Innovation is a Spontaneous Order

JASON POTTS
RMIT University, School of Economics, Finance and Marketing
RMIT College of Business
Building 80
445 Swanston Street
Melbourne 3000
Victoria, Australia

Email: jason.potts@rmit.edu.au
Web: http://www.rmit.edu.au/ID=c5w026edczcm1

Bio-sketch: Jason Potts' most recent books include *Evolutionary Economics and Creative Industries* (2011, Elgar); as co-editor of *Key Words in Creative Industries* (2012, Routledge); and co-editor of the three volume *Evolutionary Microeconomics; Evolutionary Mesoeconomics; Evolutionary Macroeconomics* (forthcoming, Elgar).

Abstract: Viewed from the market failure perspective, the order of the innovation process is a planned rational order—a *taxis*. However, from the theory of market process, innovation is a spontaneous order—a *cosmos*. How one understands the order of innovation thus turns on priors of the order of markets. This paper proposes five new arguments for the order of innovation, none of which derive from a theory of markets. All five further develop the spontaneous-order view of innovation. These are: (1) science as a spontaneous order; (2) new business models; (3) co-operation in developing technologies; (4) clusters and innovation externalities; and (5) copying processes and local adaptation.

Keywords: innovation policy, innovation process, economic co-ordination, knowledge problem

INTRODUCTION

Let *spontaneous order* refer to Adam Ferguson's definition: 'a result of human action, but not of human design' (Barry, 1982). A spontaneous order is closely related to Hayek's (1976) notion of a *catallaxy*, or what complexity theorists call *self-organization* (Colander *et al.*, 2011), although these are not equivalent concepts. In this way Hayek (1973, Chapter 2) distinguished between *taxis* (planned order, human action and human design) and *cosmos* (spontaneous order, human action but not design). To say that innovation is (largely) a *cosmos* is to say that it is (largely) the result of human action but not of human design.

The unaided human mind, operating instinctually, tends to see all order as *taxis*, as the product of deliberate design, intention and organization. For several hundred years, and certainly since the Scottish Enlightenment of Ferguson, Lord Kames, David Hume (on knowledge) and Adam Smith (on markets), and subsequently on through Charles Darwin (on species), Carl Menger (on money), and so on, the deepest and most significant insights of biological and social science have come from an unfolding recognition that more and more phenomena that were thought to be designed orders (*taxis*) are actually spontaneous orders (*cosmos*).

There are consequences to such reclassification, because once we understand a phenomenon to be the product of self-organization, we ask different questions of it (how did it form? How does it stabilize? Is it robust?). Moreover, we treat it differently. Specifically, we are far more cautious in seeking to intervene in its workings and more humble in attempts to redesign it (Hayek, 1988). So it matters whether something is classified as a spontaneous order or not. I argue in this paper that we should seek to reclassify innovation as a spontaneous order.

I adopt the standard definition of innovation as the process by which new ideas—whether as new goods or services or as new ways of doing things—are introduced into and spread throughout the economic system (Rogers, 1995). Innovation refers to the discovery and application of useful knowledge (Ziman, 2000), which has the effect of changing the economic order from within. Joseph Schumpeter (1943) famously described this basic dynamic mechanism of market capitalism as a process of 'creative destruction' (Beinhocker, 2005).

In modern economics, there are two distinct perspectives on innovation. These derive from two different models that connect innovation and markets. In the first model, innovation is effectively an extension of the *market process* (Buchanan and Vanberg, 1991), that is, a form of competition between entrepreneurial firms (Witt, 2013). The order of innovation supervenes on the order of the market process so that to the extent that the institutions of the market process produce spontaneous order, so they also produce innovation. A *cosmos* view of markets gives rise to a *cosmos* view of innovation.

In the second view, the innovation problem is equivalent to the *market failure* problem in the production of new ideas (Nelson, 1959; Arrow, 1962). Without mechanisms to correct this market failure, from a social welfare perspective innovation will be underprovided in the market. To overcome market failure, innovation requires designed institutions and policy mechanisms to guide the structure of innovation incentives and systems. The *taxis* view of markets gives rise to a *taxis* view on innovation.

Some stylized differences between the planned view of innovation as correcting market failure (broadly a Schumpeterian story, coupled to the theory of innovation systems) and the self-organizing view of innovation as arising from the market process (broadly a Hayekian story, coupled to Austrian economics) are summarized in Figure 1 below.

As we see, these turn on different points of emphasis with arguments derived from different perspectives on how markets work. For instance, the planned innovation model emphasizes market failure arising from incentive problems and resolved with imperfect competition and the creation of rents. The self-organizing model is built around knowledge and uncertainty problems and is resolved with competitive rivalry and profit seeking. There are different perspectives on the nature of innovating firms, the types of innovation finance, the entrepreneurial function, the nature of knowledge, and the dynamics of investment and business cycles. Ultimately, these translate into very different approaches to policy: with the planned model favouring direct intervention (intellectual property, industrial policy, public goods creation) and systemic approaches (innovation systems); whereas the self-organizing model tends to get by with effective market institutions and competition policy. The upshot is that the most effective approach to innovation policy is determined by one's priors about the effectiveness of the market process or otherwise in the production of new ideas.

Planned innovation	Self-organizing innovation
Schumpeterian	Hayekian
Market failure	Knowledge problems
Incentive problems	Uncertainty problems
Imperfect competition essential	Rivalrous competition essential
Incumbents crucial	New entrants crucial
Firms have general innovation capabilities	Firms have specific capabilities
Corporate R&D	Venture capital
Incentive = Rents	Incentive = Profits
Schumpeterian entrepreneur	Kirznerian entrepreneur
Scientific knowledge	Distributed, tacit knowledge
Creative destruction	Malinvestment
Innovation systems theory	Market process theory
Taxis	***Cosmos***

Figure 1: Two views on innovation

But the case for innovation as a spontaneous order becomes stronger once we step away from the market process/market failure dichotomy and look at other models of innovation as a growth-of-knowledge process. I will suggest here five distinct mechanisms that are not tied to market institutions per se, but to broader conditions of economic liberty. These spontaneous order aspects of innovation are:

1. Science (congruence with)
2. Business models (their emergence & evolution)
3. Co-operation (sharing & pooling of knowledge)
4. Clusters (spatial emergent order)
5. Copying (temporal emergent order)

FIVE THESES ABOUT INNOVATION AS COSMOS

In the *cosmos* view of innovation, design and intention over the creation of new ideas, technologies and industries are less important than we might have previously thought. These outcomes are the result of human action, but not of human design. A *taxis* view of innovation is comforting to the human spirit and to our own sense of collective power and control, and can be observed in the call for global efforts in developing new, say, energy or communications technologies, or in regulating the technological development of whole industries or sectors. But this presumption of the global ability to plan and guide innovation is far from self-evidently true: to a considerable extent, innovation is an emergent process beyond the designs of individual minds.

It is not unreasonable to observe that the *cosmos* perspective on innovation—in which the most important factors governing 'the wealth of nations', namely, new ideas and innovation, are placed beyond the gamut of human expertise and intention—can be just as unsettling to denizens of the 21st Century as Charles Darwin's *Origin of Species* was to his 19th Century contemporaries. It implies that we are not in control (or that no one is in control) of our collective destiny as shaped by new technologies and innovation. Yet the notion that innovation is a spontaneous order is equivalent to the claim that innovation is an open, complex self-organizing system with a fundamentally unpredictable future (Popper, 1972).

The market-based arguments for innovation as a spontaneous order turn on aspects of the growth of the market driving increased division of labour and specialization, an argument that goes back to Adam Smith in the *Wealth of Nations*, that then feeds back into an increased scope for recombination of ideas and of spillovers and increasing returns (called 'external economies' by Alfred Marshall). These dynamic mechanisms can explain why innovation can have emergent or unintended consequences due to market mechanisms and feedback. However, there are other mechanism that can also contribute to the spontaneous order of innovation, five of which I will outline in this paper. These are: (1) the extension of the case for science as a spontaneous order; (2) the discovery of connections between technologies and opportunities, resulting in new business models; (3) co-operation in developing technologies through the sharing and pooling of ideas; (4) clusters and spatial self-organization related to innovation externalities, and (5) copying processes by which good ideas replicate through an economic order, adding variation and local adaptation.

2.1 Like Science

The work of Michael Polanyi and others (Ames, 1989; Lavoie, 1989) explain how the institutions that generate the order of science generate a spontaneous order. I want to propose that the same line of argument applies to innovation. Science and innovation are of course different: they are done by different people; for different reasons; under different institutions, and through different organizations and practices. Yet there are also important similarities. Both involve rules, and ways of breaking those rules. Both involve creating and testing new ideas and a process by which successful new ideas are subsequently adopted and retained. Both involve substantial uncertainty and require individual agents to form a model of the world that they then seek to test. Both are partially experimental, partially theoretical operations that involve reason and experience. But the main point is that the arguments that science is necessarily an open-ended, decentralized, adaptive, rule-governed process—a *cosmos* not a *taxis*—also apply to innovation, and *for the same reasons*, namely that they are both growth- of-knowledge processes (Loasby, 1999; Ziman, 2000).

It was Michael Polanyi (1941; 1962) who first developed this argument with respect to science as a *cosmos*. Polanyi sought to explain the efficacy of independent, free inquiry in science, and the dangers of centralized control in the public interest by comparing it to the operation of the market process (Mäki, 1999; Jacobs, 1999; Butos and Koppl, 2003). For Polanyi, the progress of science depends on a 'truly deeply open conversation'.

Polanyi's 1941 *Economica* article in many ways anticipated the arguments Hayek (1973; 1978) later made in respect of the two modes of order of *cosmos* and *taxis*. Polanyi (1941, 433) wrote of 'order by spontaneous mutual adjustment' or 'dynamic order', versus 'planned order' and of 'the two alternative and opposite methods of achieving order—by limiting the freedom of the particles, or by giving full scope to their interactions'. Indeed, Polanyi offered a broad conception of spontaneous order in which the 'republic of science' and the institutions of the market are both special cases of this more general phenomenon. Of science, Polanyi argued that: (1) In freely pursuing their own choice of problems, scientists are in fact co-operating; (2) that the principle of their co-ordination consists in the adjustment of the efforts of each to the hitherto achieved results of the others; and (3) that such self-coordination of independent initiatives leads to a joint result that is unpremeditated by any of those who bring it about. These same arguments can also be claimed of innovation as an ultimately co-operative endeavour in which co-ordination is achieved through interaction and feedback, and does not require an overarching design or plan.

Polanyi did not argue that the order of science is like the order of a market. He sought a more general point: that both of these orders were themselves instances of a more general dynamic principle of co-ordination—or constitutional rules—governing the operations of a free society. Polanyi writes that:

> For in the free cooperation of independent scientists we shall find a highly simplified model of a free society, which presents in isolation certain basic features of it that are more difficult to identify within the comprehensive functions of a national body. (Polanyi, 1962, 54)

He further explains:

> This suggests a generalization of the principles governing the Republic of Science. It appears that a society bent on discovery must advance by supporting independent initiatives, coordinating themselves mutually to each other. Such adjustment may include rivalries and opposing responses which, in society as a whole, will be far more frequent than they are within science. (Polanyi, 1962, 66)

Here, Polanyi is arguing that the discovery of knowledge, and by implication any society that is built around such endeavours, as ours most surely is,[1] requires a special type of co-operation and co-ordination in which individuals are free to pursue their own interests, and that an order of 'fair' rules keeps the competitive rivalry honest and engaged. Under these conditions—that approximate a knowledge commons (Ostrom and Hess, 2006)—pooling and sharing information can occur, thus promoting individual adaptation and the growth of knowledge.

Polanyi was writing against the Cold War British government's plans to harness scientists to a centralized agenda: he was arguing against a *taxis* of science. But this same line of argument extends to centralized innovation policy. He argued that any centralized conception meant that science would proceed based only on information available to all, or information that could be communicated to the centralized experts—akin to Hayek's (1945) critique of the information requirements of central planning. Polanyi thought that this was a poor use of the distributed information in the 'Republic of Science'; while the centralization might seemingly function for a short duration, Polanyi worried about the consequences of centralization once the specific problems became exhausted. Specifically, Polanyi worried that 'in the absence of further information about the results achieved by others, new problems of any value would cease to arise, and scientific progress would come to a standstill' (Polanyi, 1962, 54). Polanyi thus explained how the co-ordination process occurs as 'coordination by *mutual adjustment* of independent initiatives' [italics added] or of 'the adjustment of the efforts of each to the hitherto achieved results of the others' (Ibid.).

Polanyi's argument turned on the significance of *tacit knowledge* (as outlined in his book *Personal Knowledge*), which became the lynchpin in his argument that science could not be centrally planned. As Philip Mirowski has further elucidated:

> Since tacit knowledge was intrinsically dispersed throughout the community, and could only be passed along piecemeal through a socialization process inculcating a particular personal commitment, there could never be any effective rationalization or codification of the process of research. (Mirowski, 1997, 134)

This is why Polanyi argued that scientific research was necessarily co-ordinated by a process of mutual adjustment; in science 'by taking note of the published results of other scientists' while in markets by 'mutual adjustment through a system of prices' (Polanyi 1969, 52).[2] Innovation involves both kinds of mutual adjustment. Agents pay attention to the results and findings of others, so there is social learning. Additionally, agents pay attention to price signals, so there is market learning. Both social learning and market learning are powerful and efficient carriers of information and knowledge.

Indeed, many others have made similar arguments, even when building from different starting points. The psychologist George Kelly (1955) wrote of the scientist as a model of human action, particularly in the face of novelty. George Shackle (1972), Brian Loasby (1999), and Peter Earl (1986) applied similar ideas in respect of the growth of knowledge under bounded rationality and uncertainty. Gus diZerega (2012) explains how Thomas Kuhn and John Ziman argue that science is a spontaneous order for the discovery of reliable knowledge. Terrence Kealey (1996) has argued that there is essentially no evidence that science benefits from centralization, and a great deal that it doesn't. He claims that not only does science and scientific research work as a spontaneous order, but that it works best that way. None of these are specifically 'mainstream' arguments, but they are plausible and coherent reasons to understand science and innovation as emergent orders.[3]

2.2 Business Models

A business model is the way in which a particular idea is exploited as an economic opportunity (Teece, 2010). A business model refers to the particular ways in which value is created and extracted, relating to the definition of the market, the scale and scope of the firm, to valuable assets and particular scarcities. Business models tend to be deeply connected to a particular institutional, technical and behavioural milieu. It is increasingly argued that business models not only change with economic evolution but also are key dimensions and aspects of that process. New business models are planned and designed at the *micro* level, and are entrepreneurially experimented with in markets, but new business models also emerge at the *meso* level in consequence of evolutionary selection processes, market feedback, and differential copying (Dopfer and Potts, 2008). Business models are therefore part of the *cosmos* of innovation; as part of an industrial ecology, they emerge.

Business models co-evolve with technologies (Beinhocker, 2006). It is hard to observe business model evolution because the successful models are usually only apparent *ex post*, once market processes have played out and structures of complementarity have been revealed. Moreover, once a set of opportunities becomes a recognizable industry, its business models will often have matured or normalized to the point that they are the standard ways of doing things, which are revealed only when disrupted (Christenson, 1997). That business models change and evolve is less widely appreciated than similar arguments that technologies or institutions change and evolve (Arthur, 2011). But from an experienced perspective it should be equally obvious. Entrepreneurs are of course at the forefront of this evolutionary trajectory, because new technologies often not only require new business models but can also enable new business models: in other words, entrepreneurship can consist entirely of new business models (Baumol, 1990).

A new business model is not required for all innovation. There are many instances within the unfolding of a technological trajectory (Dosi, 1982) where a new product is produced, marketed, and consumed in a similar way to earlier innovations (think of the innovation of shampoo, then of conditioner, which follows with the same business model). But some innovations not only require but are effectively defined by a new business model.[4] Open business models are a further example (Chesbrough, 2006).

Business models evolve and the discovery of new business models matters because business models are really just another form of technology, or institution (Nelson and Sampat, 2001). This evolutionary process seems best described by a punctuated-equilibrium framework, with periods of stasis punctuated by periods of rapid change; but this is hard to tell given the paucity of research on business models in both industrial and long-run economic dynamics. But this then raises the question of how we arrive at the best, most optimal business models? Or perhaps better, how do we avoid arriving at the worst?

One answer is that we design them. We plan and control business models in relation to revealing the possibilities of an innovation, making use of expertise and regulation to program the best solutions. This is the *taxis* model of business models and innovation. But another answer is that we grow and evolve them, making use of entrepreneurial variation and market selection over various elements and their relative success and adoption. This is *cosmos*, in which business models emerge through the distributed actions and interactions of people, technologies and institutions. Business models evolve through entrepreneurial variation and market selection, and as Beinhocker (2005) effectively argued, they are a core mechanism and dimension of the technology of economic evolution. In a micro sense business models are designed by individual firms. But in a meso/macro sense, business models are evolved through interaction effects and the emergence of what Arnold Kling (2011) calls 'patterns of sustainable specialization and trade'.

Because individual firms (manifestly) design or choose their business models, there is an aggregation fallacy in the inference that the business models that exist, as adapted to an innovation, are also designed, or that this is co-extensive with the institutions that support them. Yet this is almost certainly false. Business models and innovation are in effect a co-joint spontaneous order.

But for those seeking to preserve the status quo, new business models are sometimes easier to fight than new technology. One of the problems with large monopolistic enterprises is that they can monopolize a business model, and this can act as a *de facto* form of protection against other forms of innovation. A business model supports a prior innovation against competition from a new innovation that may require a new business model. Large monopolized firms can sometimes protect business models more easily than they can protect technologies, but the net effect is the same. Innovation usually involves new business models, and these new business models are part of the *cosmos* of innovation, as an emergent outcome.

2.3 Co-operation

In the standard economic model of 'Schumpeterian competition' (Metcalfe, 1998), or in the 'patent race' model of competitive industrial innovation dynamics (Loury, 1979; Grossman and Shapiro, 1987), firms compete through innovation. It is an entirely orthodox economic proposition to argue that forces of competition shape and drive innovation (Aghion *et al.*, 2005). The result is that a spontaneous technological and market order emerges under competition.

A similar argument can be made about the forces of co-operation (cf. Cowen and Sutter, 1999). When dealing with the fixed costs of experimentation and development, emergent co-operation can facilitate information pooling and feedback, generating the potential for new ideas to emerge and develop through social learning (Potts, 2013). Co-operation can drive innovation as much as competition, and in a similarly emergent way.

First, co-operation is essential to innovation because innovation is essentially about making and discovering new connections between things. Second, co-operation in such collective action problems was previously thought to be highly unstable because of free-rider problems, yet much new research suggests that co-operation is actually far more likely to evolve and emerge than previously recognized (Nowak, 2006, 2011).

There is a growing recognition that the early phases of any new technology are a surprisingly collaborative space. Ostrom and Hess (2006) characterize this as a 'knowledge commons' and Potts (2012) calls it an 'innovation commons'. Peterson (2012) argues that the industrial revolution can be understood as part of this same process of improved co-operative outcomes driving knowledge discovery. The new body of interdisciplinary work on open source production of knowledge and innovation supports this theme (e.g. Benkler, 2008).

Specifically, co-operation is more evolutionary stable than has been previously recognized (Boyd *et al.*, 2010). This is in part due to the economics of asymmetric information and uncertainty. Where competitive information is socially embedded—so that market information and technical information are intertwined –agents might invest in assets or engage in costly behaviours that signal co-operation in order to access new information and associated innovations.

Co-operation cannot be forced and often works best under rule-based governance (Ostrom, 1990). Co-operation is thus often a type of spontaneous order. This connection has not been widely made in the innovation literature. Still, new theoretical perspectives seek to develop the evolutionary theory of co-operation (Nowak, 2006; Bowles and Gintis, 2011) and this can be extended to the theory of innovation.

2.4 Clusters

Innovation can also be understood as a *cosmos* through its spatial clustering. A cluster—for example, Alfred Marshall's 'industrial district'—is an economic opportunity that is caused by local feedback, resulting in increasing returns. It has long been recognized that innovation seems to cluster.

Several economic forces are involved in cluster formation, including spatial economies, scale economies, and information economies. Krugman (1991) calls this 'increasing returns operating spatially'. The process of internalizing the external economies of production, consumption and innovation is the mechanism that assembles the cluster into an economic order. Clusters are in this sense not designed any more than are the patterns of comparative advantage that support emergent patterns of trade. Clusters can therefore be economically understood in terms of the dynamic outcomes of any feedback process operating over external economies that result in agglomerative tendencies, including for example preferential attachment mechanisms (Newman *et al.*, 2006). Clusters are a spontaneous order, and therefore so is the innovation processes that result from them.

Cities are a prime example of a spontaneous order, and cities can be understood from the perspective of information economics, both from the information-production and the information-cost perspective. Co-location of firms creates thick labour markets, promotes specialization in labour supply, induces specialist business services including infrastructure and transport, and further promotes the development of output markets, which in turn promotes competition and lowers consumer search costs, and so on (Glaeser, 2011). Cities are the result of processes of increasing returns, the same processes that also drive innovation. This is a naturally and spontaneously occurring clustering phenomenon.

If clusters can be planned then innovation can be planned (through that mechanism). But mounting evidence suggests that the standard model in which clustering drives knowledge sharing (external economies) thus driving innovation may be somewhat misleading, if not entirely backwards (cf. Audretsch and Feldman, 1996; Belleflamme *et al.*, 2000; Breschi and Malerba, 2001; Owen-Smith and Powell, 2004).

Instead, the argument seems to run the other way: namely that 'it is firms' capacity to absorb, diffuse and creatively exploit knowledge that shapes the learning dynamics of the cluster as a whole' (Guiliani and Bell, 2005, 64). The implication is straightforward but still widely unappreciated, namely that innovation and clusters are *both* spontaneous orders, and that the efficacy of the cluster *depends* upon the spontaneous order of the innovation process. You cannot design clusters separately from the design of innovation, which is in effect to admit that neither can be entirely designed: they are mutually constitutive spontaneous orders.

The basic units of a cluster are nevertheless knowledge-using and knowledge-generating firms. Such firms will tend to co-locate to the extent that knowledge externalities can be created and exploited. This is a property of the 'absorptive capacity' of the firms themselves, not of the environment. (The 'Coase theorem' suggests that we would expect firms to bargain and contract their way toward internalizing the externality.) Innovation networks and clusters simultaneously emerge as the network and spatial dimensions of this growth-of-knowledge process. They are the emergent *consequence* of firms discovering and exploiting knowledge complementarities. Clusters and innovation are part of a mutually constituting spontaneous order.

2.5 Copying

The role of copying in innovation has different meanings when understood as part of a *taxis* or a *cosmos*. This distinction is due to the mathematical parsimoniousness of modelling the innovation process as a class of diffusion process (Rogers, 1995). A diffusion process is a model borrowed from epidemiology to study the dynamics of infections through a population. This form of model emphasizes information replication, perhaps with some decay. Yet the problem with this model is that it downplays the fundamental amplification and discovery process of distributed *copying with adaptation* that underpins most such mechanisms, and which was indeed central to Zvi Griliches' (1957) seminal study on technological diffusion.

Copying is a process by which 'generic' rule evolution occurs, and can be a mechanism by which the copying of a new idea into a population gives rise to a spontaneous order through its population-level consequences and its interaction with local knowledge and resources (Potts, 2013). In a simple diffusion process a novel idea is introduced into a population (dropped in from outside, say) and then diffuses through the population based on the 'susceptibility to infection' or 'probability of adoption' of each agent in a connected population. Given a set of parameters describing that susceptibility, population structure, and the initial seeding of the population, a diffusion model can estimate the spread of the novel idea. These simplifications are of course part of the modelling abstraction, but this approach tends to obscure a crucial aspect of a diffusion process: the adaptive mixing of the idea with distributed or local knowledge. While the diffusion model is entirely suitable in some cases, for the most part the innovation process unfolds as a copying process, thus copying a generic rule (Dopfer and Potts, 2008). This rule will often be adapted into a local circumstance.

We can represent this process with a logistic-diffusion curve (Metcalfe, 1998), but the problem with that view is that it seems susceptible to planning and design. It fails to capture the distributed interaction with local knowledge and the way in which the overall innovation process is affected. What is actually happening at the micro level of such a process is that economic evolution is occurring in the knowledge-base of an economy through the operation of a distributed, parallel, and differential copying process. Copying processes are how innovation unfolds as a novel generic rule is selectively mixed with local knowledge in different environments, adding variation and local adaptation. This is not the same as a diffusion process where a single 'rule' replicates through a population of differentially susceptible agents. The first—copying—is a representation of a *cosmos*, the second—replication—represents a *taxis*.

An example can be seen in the difference between two types of restaurant and food, namely the difference between US food franchises—such as McDonalds or Pizza Hut—and what we may loosely call 'Chinese food', which has also spread all over the world, but not by the same mechanism and with different consequences for knowledge and economic structure.[5] In essence Chinese food has spread through copying, such that it mixes with local circumstance and opportunity. This can mean different ingredients, different economic institutions and circumstances, leading to different product and business models, all of which can be observed by others. This provides further information, including about success and failure. This is valuable information about what works and what doesn't in different environments. In the process, the knowledge base of 'Chinese food' is evolving. But the franchise model does not achieve this, or at least not to anything like the same extent, and instead depends on the quality of decisions made centrally.[6]

It is unclear whether distributed copying or centrally-controlled replicating is the superior strategy without further information on aggregate preferences and environmental circumstances. But we can observe their differentiating aspects. For a start, they learn in different ways. Chinese food learns adaptively and locally, with a great deal of system-wide experimentation networks (and clusters) of observations. McDonalds (say) learns at the centre, with considerable more investment in expertise. The business model is then based on a standardized delivery. There is also a different fit with the local environment, with greater opportunity for adaptation to local conditions and opportunities with Chinese food. But there is also greater cost in that experiment that is unable to be spread over many others.

3 IMPLICATIONS

Our starting premise of this paper was that there are two broad views on the nature of the order of innovation—as a planned order or a self-organizing order—that usually come bundled with one's priors on the nature of the market order. Specifically, where one is predisposed to see market failure, one will also tend to a *taxis* view of innovation, and the concomitant role of planning and 'innovation policy'. However, where one tends toward a market process view, one will also tend toward a *cosmos* view of innovation as the outcome of a spontaneous order, and thus toward scepticism of the efficacy of innovation policy. The purpose of this paper has been to propose five additional reasons that stack up on the *cosmos* side of the argument.

The five points above—science, business models, cooperation, clusters, copying—outline five further ways in which innovation should be understood as a spontaneous order. The parallel with science suggests seeking lessons in the governance of science. In science, for the most part, the gains from decentralization, as well as the costs of centralization, are high. Innovation is likely to be similar. Furthermore, the institutions that do work in incentivizing science—such as the norm-governed reputational economy—might be effectively replicated in the innovation economy.

Business models are a particular class of institution that also needs to be open in order for economic evolution to occur. Many new technologies and other new ideas for economic opportunities require new, or at least modified, business models. It is impossible to know these beforehand: they must be discovered. This part of the innovation process works best as a *cosmos*.

Co-operation is fundamental to transaction costs and to copying. But co-operation tends to be something that emerges under certain rules, and not otherwise. It is not something that can be designed or imposed. To the extent that co-operation matters to innovation, then innovation is best understood as a *cosmos*. Co-operation is never a *free* policy variable, in either sense of the word. Clusters simply mean that there is also a spatial dimension to the folly of picking winners, and that the price we pay for this is measured in the distortions to the spatial economic forms that would be generated by an open system. Copying simply means the mechanism by which local knowledge is adapted into an unfolding process. This is, in essence, a dynamic version of Hayek (1945).

None of these lines argues entirely against policy intervention in the innovation context, but they do suggest a greater wariness may be warranted regarding the often hidden and unintended costs of *taxis* intervention. The costs fall on the growth of knowledge, and so is a species of economic welfare forgone. It is easy enough to be constructivist and to suppose that the many innovations we see around us are the result of great and successful plans that are of the sort that Hayek (1973, Chapter 2) defined as a *taxis* rather than an unintended type of order—a *cosmos*. In such a *taxis*, innovation is the result of investment following a plan. Innovation produces a good, as structured by an innovation system and incentivized by an innovation policy (Metcalfe, 2005). This sort of planned innovation design is widely believed to be part of how a rational economic order grows (OECD, 2010). Obviously this is in part true. But it is also partly wrong, in that it undervalues or ignores the *cosmos* aspect of the mechanism, the extent to which the innovation process best unfolds as an emergent spontaneous order.

In *cosmos*, innovation evolves through rule-governed interaction via co-operation, clusters and copying, and without any end in mind. Innovation is a spontaneous order. In *taxis*, it is through targeted investment and support. This distinction between the *taxis* and *cosmos* aspects of innovation currently is not, but should be, a far more fundamental part of innovation theory, and hence innovation policy.

NOTES

1 Polanyi (1962, 74) argues that: 'The Republic of Science is a Society of Explorers. Such a society strives towards an unknown future, which it believes to be accessible and worth achieving.'

2 See Metcalfe (2010, 12) on the relation between Hayek's (1973) spontaneous order and Polanyi's (1962) concept of a republic of science.

3 A more recent example comes from 'open science' (Nielsen, 2012), which is a parallel to 'open innovation' (Chesbrough, 2005). Open science is the drive toward sharing and pooling data and discovery. Most examples come from physics and astronomy at the moment (e.g. arXiv, Galaxy Zoo, Foldit) but this is spreading to other sciences. A key rationale is the benefits that come from an open distributed model in respect of the discovery process.

4 For example, think Sears and catalogue sales; the supermarket; Gillette loss-leading on handles and profiting on shaving heads; or applications of rental-based businesses; or Google giving away search in exchange for eyeballs that are then auctioned off millions of times a second; think Groupon, or Ebay, or Amazon, or Etsy (von Hippel, 2005).

5 This observation was made by *New York Times* food columnist Jennifer Lee in a TED talk: www.ted.com/talks/lang/en/jennifer_8_lee_looks_for_general_tso.html.

6 Other examples of these rule-copying processes (from my own work) include investment decision rules (Chai, Earl and Potts 2008), happiness (Potts, 2011), and the development of video games (Banks and Potts, 2010).

REFERENCES

Aghion, P., Bloom, N., Blundell, R., Griffith, R. and Howitt, P. (2005). Competition and innovation: an inverted-U relationship. *Quarterly Journal of Economics*, 120(2): 701-28.

Ames, B. (1989). *Science and Spontaneous Order*. Bowling Green: Bowling Green State University.

Arrow, K. (1962). Economic welfare and the allocation of resources for invention. In: Nelson, R. (Ed.) *The Rate and Direction of Inventive Activity*. Princeton: Princeton University Press, pp. 609-25.

Arthur, W. B. (2011). *The Nature of Technology*. New York: Free Press.

Audretsch, D. and Feldman, M. (1996). R&D spillovers and the geography of innovation and production. *American Economic Review*, 86(3): 630-40.

Banks, J. and Potts, J. (2010). Consumer co-creation in online games. *New Media and Society*, 12(2): 253-70.

Barry, N. (1982). The tradition of spontaneous order. *Literature of Liberty*, 5: 7-52.

Baumol, W. (1990). Entrepreneurship: productive, unproductive, and destructive. *Journal of Political Economy*, 98(5): 893-921.

Beinhocker, E. (2006). *The Origin of Wealth*. Cambridge, MA: Harvard Business School Press.

Belleflamme, P., Picard, P. and Thrisse, J. (2000). An economic theory of regional clusters. *Journal of Urban Economics*, 48(1): 158-84.

Benkler, Y. (2008). *The Wealth of Networks*. New Haven: Yale University Press.

Bowles, S. and Gintis, H. (2011). *A Cooperative Species: Human Reciprocity and Its Evolution*. Princeton: Princeton University Press.

Boyd, R., Gintis, H. and Bowles, S. (2010). Coordinated punishment of defectors sustains cooperation and can proliferate when rare. *Science*, 328: 617-20.

Breschi, S. and Malerba, F. (2001). The geography of innovation and economic clustering: some introductory notes. *Industrial and Corporate Change*, 10(4): 817-33.

Buchanan, J. and Vanberg, V. (1991). The market as a creative process. *Economics & Philosophy*, 7(2): 167-87.

Butos, W. and Koppl, R. (2003). Science as a spontaneous order. In: Jensen, H. *et al.* (Eds.) *The Evolution of Scientific Knowledge*. Cheltenham and Northampton, MA: Edward Elgar, pp. 164-88.

Chai, A., Earl, P. E. and Potts, J. (2007). Fashion, growth and welfare: an evolutionary approach. *Advances in Austrian Economics*, 10(11): 187-207.

Chesbrough, H. (2006). *Open Business Models*. Cambridge, MA: Harvard University Press.

Christenson, C. (1997). *The Innovator's Dilemma*. New York: Harper Business.

Colander, D., Holt, R. and Rosser, B. J. (2011). The complexity era in economics. *Review of Political Economy*, 23(3): 357-69.

Cowen, T. and Sutter, D. (1999). The costs of cooperation. *Review of Austrian Economics*, 12: 161-73.

Dopfer, K. and Potts, J. (2008). *The General Theory of Economic Evolution*. London: Routledge.

Dopfer, K., Foster, J. and Potts, J. (2004). Micro–meso–macro. *Journal of Evolutionary Economics*, 14: 263-79.

Dosi, G. (1982). Technological paradigms and technological trajectories. *Research Policy*, 11(3): 147-62.

Earl, P. E. (1986). *The Economic Imagination*. Cheltenham: Harvester Wheatsheaf.
Giuliani, E. and Bell, M. (2005). The micro determinants of meso-level learning and innovation: evidence from a Chilean wine cluster. *Research Policy*, 34(1): 47-68.
Glaeser, E. (2011). *Triumph of the City*. New York: Penguin.
Griliches, Z. (1957). Hybrid corn: an exploration in the economics of technological change. *Econometrica*, 25(4): 501-22.
Grossman, G. and Shapiro, K. (1987). Dynamic R&D competition. *Economic Journal*, 97: 372-87.
Hayek, F. A. (1945). The use of knowledge in society. *American Economic Review*, 39: 519-30.
Hayek, F. A. (1973). *Law, Legislation and Liberty, Volume 1: Rules & Order*. Chicago: University of Chicago Press.
Hayek, F. A. (1978). The results of human action but not of human design. *In: New Studies in Philosophy, Politics and Economics*. Chicago: University of Chicago Press, pp. 96-105.
Hayek, F. A. (1988). *The Fatal Conceit*. Chicago: University of Chicago Press.
Hippel, E. von (2006). *Democratizing Innovation*. Cambridge, MA: MIT Press.
Jacobs, S. (1999). Michael Polanyi's theory of spontaneous orders. *Review of Austrian Economics*, 11: 111-27.
Kealey, T. (1996). *The Economic Laws of Scientific Research*. London, UK: Macmillan.
Kelly, G. (1955). *The Psychology of Personal Constructs*. New York: Norton.
Kling, A. (2011). PSST: patterns of sustainable specialization and trade. *Capitalism & Society*, 6(2) [e-journal].
Krugman, P. (1991). Increasing returns and economic geography. *Journal of Political Economy*, 99: 483-99.
Langlois, R. (1995). Do firms plan? *Constitutional Political Economy*, 6: 247-61.
Lavoie, D. (1989). Economic chaos or spontaneous order: implications for political economy of the new view of science. *Cato Journal*, 8(3): 613-36.
Loasby, B. (1999). *Knowledge, Institutions and Evolution in Economics*. London: Routledge.
Loury, G. (1979). Market structure and innovation. *Quarterly Journal of Economics*, 93: 395-410.
Mäki, U. (1999). Science as a free market: a reflexivity test in an economics of economics. *Perspectives on Science*, 7(4): 486-509.
McCloskey, D. (2007). *Bourgeois Virtues*. Chicago: University of Chicago Press.
Metcalfe, J. S. (2005). Systems failure and the case for innovation policy. In: Llerena, P. and Matt, M. (Eds.) *Innovation Policy in a Knowledge-Based Economy*. Berlin: Springer, pp. 47-74.
Metcalfe, J. S. (1998). *Evolutionary Economics and Creative Destruction*. London: Routledge.
Metcalfe, J. S. (2010). The university and business relations: connecting the knowledge economy. *Minerva*, 48: 5-33.
Mirowski, P. (1997). On playing the economics trump card in the philosophy of science: why it did not work for Michael Polanyi? *Philosophy of Science*, 64: 127-38.
Nelson, R. (Ed.) (1993). *National Systems of Innovation*. New York: Oxford University Press.
Nelson, R. and Sampat, B. (2001). Making sense of institutions as a factor shaping economic performance. *Journal of Economic Behavior and Organization*, 44: 31-54.
Newman, M., Barabasi, A. L. and Watts, D. (2006). The Structure and Dynamics of Networks. Princeton: Princeton University Press.
Nielsen, M. (2012). *Reinvesting Discovery: The New Era of Networked Science*. Princeton: Princeton University Press.
Nowak, M. (2006). Five rules for the evolution of cooperation. *Science*, 314(5805): 1560-63.
Nowak, M. (2011). *Supercooperators*. New York: Free Press.
OECD. (2010). *OECD Innovation Strategy.* Paris: Organization for Economic Co-operation and Development.
Ostrom, E. (1990). *Governing the Commons*. Cambridge: Cambridge University Press.
Ostrom, E. and Hess, C. (Eds.) (2006). *Understanding Knowledge as a Commons*. Cambridge, MA: MIT Press.
Owen-Smith, J. and Powell, W. (2004). Knowledge networks as channels and conduits: the effects of spillovers in the Boston Biotechnology Community. *Organization Science*, 15(1): 5-21.
Peterson, G. (2012). The social origins of economic growth: social and technological innovation caused the industrial revolution. Working paper, University of Illinois.
Polanyi, M. (1941). The growth of thought in society. *Economica*, 8: 428-56.
Polanyi, M. (1962). The republic of science. *Minerva*, 1: 54-74.
Popper, K. (1972). *Objective Knowledge: An Evolutionary Approach.* Oxford: Clarendon Press.
Porter, M. (2000). Location, competition and economic development: local clusters in the global economy. *Economic Development Quarterly*, 14(1): 15-34.
Potts, J. (2011). The use of happiness in society. *Policy*, 27(1): 3-10.
Potts, J. (2012). Innovation commons. Conference paper, 14th International Schumpeter Society Conference, Brisbane, Australia.
Potts, J. (2013). Rules of spontaneous order. *Cosmos* & *Taxis*, 1(1): 30-41.
Ridley, M. (2011). *The Rational Optimist: How Prosperity Evolves*. London: Harper Collins.
Rogers, E. (2005). *The Diffusion of Innovations* (5th Edition). New York: Free Press.
Schumpeter, J. A. (1943). *Capitalism, Socialism and Democracy*. London: George Allen & Unwin.
Teece, D. (2010). Business models, business strategy, and innovation. *Long Range Planning*, 43(2-3): 172-94.
Witt, U. (2013). Competition as an ambiguous discovery procedure: a reappraisal of Hayek's epistemic market liberalism. *Economics and Philosophy*, 29: 121-38.
Ziman, J. (Ed.) (2000). *Technological Innovation as an Evolutionary Process*, Cambridge: Cambridge University Press.