

**Kirznerian Entrepreneurship and the Economics of Science**

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## I. Introduction

Does the production of scientific knowledge<sup>1</sup> differ in certain important respects from the kinds of activity economics typically studies? If it does, the kinds of coordinating mechanisms at work in science that would allow us to see such activities as an Hayekian “order” might well differ from the order we more readily associate with *catallactic* activity, defined here to refer to “market phenomena” (Mises 1966, Chapter XIV). As Professor Kirzner and Mises before him have so adeptly shown, entrepreneurial activity is central to understanding how markets work. We advance the claim that because “scientific activity,” or at least salient aspects of it, differs from catallactic activity, the coordinating mechanisms found in science do not necessarily involve catallactic entrepreneurship. As such, more than Kirznerian entrepreneurship must be used to describe the coordinating mechanisms in science. While this suggests, as Kirzner (2000) has noted, caution in applying insights gained from economic theory to non-market domains, we also note that actual ongoing changes in institutional arrangements and structures are likely to make scientific activity increasingly more market-like, therefore permitting a fuller catallactic treatment of science than the currently dominant institutional forms allow. Scientific activity may be largely non-market activity, but it does not have to be.

## II. Market Coordination

The principal objects of study in economics are markets. What goes on in markets, how they work, and the results they generate form the primary body of questions economists strive to answer. Markets, as Buchanan and others remind us, are institutional arrangements by which property rights claims are exchanged. According to this view, the domain of economics is not so much about resource allocation per se as it is about the spontaneous ordering and coordinating processes that stem from individuals' actions to remove "felt uneasiness" (Mises 1966). The elucidation of these processes as well as the relevant economic and institutional conditions that affect their efficacy provide the essential framework for analyzing the economy as a market process.

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<sup>1</sup> We explain below what we mean by “science.”

Central to market process theory is the role provided by the entrepreneurial function, especially as developed by Mises and Hayek and more recently by Kirzner. It is a theory in which the tendency toward coordination of individuals' plans involves a process driven by the ceaseless activity of entrepreneurs. Hayek (1937 [1948]) pointed out that economics begins with two basic facts which must be accounted for: (1) the logic of choice of the individual, and (2) social coordination within the market economy. The translation of the logic of action into social coordination was not, however, unproblematic according to Hayek. The equilibrium implied in the means-ends calculation of the individual could be derived through pure logic, but that was not the case for the interaction among individuals. In order to explicate the coordinative properties of the market system, the economist had to specify exactly how individuals in their disparate situations come to learn how to organize their affairs so as to dovetail with the plans of others in the market and thereby realize the benefits of exchange. The signals of property, prices and profit/loss that exist within the market are indispensable aids in coordinating the division of knowledge that exists within society. As originally pointed out by Mises in 1920, and then developed further by both Mises and Hayek in the 1930s and 1940s, the key economic insight was how the institutions of the market society enabled economic actors -- through the practice of monetary calculation -- to expand the intellectual division of labor in society, while alternative institutional arrangements, such as the proposals for socialism popular in the 1920s, 1930s, and 1940s would have to forego the intellectual division of labor.<sup>2</sup>

As presented by Kirzner (1979; 1997), the Mises-Hayek market process approach focuses on entrepreneurial activity when means and ends are unknown, which stands in contrast to "economizing" (or neoclassical maximizing) when means and ends are both known. For Kirzner entrepreneurial activity applies to situations of "radical or sheer ignorance" that cannot be removed by lower transactions costs or search. Thus, the concept of entrepreneurship according to Kirzner does not apply to the neoclassical notion of "rational ignorance." This distinction is relevant because coordinating mechanisms have no reason to be set in motion in the presence of "rational ignorance": given existing transactions costs, it is perfectly appropriate to imagine the attainment of equilibrium even though not all potentially utility enhancing exchanges are consummated. This is because the costs

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2. Boettke (1998) provides a discussion of the shared research program of Mises and Hayek on the issue of economic calculation while recognizing the differences in emphasis that is evident in their writings on the issue.

of recognizing and acting on the potential exchange outweigh the benefits that would be realized from the exchange, and therefore rational choosers will ignore the opportunity. Alternatively, Kirzner's notion of sheer ignorance implies that disequilibrium will persist until entrepreneurs sniff out hitherto unknown opportunities for profit. Individuals are unaware that they in fact are unaware. Something must come into existence which alerts individuals to opportunities of which they simply were unaware. The coordinating mechanisms that come into play as a consequence of entrepreneurial activity necessarily pertain to an initial state of inconsistent plans, implying that market process theory inherently concerns itself with the economics of disequilibrium (Ikeda 1994).

The mere existence of opportunities for entrepreneurial profit does not imply that such opportunities will be exploited. Two reasons account for this: first, opportunities must first be noticed and second, they must be acted upon. Kirzner addresses the former by positing a kind of entrepreneurial learning he calls "alertness" (Kirzner 1973). What is learned is a previously unknown (putative) opportunity for profit that is somehow autonomously perceived by the entrepreneur.<sup>3</sup> For Kirzner, alertness allows one to discover "one's previous (utterly unknown) ignorance" via an "attitude of receptiveness to available (but hitherto overlooked) opportunities" (1997, p. 72). But alertness, Kirzner holds, is not passive; instead, it refers to "the human propensity to sniff out opportunities lurking around the corner" (1979, p. 29), although there is no apparent algorithm for discovering such opportunities.<sup>4</sup> The key notion here is that entrepreneurial alertness is necessary for the discovery of existing price discrepancies. Such discovery, Kirzner maintains, constitutes genuine surprise that is distinctive from both "deliberately produced information in standard search theory" on the one hand and "sheer windfall gain generated by pure chance" on the other (1997, p. 72). In addition, as Mises (1966) and Salerno (1994) emphasize, entrepreneurship must also involve "appraisement" – the "anticipation of an expected fact" that "aims at establishing [future] prices" (Mises 1966, p.332). Accordingly, appraisement inheres in and is not separable from entrepreneurial action.

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3. Note that in Kirzner's treatment entrepreneurial alertness is costless. Thus, no expenditure of resources is either required or helpful in perceiving the existence of unexploited opportunities. Search activity, on the other hand, is costly, indicating that even though potentially utility increasing exchanges could be made, the net benefit of doing would be negative once search costs (or transactions costs) are included. For Kirzner, the elimination of "sheer ignorance" is always welfare improving.

4. Hayek's cognitive theory provides an account of learning that Butos and Koppl (1999) apply to Kirznerian entrepreneurs.

The coordinating tendencies of the market process in Austrian theory depend on the reliability of entrepreneurial activity, motivated by the filters of profit and loss, to change price and output data in the correct directions. Whether or to what extent entrepreneurial activity is on balance reliably coordinating involves considerations beyond the scope of the discussion here. Instead, we will simply assume for the present purposes that the market process tends to work reasonably well provided certain institutional elements (e.g., defined and enforced property rights, rivalrous competition) are operative. We assume, in short, that Paris gets fed.

It is also useful for the discussion below to note here that profits and losses are expressed as (monetary) prices. Entrepreneurs bring to fruition the discovery of perceived opportunities by comparing prices and then acting on those differentials. Entrepreneurial calculation of anticipated profits hooks into the entire constellation of market determined (though non-equilibrium) prices. The structure of prices, both as it exists and as it will be, provides the principal instrument by which the filters of profit and loss and consequently entrepreneurial activity instigate the sorts of market adjustments necessary for the fuller coordination of plans. This is true whether we refer to "Type 1" entrepreneurship, by which we mean the pure arbitrage activities of individuals as they notice opportunities for profit, or "Type 2" entrepreneurship, where the individual provides an organizational environment in which others discover hitherto unknown possibilities for improvement in the existing state of affairs. Type 1 entrepreneurship refers to classic entrepreneurial behavior, while Type 2, as being developed by Sautet, refers to the activity of the firm manager or promoter.<sup>5</sup> Both close gaps in existing knowledge by bringing forth new knowledge, and thus improve the coordination of economic activities -- one by recognizing opportunities within the existing array of affairs, and the other by changing the existing organization of affairs. The important point for our purposes, is that entrepreneurship whether of Type 1 or Type 2 requires the moorings of the market to discipline wishful thinking and transform them into realized improvements. In short, the efficacy of the market process cannot be isolated from the various social structures and institutional arrangements integral to entrepreneurial activity. If entrepreneurial activity is to foment the elimination of error, the institutional framework must be equipped to further the discovery of error and provide the means to correct error. The idea of "the market" is more than just a useful metaphor; it is the actual

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5. See Frédéric Sautet *An Entrepreneurial Theory of the Firm* (1999). Kirzner has also made this distinction in earlier writings (though not using the labels we employed to distinguish between the types of entrepreneurship).

framework by which the economic process instantiates itself.

### III. Does Entrepreneurial Activity Apply to Science?

As discussed above, the Kirznerian tendency toward coordination that occurs in markets rests on the existence of incompatible plans that represent opportunities for profit. Such opportunities, Kirzner holds, are not those that search could uncover or which would be exploited if transactions costs were lower. Instead, these opportunities exist due to "sheer ignorance." It is only through the activities of alert entrepreneurs who literally "sniff out" such opportunities that the coordination of plans occurs. But the setting in which such corrective mechanisms operate is the amalgam of arrangements that we call markets. Economic theory, which seeks to explain how markets work, cannot be assumed to have established that the kinds of coordinating mechanisms relevant for the market setting necessarily carry over to non-market activities.

The main question to address here is whether or in what sense scientific activity constitutes a form or structure of social cooperation similar to markets.<sup>6</sup> Although there are several points of intersection with markets that are explanatorily significant for understanding science,<sup>7</sup> we believe that science, in general, is not a market activity. The coordinating mechanisms of science are not entrepreneurial in Kirzner's sense and thus a fuller explanation to account for the growth of knowledge we observe in science must be sought elsewhere. This suggests that economists should be attentive to potentially important qualifiers when applying economics to science. At the same time, we think it is also important to point out there are rather clear indications that the institutional framework of science, including its organization, funding and legal status, is changing in ways that may induce science to become more like a market.

For the purposes of our discussion, we consider here only those institutional forms of science in which the production of "reliable and codifiable knowledge" principally occurs as a by-product of non-catalytic

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6. Also see Kirzner (1997).

7. A full treatment of the ways economic analysis is undoubtedly essential for understanding science falls outside the scope of this paper. It is clear that our understanding of non- and quasi-market activities benefits from the application of concepts of economics and its tools. See, for example, Diamond's (1996) literature survey of the economics of science, Stephan (1996), Wible (1997), and Al-Ubaydli and Kealey (2001).

mechanisms. In particular, as treated here, science involves the production of an output for which property rights are not enforceable or sufficiently well-established to support the exchange of property rights and the emergence of prices. In general, we may loosely think of such forms as comprising “university science” as opposed to institutional arrangements anchored to clear catallactic profit and loss mechanisms. Our conception of science turns less on defining what it is and more on the institutional arrangements concerning property rights in which such activity occurs. It is commonplace to hear about the “marketplace of ideas” as if the production and distribution of scientific knowledge were market activities.<sup>8</sup> In general, when we think of the creation of scientific knowledge that occurs at universities, government laboratories, and research institutes, our description of such activity will differ markedly from the description we would provide for the markets for apples, bonds, or carpenters. Catallactic theory applies to market exchange and only markets generate prices. In market economies, science exists within and as part of the nexus of market interactions and enjoys various degrees of intimacy with market activity. And it is true that standard economic concepts suggested by scarcity, incentives, and choices provide a distinctive and useful perspective on scientific activity. But for the kind of science considered here, the institutional arrangements are such that scientific activity does not generate market prices for the things it produces.

The association often made between market activity and science, however, does emanate from certain kinds of similarities economists find relevant. Austrians, for example, conceptualize science, like the market order, as an emergent social order that generates unintended outcomes in the form of new knowledge. It is a Hayekian cosmos, even though, like the market, it may also contain significant constructivist elements. Science is characterized by a division of knowledge, perhaps suggesting some commonalities between its structures and mechanisms and those identified with markets in that scientific activity occurs in a context of constrained choice and scientists, like anyone else, engage in self-interested behaviors. While markets and science both generate knowledge, the knowledge produced by each is distinctive.<sup>9</sup>

According to others, and generally at odds with Hayekian and Austrian views, scientific activity can be

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8. The late William Bartley (1986) argues that the growth of knowledge is a part of economics because knowledge is a form of wealth. Also see, for example, Nelson (1959), Arrow (1962), and Hirshleifer (1971) for early treatments of science as an economic activity.

9 See Hayek 1973, Lavoie 1985, Koppl and Butos 1999, Butos and McQuade 2002.

expressed by conventional rational choice market models or at least analyzed against a backdrop of neoclassical theory. Not surprisingly, the non-rivalrous character of the knowledge often generated by scientific activity has been used by neoclassicists to cast scientific knowledge as a public good, with the attendant implication of the failure of individual rationality to ensure efficient allocative outcomes. Such arguments have been widely used to justify government subsidization of science, although our argument below suggests that widening the scope of property rights within science can serve as an antidote to policies that perpetuate via government subsidies the “publicness” of goods that under alternative institutional arrangements would be produced and allocated by standard market mechanisms.

Another approach suggested by James Wible (1995) the production and distribution of scientific knowledge shares important similarities with long term asset markets. If so, they may exhibit characteristics similar to those Keynes analyzed in The General Theory. If the creation of knowledge renders existing probability distributions irrelevant and if no calculus is available that enables rational decision-making, as in Keynes's bond market, scientific activity may reflect the venting of "animal spirits" in the form of herding, knowledge cascades, and sub-optimal lock-in of scientific knowledge and technologies. This view sees scientific activity, especially in pure research, existing in a world of outcomes dominated by the vagaries of radical uncertainty that creates a kind of market failure justifying government subsidization of science.

These aforementioned approaches to the economics of science provide a snapshot of the different ways economists attempt to study science (also see, for example, Diamond 1996, Dasgupta and David 1994). These approaches, though dissimilar in important ways, suggest that the diverse insights economists can bring to bear on science may indeed be appealing. The economic way of thinking examines the logic of action in terms of opportunity costs, and in the most abstract sense this logic is reflected in the choices of individuals wherever and whenever they pursue their ends by employing scarce means. But economic analysis since the time of the classical economists has also entailed the recognition and explanation of a pattern of order which is not immediately obvious to observers. This second component of the economic way of thinking has been termed invisible hand explanations or spontaneous order theory. The translation of the logic of action to social coordination between various individuals, and under what conditions such a translation is possible, has been the main intellectual contribution of

economics since its beginnings. For our purposes, however, the point we want to stress is the institutionally contingent nature of the ability of the economist to postulate this result. The economic way of thinking is not the problem, but not all spontaneous outcomes that emerge from the interaction of individuals can be said to generate an order which serves the public benefit. The logic of economic argument, especially when applied to the market process, provides a structure which many have found seductive, but the seduction can be misplaced if the institutional environment is not appropriately established.

Hayek pushed spontaneous order explanations not only within the specified institutional environment of the market economy, but also to issues associated with that institutional environment and the selection between different institutional environments. This is a comprehensive research program, and as such it is seductive since it can too often stop us from asking the important questions about the institutionally contingent nature of plan coordination.. Applications of spontaneous order beyond the sphere of monetary calculation, such as to the law or politics, have been questioned by scholars who are genuinely favorable to the logic of economic reasoning and invisible hand explanations within the market setting.<sup>10</sup> Thus, we have to ask how the institutional configuration of the “republic of science” (Polyani 1962) impacts upon the ability of scientists to coordinate their plans with one another, and what incentives and informational signals exist within that arrangement for the detection and correction of scientific error.

In connection with non-rivalrous scientific knowledge, research mechanisms have evolved to internalize the uncaptured social benefits scientific activity produces. Patents, copyrights, taboos against plagiarism, conventions of citation, tenure, prizes, and funding, are just a few obvious mechanisms that promote scientific activity.<sup>11</sup> These coordinating mechanisms differ from the Kirznerian entrepreneurial process that occurs in markets. According to

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10. For example, Bruno Leoni (1991, pp. 1-186) advanced a spontaneous order explanation for the law built on the analogy to the market economy, but denied that such an analogy should be drawn in politics (ibid., 189-248). Murray Rothbard (1962), in reviewing Leoni's work, challenged the robust nature of the analogy to the law itself, and suggested that there must be some standard to judge the *content* of the law. Custom must be subjected to the higher test of reason, according to Rothbard. There is simply no theoretical or historical reason to believe that whatever judge-made law may evolve will be consistent with individual liberty. Israel Kirzner has made similar criticisms on many occasions (e.g., Kirzner 1992, pp. 163-179). James Buchanan has strongly defended spontaneous order explanation within the market setting and has been a pioneer in pushing the logic of economics beyond market setting to political markets, yet he denies that spontaneous order explanations apply in the choice between rules within which activity of markets and politics take place (see, e.g., Buchanan 1977, pp. 25-39).

11. From a growth of knowledge-biological perspective, Hull (1988, esp. chapter 9) points out that the production of new knowledge hinges on a large volume of attempts because the attrition of contributions is also high. Ensuring enough

Kirzner's view, alertness and discovery of an hitherto unknown error in individuals' plans induces an arbitrage (and a legally enforceable) exchange of economic goods. Scientists also make discoveries about inconsistencies (errors) in our knowledge. But the correction that ensues in science does not always (or perhaps even mainly) imply exchanges that transfer of property rights claims at monetary prices. Since ordinarily there is no identifiable buyer of scientific knowledge, what it means to satisfy the preferences of consumers is different in science compared to what occurs in market equilibration. The analytical definiteness and closure of the increased satisfaction buyers reap from successful entrepreneurial activity in market settings is not present or obvious when we examine science. What are the functional equivalents of property, prices and profit/loss in scientific enterprise? In instances of this kind, the nature of the equilibration processes and in coordinating mechanisms market and scientific activities cannot be presumed to be the same. Yet, it is intriguing to contemplate whether the Kirznerian model might suggest itself more vigorously as a tool for analyzing science if the institutional framework of science were to change in ways that established more clearly defined property rights. In that case, as we discuss below in Section IV, science would be expected to exhibit more market-like attributes.

How science should be studied is not an idle question. Although economic approaches to science have become increasingly prominent (see, for example, Sent 1999), philosophers of science and economic methodologists have maintained a long-standing interest in the growth of scientific knowledge. According to post-positivist philosophy of science, the growth of reliable knowledge occurs within a non-justificationist framework involving the removal of scientific error. Even if scientists are narrow and self-serving, the "republic of science" operates as an abstract self-governing, self-correcting order that over time eliminates falsity. According to Popperians, this is achieved by scientists adhering to certain methodological rules and procedures, such as falsification, to weed out error. Rigorous and persistent attempts to falsify hypotheses results in the progressive elimination of the "blacker" claims about reality. An alternative view stemming from Kuhnian sociology of knowledge sees the self-correcting aspects of science embodied not in methodological prescriptions but in a social milieu in which scientific conventions, training, tuition, and certification are important. Science in this Kuhnian view is constrained activity, but the constraints are embedded in social rules and not more narrow methodological ones. As developed by Bartley

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attempts, given the public goods character of scientific knowledge, requires mechanisms that compensate the innovators.

(1984) and Weimer (1979), science as a self-correcting process principally emerges from critical discourse.<sup>12</sup>

In both of the philosophy of science views mentioned above, rationality in science is processive since truth is never absolutely established but is always contingent and subject to refutation, falsification, and criticism. This kind of on-going, open-ended self-correcting knowledge process in science brings to mind ways that economists often conceptualize market activity. Yet, in market activity there does occur a kind of closure or determinateness as consumer preferences in fact are (or are not) satisfied. In economics we can speak about a "payoff" at the end of the day that is not possible in the views of science discussed above. In market activity the consumer serves as an arbiter of whether entrepreneurial activity is successful or not. This criterion of equilibration is not ordinarily available in science. Moreover, even if the coordinating mechanisms attributable to falsification and criticism are indeed error-eliminating (and there may be reasons to think these may not always work well)<sup>13</sup>, the method by which discovery and correction occur in science is not one of entrepreneurial price and quantity adjustment.

#### **IV. Is Science Becoming More Like Market Activity?**

Up to now we have suggested that science does not embody the kinds of equilibrating processes associated with market activity. But there is increasing evidence that the institutional structure of science is undergoing important and rapid change that are making some scientific activities more like market activity. If so, it may be possible to apply in a more vigorous way Kirznerian market process economics.

Researchers have found that the institutional framework of scientific activity seems to be moving away

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12. In the economics literature a position roughly similar to that of Bartley and Weimer is found in McCloskey (1985).

13. Fraud, replication failure, data mining, etc are well-known (and documented) activities that may perpetuate error in science.

from traditional government-university collaboration and toward arrangements and networks that more integrally include private firms (see, for example, Etzkovitz 1993). Government sponsored and directed research, though profoundly significant for maintaining science as a political and non-market process, may be giving way to more profit-seeking arrangements between academic research communities and entrepreneurial firms, such as has been occurring in the bio-tech area. In the past, the demarcation was sharper between the producers of scientific knowledge (largely university researchers) and the distributors of the fruits of that knowledge to the public in the form of goods and services. The blurring of this line and the closer integration of these functions in different organizational structures suggests a new institutional setting for the production and distribution of knowledge (Nightingale, 1997).

These institutional changes have the important effect of reducing the non-excludibility of scientific knowledge. Opportunities will emerge for the exchange of property rights in science and thus for prices to be established that reflect underlying scarcities and valuations. Even if it is still the case that science might exhibit "market failure" along the lines discussed earlier in connection with Keynes-type uncertainty, the increasing marketization of scientific activity will tend to induce a kind of Kirznerian entrepreneurial process of discovery and equilibration for ameliorating such problems. The role of "Type 2" entrepreneurship is central in generating this new environment, an environment that will provide greater scope for "Type 1" entrepreneurship in coordinating plans within the enterprise of science. The production of scientific knowledge would simply become another activity governed by market processes.

Some commentators, in noticing this changing institutional milieu in science, have not always seen these innovations as welfare-enhancing. They point, for example, to the incentives of profit-seeking firms to withhold useful scientific knowledge or to limit the ways it might be used in order to better capture monopoly rents. In addition, "science for profit" suggests to some that important social priorities will be heavily discounted by the marketization of science. Although these issues cannot be addressed here, from the Kirznerian perspective discussed above such changes would carry positive effects through the increased the scope of entrepreneurial discovery in science.

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