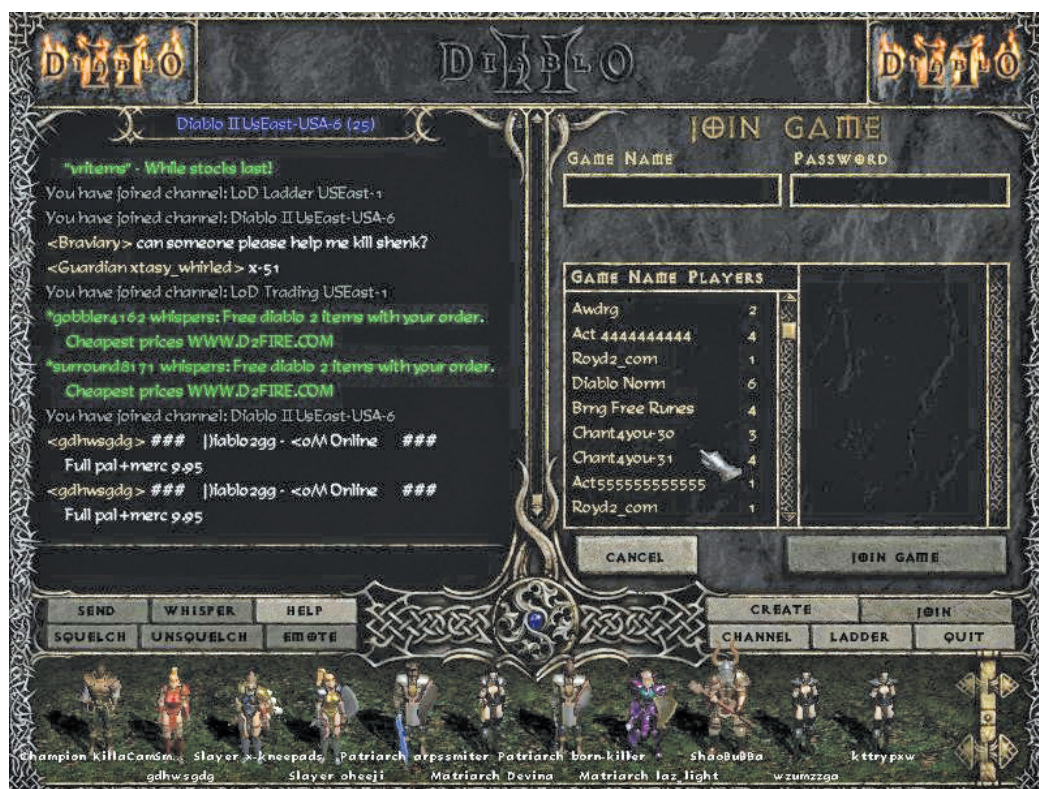
The multiplayer gameplay of Diablo II focused on item acquisitions and exchange. Players acted in a barter economy with limited institutions to resolve the exchange frictions that needed to be overcome for successful economic activity to take place. In addition, no central authority existed or could exist to provide an alternative currency or cause some other object to become the focal monetary unit. Nevertheless, the economic behavior of the community as a whole, as documented through the evidence provided by the records of message board trades, shows exchange behavior with a widespread and effective currency. While this does not show that the chartalist account of the formation of money—the imposition of obligations by the strong on the weak, with the goods in which these obligations are denominated acquiring value due to their ability to discharge the obligation—is not sufficient, it does suggest that it is not necessary. In contrast, the Mengerian account of the formation of money—convergence by market processes to a commodity, or commodities, which possesses properties amenable for use in indirect exchange—is sufficient, although we cannot say from our analysis whether it is necessary. While the historical emergence of monies contains elements of both accounts, it is nonetheless true that the key causal explanation lies in exchange behavior and emergent convergence (Salter and Luther 2014). Our analysis further highlights the importance of these mechanisms.

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APPENDIX A: SOME SCREENSHOTS OF THE DIABLO II INTERFACE



The online interface: Left is the current chat channel (note the various advertisements), right is the join game interface (“Brng Free Runes” is another example of the game name as a communication medium). The bottom bar of characters represents the characters currently in the active chat channel.



The inventory itself, with some charms (the 3x4 collection of objects), the Horadric Cube and two Tomes (leftmost 2 columns), along with random items.



The stash, an additional space for holding items. Note the various sizes items can occupy: the grey object is a rune, the other 1x1 objects being two models of rings and various gems.

NOTES

- 1 Parts of this section are largely reproduced from Salter and Stein (2014).
- 2 Diablo II, along with its expansion, *Diablo II: Lord of Destruction*, was released by Blizzard Entertainment in 2000 and 2001 respectively. Both games received tremendous critical acclaim and still have an active playing community to this day.
- 3 While this is a core tenant of the chartalist theory, readers should note this is a purely positive, not normative, statement. No ethical position is implied either way; it is merely a statement of interpersonal relations as it pertains to the discharge of involuntary debt obligations.
- 4 In addition, recent work by Luther and White (2012) suggest that government is not necessary to *sustain* a given monetary regime, regardless the role it played in that regime's emergence. This suggests the importance of established network effects (Luther 2013b).
- 5 A phenomenon very common in *Diablo II* as well, but not the topic under investigation here.
- 6 See Castronova (2004), the symposium in the *Southern Economic Journal* on Second Life (Vol 78(1)), or the recent news that industry leader Valve Software has hired an academic economist to handle the interactions of their virtual currencies (see <http://blogs.valvesoftware.com/economics/it-all-began-with-a-strange-email/>)
- 7 Kiytoaki and Wright (1989) cite Niehans' book-length exposition, rather than the article, but the development of the concept is nonetheless clear.
- 8 In addition, recent work by Luther and White (2012) suggest that government is not necessary to *sustain* a given monetary regime, regardless the role it played in that regime's emergence. This suggests the importance of established network effects (Luther 2013b).
- 9 This section is largely reproduced from Salter and Stein (2014).
- 10 For clarity, although players of *Diablo II* often did not distinguish between these two categories, we distinguish between equipment and items. Equipment meaning objects which were directly used by the character, in contrast to items, which were a class of rewards that served as inputs into equipment creation or improvement. These items, such as gems and runes, have, as we will discuss, particular economic properties (relatively homogeneity, high marketability, low storage costs) that made them a focal choice for a monetary unit.
- 11 The two major item classes, gems and runes, were subdivided only as follows: Gems came in five types and five grades of quality; each type provided some particular set of bonuses, which increased as quality increased. The highest quality gems (regardless of type) were also an element in equipment customization. Runes come in 33 different types (designated by 2-4 character combinations of English letters, such as 'Eld' or 'Jah'), each of which provided different properties.
- 12 Each character had access to a maximum of 96 total 'squares' of inventory space for items and equipment not currently being used. These were divided into a 4x10 inventory grid used for direct interaction with the environment (picking up objects when monsters were defeated, discarding unwanted objects), a 6x8 grid known as the stash meant for long-term storage, and an additional 12 total squares due to the Horadric Cube, an item which occupied a 2x2 area of a character's inventory but provided an internal 3x4 area of storage. (Images of the inventory and stash located below, see appendix A)
- 13 Two characters from the same account are not allowed to be logged into the server at the same time. Thus, transferring an item from one character to another on an account without risk involved enlisting a trusted second-party to hold the item while the player changed characters. Without the cooperation of another player, transfer generally involved joining a publicly available game, throwing the items to be moved on the ground (where they could be picked up by anyone who happened across them), leaving the game, rejoining the game the other character, and retrieving the items. Common risks during these transfers included having the items picked up by other characters, loss of internet connection during the process, or having all other characters exit the particular game instance (leading the server to close the game permanently and leave all items in it permanently unavailable).
- 14 While informational frictions are relatively limited due to the perfect observability of object properties, the comparative homogeneity of gems and runes does avoid having to perform comparisons of within-item variations that impact exchange values. That is, a Perfect Ruby is identical to all other Perfect Rubies, compared to having to evaluate equipment based on the realizations

of its random properties. To return to the example of the unique sword from footnote 14, the epistemic burden of remembering the exchange relationship between all possible realizations of the bonus physical damage to all other goods is far higher than for the relatively homogenous gems or runes, especially when many items had three to six such variable properties, the various realizations of each were independently distributed and required comparison. Using that same unique sword, along with the 100-200 physical damage percentage bonus, there could be an additional 30-50 percent bonus to attack accuracy, a variable bonus to amount of health, etc... evaluating the relative importance of these bonuses and thus the ultimate value of the item added an additional epistemic constraint to finding a mutually agreeable exchange.

- 15 Use of the online servers was subject to a Terms of Service, but only conduct which negatively altered the ability to provide service (such as intentionally inducing latency into the network connections, or attempting to directly alter the game client or server, or automation of the gameplay [known as 'botting']) were punished: no enforcement of player-to-player contracts was ever offered or enforced.
- 16 Some may object that the programmers and/or server maintainers of Diablo II constitute a 'state,' since they set, and can change, the institutions of in-game play. But taking this broad a definition of a state means that every social system must have a state, since every social system has some framework of rules by which it is governed. Rather than expanding the definition of a state to make its presence in the social world tautologous, we maintain the (implicit) Weberian categorization—a legitimized monopoly on the initiation of coercion—is the most useful.
- 17 Common names including: Trading, Trades, Tradez, Trade Here, Trade Post, etc. In general, the more the name departed from "trade", the less preferred or common the game name was.
- 18 The online interface before joining a particular game instance also included a series of chat channels, of which some of which were designated "trade channels" and were meant to be a focal location for exchange outside of particular game instances (where trades would be limited to cycling through individuals in the bilateral exchange interface displaying and bargaining over goods). These lobbies were just unmoderated chat channels, and the limited area of the chat displayed in the

interface represented a commons where each individual attempting to publicize their desired exchanges had an incentive to maximize visibility at the expense of all others attempting the same thing. Individuals who (in violation of the Terms of Service, but rarely if ever punished) were selling in-game items for real-world currency over time crowded out most individual in-game traders through the use of automated accounts to spam the channel with advertisements. These 'spambots' from various competing sites over time rendered the chat channels meant for trading unsuitable for this purpose, and players interested in conducting in-game exchange migrated away.

- 19 The Stone of Jordan in the early versions of Diablo II shares many of the properties of the runes and gems: it is a ring, a class of equipment with the minimum storage cost, properties that were totally fixed (minimal heterogeneity), and useful for any conceivable character.
- 20 This soft upper limit of forty likely the result of the trade interface: forty 1-square objects represented the maximum volume of currency that could be exchanged in a single transaction.
- 21 Along with the ubiquitous Stones of Jordan, several years of attempts to compromise the game's software had led to various other items outside of the scope of those intended by the developers. These 'hacked' items often trivialized the difficulty of the game, and were the subject of much fragmentation between players who enjoyed the powerful nature of hacked characters, and others who disliked the impact they had on the game.
- 22 Players reaching the highest experience levels the fastest in the new system would be displayed in a ranking by class (the ladder) as a public recognition of their skill.
- 23 Since most character abilities had been rebalanced and previous character customization could not be undone, this also provided an opportunity for all players to start anew.
- 24 Of particular interest in these changes to the game environment for the purposes of understanding the evolution of currency was the introduction of a large set of powerful "runewords", equipment that was created by combining multiple runes together. Many of the new runewords introduced became critical elements of end-game character builds. The particular types of runes needed (especially for some of the runes of medium-to-high rarity) to create any given runeword overlapped significantly, leading to these runes having nearly

universal salability even before their role as currency was solidly established.

- 25 With all of the wealth (and along with it the money supply) of the old system removed and the drastic changes to the relative use-values of items it would be surprising if the same exact items had the right combination of qualities to be the monetary unit, but possible path-dependence was curtailed by Blizzard, who changed the item system to make the acquisition of Stones of Jordan go from common (1 in 59) to exceedingly rare (1 in 8809).
- 26 This section is largely reproduced from Salter and Stein (2014).
- 27 In addition, the differences between major trade forums also allowed players to select into a community depending on their views regarding counterfeit items or game exploits. The forum which provides the basis for our dataset attempted to enforce norms regarding the types of items that could be exchanged to facilitate “legitimate” play (that is, avoiding counterfeit or hacked items). In addition to regulations to ensure that the trade forum itself was orderly (such as restrictions on new post creation and sanctions for individuals documented to have violated contracts developed on the forum), the forum’s moderators also maintained a list of objects which were, as known counterfeits, banned from being exchanged. Other forums had a more permissive stance on these sort of items. As one of us argues elsewhere (Stein 2013), these differences are based on the difference in the currency systems adopted: while the “legitimate” forum did not offer any particular exchange instrument besides in-game currency, the forum with the more permissive trade regulations developed a scrip currency for the forum, obtained by donations to the administrators.
- 28 <http://diablo.incgamers.com/forums/forumdisplay.php?161>. Our dataset begins in late January 2004 before when a server error has made messages inaccessible, and last until the end of 2008 when the ‘archival’ forum’s records end, subsequent exchanges being conducted in the (still active) current USEast trade forum.
- 29 Referred to as one’s “In Search Of” and abbreviated ISO.
- 30 Referred to as one’s “For Trade” and abbreviated FT.
- 31 Similar in form to the game-naming conventions for simple exchanges: <http://diablo.incgamers.com/forums/showthread.php?130352> is a representative thread of this kind of simple barter request. The thread’s title (what would be seen while scrolling through the list of

message board posts before examining any particular post in detail) is “[L] FT: Tals Full Set ISO: Vex” The [L] indicates that the items are being traded on the Ladder. “Tals Full Set” is a Set of high-level equipment, which this player is offering for a ‘Vex’ rune, one of the high-value runes. The body of the message is: “Well just as the title states, Tals Set for Vex Rune”, followed by his in-game and forum contact information.

- 32 <http://diablo.incgamers.com/forums/showthread.php?127186> is typical of these warehouse-type postings, as well as being illustrative of the sheer number of accounts and mules required to store significant inventories of large items.
- 33 Mainly, 1-square charms with desirable properties such as bonuses to acquired item quality or large amounts of bonus poison damage, which were considered another unit of currency besides Stones of Jordan in the non-ladder economy during this time, documented in various attempts at compiling price lists such as those here: <http://diablo.incgamers.com/forums/showthread.php?126925>.
- 34 The following quoted formulation of an In Search Of list is representative:
Okey...
Currently, I am in search of
Harlequin Crest (--Main ISO--)
Runes (--Secondary ISO--)
Tradeables (--In case you have no runes or a Harlequin Crest--) <http://diablo.incgamers.com/forums/showthread.php?126709>
- 35 To avoid economic stagnation in the Ladder economy and to allow for another rush of new characters “climbing the ladder”, Blizzard would move all current Ladder characters into the non-ladder economy periodically. These ladder resets occur periodically over the whole course of the dataset.
- 36 Over all the threads created in the dataset, 1,831 posts explicitly use either ‘tradeable’ or the most common alternate spelling, ‘tradable’. 1,029 of these are in the year 2004. In contrast, ‘currency’ is explicitly mentioned by 4,339 posts over the entire dataset, only 396 of which are in 2004. While compared to the total number of threads in the sample 100,141, these may be small numbers, they are indicative of the terms that would’ve been familiar to the expected audience. Most posts instead mention by item type at least one or more items that would be considered tradeable or a currency item rather than refer to them in the general form. Runes and

perfect-grade gems (referred to as pgems), are far more common, especially runes, which appear in one of four common permutations in 45,851 of the messages.

- 37 Conventions presented here that require explanation later become standard, such as presenting the “retail” or “Buy it Now” (abbreviated to BIN) price of any item with a number in brackets. User Seryph, for instance, presents a list of various equipment he is trying to for exchange for particular items: Perfect Amethysts, Ral runes, and Amn runes. He prefaces his list (written January 28, 2004) with this explanation of the system: “The numbers in the “[]” next to each items equal how much I need for that item. Example: M’avina’s Embrace [3]. That means you can give me 3 PAme, maybe 2 Ral and an Amn, maybe 2 Amn and a PAme. That’s pretty much it, bid away.” Had this same post been written later in time, adding such an explanation to the front of the post would have seemed strange, as such behavior was commonplace (only the particulars of his exchange ratio would have differed). (<http://diablo.incgamers.com/forums/showthread.php?126961>)
- 38 <http://diablo.incgamers.com/forums/showthread.php?128950>
- 39 The volume of trades and the tendency for at least some actual exchanges to be settled without explicit record on the message board made keeping complete records difficult.
- 40 <http://diablo.incgamers.com/forums/forumdisplay.php?25>
- 41 One such guide, written August 30, 2005, explains the basics of the economy as follows: Now, the trading scale of D2 is not measured, as some might expect, by gold, which is pretty much worthless. Instead, there are three key items that generally dictate the price of items in the D2 world. (1) Perfect Gems for the cheap items. (2) Um runes for the middle class items. (3) Ist runes for the very elite items. (<http://diablo.incgamers.com/forums/showthread.php?382411>)
- 42 This pointing system was meant to reflect exchange rates that would be stable during the later parts of any given ladder season (before a reset) to account for the eventual inflation as more and more players reached the endgame and the resultant acceleration of entry of items and equipment into the economy.
- 43 Since even currency was heterogeneous and indivisible, divisibility was added into the system by items of currency of different values serving as different denominations: Perfect Gems functioned as the

smallest denomination, with runes of various rarity and marketability functioning as bills of various sizes.

- 44 Such as the introduction to <http://diablo.incgamers.com/forums/showthread.php?254626>: “I don’t do much (read: any) trading, so I’m only going off of the price guide and hoping most of that is still current“
- 45 Another forum that is referenced by players on the forum our data is taken from is no longer accessible.
- 46 Players having discovered over the course of several Ladder seasons approximately the contours of the relative exchange-values that would prevail over the course of the ladder season.
- 47 Some of these new items became units of currency due to their homogeneity, while the equipment that these items were an input into the creation of became some of the more commonly traded objects on the forum.
- 48 <http://diablo.incgamers.com/forums/showthread.php?605667>
- 49 Since the relative values of the various currency units differed between players (and the lack of any single individual or institution able to dictate relative exchange rates between currency units) providing a complete list was crucial.
- 50 <http://diablo.incgamers.com/forums/showthread.php?471376> is a typical post of this type.

Editorial Information

AIMS AND SCOPE

COSMOS+TAXIS takes its name and inspiration from the Greek terms that F. A. Hayek famously invoked to connote the distinction between spontaneous orders and consciously planned orders.

COSMOS+TAXIS publishes papers on complexity broadly conceived in a manner that is accessible to a general multidisciplinary audience with particular emphasis on political economy and philosophy.

COSMOS+TAXIS publishes a wide range of content: refereed articles, unrefereed though moderated discussion articles, literature surveys and reviews in accordance with the Creative Commons initiative.

COSMOS+TAXIS invites submissions on a wide range of topics concerned with the dilemma of upholding ethical norms while also being mindful of unintended consequences.

COSMOS+TAXIS is not committed to any particular school of thought and is certainly not a talking shop for ideologues of any stripe.

SUBMISSIONS

COSMOS+TAXIS only accepts digital submissions:
David.Andersson@nottingham.edu.cn

Submitting an article to COSMOS+TAXIS implies that it is not under consideration (and has not been accepted) for publication elsewhere. COSMOS+TAXIS will endeavor to complete the refereeing process in a timely manner (i.e. a publication decision will be made available within three months).

Papers should be double-spaced, in 12 point font, Times New Roman. Accepted papers are usually about 6,000-8,000 words long. However, we are willing to consider manuscripts as long as 12,000 words (and even more under very special circumstances). All self-identifying marks should be removed from the article itself to facilitate blind review. In addition to the article itself, an abstract should be submitted as a separate file (also devoid of author-identifying information). Submissions should be made in Word doc format.

1. Submissions should be in English, on consecutively numbered pages. Both American and UK spellings and punctuation are acceptable as long as they adhere consistently to one or the other pattern.
2. Citations should be made in author-date format. A reference list of all works cited should be placed at the end of the article.

The reference style is as follows:

Author, A. B. (2013). Title. *Journal*, 1(1): 1-10.

Author, C. D., Author, B., and Author, C. C. (2013). In: *Title*. City: Publisher, pp. 1-10.

Author, J. E. and Author, B. (Eds.) *Title*. City: Publisher, pp. 1-10.

Author, E. F. (2008). *Title*. Place: Publisher.

3. All notes should be as end notes.
4. No mathematical formulae in main text (but acceptable in notes or as an appendix).

Please consult a previous issue of COSMOS+TAXIS to see a fully detailed example of the Journal's elements of style.

CONTACTS

COSMOS+TAXIS welcomes proposals for guest edited themed issues and suggestions for book reviews. Please contact the Editor-in-Chief to make a proposal:
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All business issues and typesetting are done under the auspices of the University of British Columbia. Inquiries should be addressed to the Managing Editor: leslie.marsh@ubc.ca

The COSMOS+TAXIS website is hosted by Simon Fraser University:

<http://www.sfu.ca/cosmosandtaxis.html>

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