

Retrospectives

Friedrich Hayek and the Market Algorithm

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This feature addresses the history of economic terms and ideas. The hope is to deepen the workaday dialogue of economists while perhaps also casting new light on ongoing questions. If you have suggestions for future topics or authors, please contact Joseph Persky, Professor of Economics, University of Illinois, Chicago, at jpersky@uic.edu.

Introduction

Friedrich A. Hayek (1899–1992) is known for his vision of the market economy as an information processing system characterized by *spontaneous order*: the emergence of coherence through the independent actions of large numbers of individuals, each with limited and local knowledge, coordinated by prices that arise from decentralized processes of competition. Hayek is also known for his advocacy of a broad range of free market policies and, indeed, considered the substantially unregulated market system to be superior to competing alternatives precisely because it made the best use of dispersed knowledge:

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† For supplementary materials such as appendices, datasets, and author disclosure statements, see the article page at

<https://doi.org/10.1257/jep.31.3.215>

doi=10.1257/jep.31.3.215

[The market is] a system of the utilization of knowledge which nobody can possess as a whole, which ... leads people to aim at the needs of people whom they do not know, make use of facilities about which they have no direct information; all this condensed in abstract signals ... [T]hat our whole modern wealth and production could arise only thanks to this mechanism is, I believe, the basis not only of my economics but also much of my political views (Hayek 1994, p. 69).

These political views included opposition not only to Soviet-style central planning, but also to monetary and fiscal demand management policies, collective bargaining, wage floors, and significant public expenditures. Such forms of interference with the market, in his view, would compromise its ability to deliver continued prosperity.¹ His hostility to Keynes and Keynesian policies, in particular, was deep and visceral.

Following conventional usage, we shall use the term *laissez faire* to represent this general stance and the associated suite of policy positions. Hayek himself rejected the term, which he associated with a tradition in social thought that considered human beings to be endowed with the “intellectual and moral attributes” necessary to “fashion civilization deliberately” (Hayek 1960, pp. 60-61). He firmly opposed the view that institutions were “deliberate contrivances,” arguing instead that they emerged through trial and error across generations. Successful societies were those in which “man’s more primitive and ferocious instincts” were “tamed and checked by institutions that he neither had designed nor could control.” These institutions would then survive and spread through learning and imitation rather than deliberate design.

Hayek drew a sharp contrast between his approach and Walrasian general equilibrium theory, which itself had been used to make a case for *laissez faire* on the basis of the two fundamental theorems of welfare economics. These can be roughly stated as follows: a competitive price-taking market equilibrium will be Pareto-efficient, and any distributional concerns about the outcomes of such a market can be addressed through a redistribution of endowments. It was these theorems that Gérard Debreu (1984) presumably had in mind when he reportedly claimed that “the superiority of the liberal economy is incontestable and can be mathematically demonstrated.” In contrast, Hayek did not consider the welfare theorems to be compelling arguments for his policy stance. As he put it, the “argument in favor of competition does not rest on the conditions that would exist if it were perfect” (1948, p. 104). Instead, his case for competitive markets rested on the idea that competition was a “procedure for discovering facts which, if the procedure did not exist, would remain unknown or at least would not be used” (Hayek 1968). In this view, the superiority of competition as a procedure for discovering and utilizing knowledge could be established only through a comparative evaluation of economic systems.

¹ However, Hayek did support a universal basic income (1979, p. 55), and was generally opposed to free banking (White 1999).

Our purpose in writing this paper is twofold:

First, we believe that Hayek's economic vision and critique of equilibrium theory not only remain relevant, but apply with greater force as information has become ever more central to economic activity and the complexity of the information aggregation process has become increasingly apparent. Advances in computational capacity and the growth of online transactions and communication have made the collection and rapid processing of big data feasible and profitable. Many markets now involve algorithmic price-setting and order placement alongside direct human action, raising interesting new questions about the processes by which information is absorbed and transmitted by prices.

Second, we wish to call into question Hayek's belief that his advocacy of free market policies follows as a matter of logic from his economic vision. The very usefulness of prices (and other economic variables) as informative messages—which is the centerpiece of Hayek's economics—creates incentives to extract information from signals in ways that can be destabilizing. Markets can promote prosperity but can also generate crises. We will argue, accordingly, that a Hayekian understanding of the economy as an information-processing system does not support the type of policy positions that he favored. Thus, we find considerable lasting value in Hayek's economic analysis while nonetheless questioning the connection of this analysis to his political philosophy.

It is worth noting that Hayek shared the 1974 Nobel Memorial Prize in Economics with Gunnar Myrdal “for their penetrating analysis of the interdependence of economic, social and institutional phenomena.” These two economists were poles apart politically, one being a committed social democrat and the other a classical liberal. Yet, if the argument in this paper is sound, Hayek's economic vision ought to be of value to those with Myrdal's politics, just as Myrdal's analytical contributions remain of broad interest and relevance.

Hayek on Competition, Equilibrium, and Disequilibrium

Even prior to the publication of his celebrated 1945 paper “The Use of Knowledge in Society,” Hayek had developed a highly sophisticated and pioneering understanding of intertemporal equilibrium and the conditions under which it could be achieved or sustained. In a 1937 paper in *Economica*, he defined equilibrium as a set of individual plans that could be executed without mutual interference. This allows for the possibility that individual beliefs depend upon local knowledge and differ, provided that these beliefs are not contradicted as plans unfold. This notion of equilibrium is thoroughly modern, dynamic, and unrestrictive—and quite distinct from a general equilibrium model in which prices are uniform and public. Its development by Hayek is a significant—though little recognized—accomplishment in its own right. Indeed, Hayek claimed later in life that it “seems to me in

retrospect the most original contribution I have made to the theory of economics (1994, p. 68).²

But Hayek was not particularly interested in the properties of equilibrium itself, and saw the strength of the market economy as arising from the learning and diffusion of new information that it accomplishes in *disequilibrium*. Unforeseen (and often unforeseeable) changes in economic fundamentals that are initially recognized by only a small number of individuals would lead, through the messages conveyed by changes in prices, to adjustments across the entire economy.

Boettke (1997) traces the process by which Hayek, along with Ludwig von Mises, drew increasingly sharp distinctions between their thinking and the emerging Walrasian general equilibrium approach, partly in response to its effective use by Oskar Lange, Abba Lerner, and other proponents of the economic feasibility of central planning in the “socialist calculation” debates of the 1930s.³ Lange, Lerner, and others argued that central planners could set prices and quantities to achieve the market outcome if they wished, but could also improve upon that outcome by taking into account externalities and other factors that a market would not consider. Hayek argued in response that it was impossible for central planners to choose prices and quantities that would achieve the market outcome, because the necessary information about preferences and production could not be known in advance, and only emerged through the process of market interaction.

Hayek’s sharpest critique of the equilibrium model and the conception of competition on which it was built came in his 1948 paper “The Meaning of Competition.” Here he argued that “the modern theory of competition deals almost exclusively with a state ... in which it is assumed that the data for the different individuals are fully adjusted to each other, while the problem which requires explanation is the nature of the process by which the data are thus adjusted.” That is, “the modern theory of competitive equilibrium *assumes* the situation to exist which a true explanation ought to account for as the effect of the competitive process.”

In Hayek’s (1948) view, assuming a state of equilibrium effectively precludes a serious analysis of competition, which he defines, following Samuel Johnson, as “the action of endeavoring to gain what another endeavors to gain at the same time.” He continues as follows:

Now, how many of the devices adopted in ordinary life to that end would still be open to a seller in a market in which so-called “perfect competition”

²The 1937 paper was originally read in 1936 as the presidential address to the London Economic Club. Glasner and Zimmerman (2014) note that the central arguments in this paper had been anticipated in a 1928 paper by Hayek in German.

³This debate led Hurwicz and others to develop the theory of mechanism design; see, for instance, Hurwicz’s (1984) comment on Kirzner (1984). Maskin (2015) argues that two of Hayek’s central claims—that the market mechanism is informationally efficient and incentive compatible—have been formally established in work by Mount and Reiter (1974), Jordan (1982), and Hammond (1979). These results show that the market mechanism is efficient at equilibrium without addressing whether an equilibrium is reachable. Furthermore, the mechanism uses prices that are centrally given, in that the same price vector is somehow transmitted to all market participants.

prevails? I believe that the answer is exactly none. Advertising, undercutting, and improving (“differentiating”) the goods or services produced are all excluded by definition—“perfect” competition means indeed the absence of all competitive activities.

He goes on to point out another absence in the standard model—social relationships among market participants:

Especially remarkable in this connection is the explicit and complete exclusion from the theory of perfect competition of all personal relationships existing between the parties. In actual life, the fact that our inadequate knowledge of the available commodities or services is made up for by our experience with the persons or firms supplying them—that competition is in a large measure competition for reputation or good will—is one of the most important facts which enables us to solve our daily problems.

Is Hayek’s Critique Obsolete?

Hayek’s arguments have not been ignored by economists. Many of the important phenomena that cannot be accommodated by the Walrasian framework—advertising, undercutting, differentiating, reputation-building, and relational contracting—as well as other related phenomena such as bargaining and search, have been the focus of intense research effort over recent decades.⁴ These advances explicitly allow for opportunistic and entrepreneurial behavior that goes well beyond the passive price-taking of agents in the Walrasian model, and this raises the question of whether Hayek’s critique has been rendered obsolete by subsequent developments in the economics of information and applied game theory.

We think not. Economic analysis largely continues to be based on characterizations of equilibrium states, without attention to the processes through which such states might (or might not) be reached. For example, most contemporary models of strategic competition and search are equilibrium models, characterized by mutually consistent plans. These plans may have complicated features, with actions being contingent on history and the realization of random variables, but there is a common understanding across all individuals regarding the structure of the economy in which they are embedded. Left unaddressed is the process through which such a common understanding might arise.

⁴With the exception of the literature on mechanism design, discussed in the previous footnote, these developments have occurred quite independently of Hayek’s thought. A notable exception is Makowski and Ostroy (2001), who argue that Hayek’s critique of the standard model can be countered by reformulating that model with active rent-seeking agents, and redefining competitive equilibrium. Their proposed theory of markets takes explicit account of the concern that prices “will not be discovered unless opportunistic market participants find it in their self interest to reveal their trade-relevant private information.”

This lack of attention to disequilibrium dynamics parallels the absence of an account of how a competitive equilibrium might arise in the Walrasian model itself. Hayek's critique of the latter applies also to richer conceptions of equilibrium in strategic settings with private and incomplete information. To see this point, consider Hayek (1948, p. 93):

The problem becomes one of how the "data" of the different individuals on which they base their plans are adjusted to the objective facts of their environment (which includes the actions of the other people). Although in the solution of this type of problem we still must make use of our technique for rapidly working out the implications of a given set of data, we have now to deal not only with several separate sets of data of the different persons but also—and this is even more important—with a process which necessarily involves continuous changes in the data for the different individuals. ... [T]he causal factor enters here in the form of the acquisition of new knowledge by the different individuals or of changes in their data brought about by the contacts between them.

Hayek's belief was that this process would lead to a diffusion of individually acquired knowledge across the economy and result in a more effective utilization of knowledge than would be possible under a centralized mechanism. In Hayek's view, the data that individuals have at their disposal consists of "abstract signals" including prices proposed, actions taken by others, and if bargaining actually takes place, information gained in the bargaining process even when no transaction was agreed upon (Kirman, Schulz, Härdle, and Werwatz 2005).

Most of the criticism that Hayek made of the various approaches to analyzing the functioning of the market process turned on the idea that the coordination of individual actions and beliefs is taken as given and the process by which this happens is not discussed. In his words (1948, p. 94):

[T]he description of competitive equilibrium does not even attempt to say that, if we find such and such conditions, such and such consequences will follow, but confines itself to defining conditions in which its conclusions are already implicitly contained and which may conceivably exist but of which it does not tell us how they can ever be brought about. ... competition is by its nature a dynamic process whose essential characteristics are abstracted away under the assumptions underlying equilibrium analysis.

Even within the Walrasian framework, the need to provide disequilibrium foundations for equilibrium analysis has been a recurring theme. Fisher (1983) was especially emphatic on this point, although he later wrote in a more pessimistic key: "The search for stability at great levels of generality is probably a hopeless one. That does not justify economists dealing only with equilibrium models and assuming the problem away" (Fisher 2011, p. 43).

When Prices Are Messages and Entrepreneurial Discovery is Destabilizing

While Hayek had little use for general equilibrium theory, he did implicitly assume that the process of entrepreneurial discovery would be stabilizing on average—that the profit opportunities that arose in disequilibrium would be exploited in a manner that sustained coherence and order in the system (Kirzner 1997). But the same problems of stability that have plagued general equilibrium theory also arise in the context of entrepreneurial discovery: individually profitable activities can be destabilizing in the aggregate.

In fact, the interpretation of prices as signals can itself give rise to destabilizing feedbacks, especially through the linkage of financial and goods markets. Because changes in asset prices can lead to substantial short-term capital gains and losses, information relevant to changes in such valuations will be actively sought. To the extent that a rise in the price of an asset can be used to infer that this happened as a result of the reaction of informed individuals to a change in the conditions of demand or supply, other individuals may seek to profit by buying and hoarding the asset in anticipation of further increases in price. But this activity itself has price effects, which in turn may result in rational hoarding by others, amplifying the destabilizing process.

To illustrate this problem, consider a classic passage from Hayek's celebrated 1945 paper:

It is worth contemplating for a moment a very simple and commonplace instance of the action of the price system to see what precisely it accomplishes. Assume that somewhere in the world a new opportunity for the use of some raw material, say tin, has arisen, or that one of the sources of supply of tin has been eliminated. It does not matter for our purpose—and it is very significant that it does not matter—which of these two causes has made tin more scarce. All that the users of tin need to know is that some of the tin they used to consume is now more profitably employed elsewhere, and that in consequence they must economize tin (p. 526).

Not only do the agents not need to know much, according to Hayek, the process works well even if most of them know almost nothing. He continues:

There is no need for the great majority of them even to know where the more urgent need has arisen, or in favor of what other needs they ought to husband the supply. If only some of them know directly of the new demand, and switch resources over to it, and if the people who are aware of the new gap thus created in turn fill it from still other sources, the effect will rapidly spread throughout the whole economic system and influence not only all the uses of tin, but also those of its substitutes and the substitutes of these substitutes, the supply of all the things made of tin, and their substitutes, and so on; and all this

without the great majority of those instrumental in bringing about these substitutions knowing anything at all about the original cause of these changes.

The conclusion, Hayek reasons, is that:

The whole acts as one market, not because any of its members survey the whole field, but because their limited individual fields of vision sufficiently overlap so that through many intermediaries the relevant information is communicated to all.

Suppose that the demand for tin has risen or the supply fallen, as Hayek postulates, and that the process he has in mind begins to operate. The price of tin begins to rise (though it cannot adjust instantaneously to the new equilibrium price). To an individual familiar with Hayek's argument, this change in price is *informative*: it is likely to have been caused by some changes in demand or supply. Recognizing this, such an individual may seek to profit by buying and hoarding tin in anticipation of further increases in price. But this activity itself has price effects, which in turn may result in hoarding by others, and so on. The changes in the price of tin will be driven by some combination of fundamental factors (of the kind that concern Hayek) and speculative forces that seek to extract information from prices. If speculative interest is strong enough, the result can be considerable nonfundamental volatility in the price of tin.

The mathematician Henri Poincaré recognized this problem as far back as 1908, after having been the examiner for Bachelier's (1900) pioneering thesis on market efficiency. Poincaré observed that the attempt to extract information from prices and other market signals could result in a form of herding that is not due to the psychological frailties of market participants, but arises simply because it makes economic sense in many instances to follow the crowd.

These effects can be captured by models of information cascades in which herding arises as a rational response to the extraction of information from the actions of others, as in the literature on observational learning (Banerjee 1992; Bikhchandani, Hirschleifer, and Welch 1992; Smith and Sorensen 2000). In this journal, Bikhchandani, Hirschleifer, and Welch (1998) survey this literature and explore the logic of this argument. And when there are strategic incentives to manipulate beliefs, information available to one party can be lost in the process of communication (Crawford and Sobel 1982).

In financial markets, attempts to extract information from prices can give rise to prolonged departures from fundamentals in theoretical models (Hong and Stein 1999; Abreu and Brunnermeier 2003), the empirical counterpart of which is excess volatility in prices (LeRoy and Porter 1981; Shiller 1981). When leverage is significant, relatively small informational shocks can give rise to large asset revaluations as funding dries up and assets must be liquidated at fire sale prices (Brunnermeier and Pedersen 2009; Adrian and Shin 2010; Geanakoplos 2010). Because information is costly to acquire and process, assets that have sufficient seniority are considered

safe under normal conditions; these can suddenly start to be perceived as risky and “information-sensitive” in crisis conditions, causing trading volume to collapse or markets to shut down entirely (Gorton 2012). Several of these mechanisms have been discussed by Brunnermeier (2009 in this journal) in the context of financial crisis of 2007–2008.

Such phenomena do not remain confined to the financial sector, because asset prices have real effects. One obvious example is the link between home values and new construction, but the point is considerably more general. The prices of claims on future income flows inevitably affect current production and consumption decisions, and prices of goods and services will not track relative resource scarcity consistently and reliably when assets are mispriced. And the most information-sensitive markets are subject to some of the most spectacular failures.

Hence, the economics of information does not lead us to a case for unregulated markets. But most of the above theory supporting this conclusion is obtained using equilibrium analysis, to which Hayek’s many objections have been noted above. We next consider disequilibrium dynamics.

Disequilibrium Dynamics and Complex Adaptive Systems

The need to consider disequilibrium foundations of equilibrium economics has often been recognized, but explicit models of disequilibrium dynamics in economics remain rare. Exceptions include the work on learning in macroeconomics (Marcet and Sargent 1989; Woodford 1990; Evans and Honkapohja 2001). As in general equilibrium theory, general convergence results do not exist, although there are examples of sharp differences in the predictions of such models relative to those assuming equilibrium behavior throughout (Howitt 1992; García-Schmidt and Woodford 2015).

Further away from the mainstream there are models of complex adaptive systems, in which aggregate outcomes are determined by the social interaction of agents with limited and local knowledge. Epstein (2007) calls this approach to social science *generative*, while Tesfatsion (2006) calls it *constructive*. Its connection to Hayek’s thought and method has been noted by Vriend (2002), Rosser (2012), and Axtell (2016), among others. This literature makes intensive use of computational rather than analytical methods, and it does not limit its focus to equilibrium paths; see Epstein and Axtell (1996) for an important and early contribution.

Among the earliest contributions to this literature is Schelling’s (1971) model of segregation in self-forming neighborhoods. Here the agents are arrayed on a checkerboard grid. Each agent belongs to one of two groups. If agents are bordered by too great a proportion of neighbors from the other group, they will move. This process is repeated until a steady state is reached at which no agent wants to move. Schelling finds that integration can be sustainable once attained, but also that integrated states are extremely unlikely to be reached from arbitrary initial allocations, even when preferences are quite tolerant. That is, segregation is an *emergent*

property of the model, even though integration cannot theoretically be ruled out. It is not easy to obtain this insight through equilibrium analysis alone. And despite its simplicity, the model itself continues to be useful in organizing data (Cutler, Glaeser, and Vigdor 1999; Sethi and Somanathan 2004; Card, Mas, and Rothstein 2008; Bayer, Fang, and McMillan 2014).

Such agent-based models have also been successful in furthering our understanding of flows of pedestrian and vehicular traffic. Simple rules of avoidance can lead to flowing lines and other systematic patterns when density is low, but then as densities increase, bottlenecks, stop-go flows, and even gridlock can arise. Indeed, after the 2006 stampede in which close to 350 pilgrims died during the Hajj to Mecca, Dirk Helbing and his colleagues examined pedestrian crowd flows using computational methods in a collaboration with the Saudi government, and designed, implemented, and supervised a new set of pathways (Haase et al. 2016). The result was a substantial reduction in accidents.⁵

When this approach is applied to markets, then patterns of specialization, distribution, and prices arise as emergent properties of the interaction structure. That is, aggregate outcomes emerge that cannot be deduced analytically or in any other straightforward way from behavioral rules adopted by actors or any other attributes of individuals. A key element in this literature is the absence of *imposed* coordination across individuals in actions and beliefs. There is no assumption that individual plans are mutually consistent, or that subjectively perceived laws of motion coincide with the objectively realized laws of motion to which these perceptions give rise. There is no assumption that equilibrium markets clear, as in general equilibrium theory. This does not, of course, rule out model-consistent expectations or market clearing as *endogenous* outcomes, arising through responses by individuals.

A large and heterogeneous collection of models with these features is commonly grouped together under the umbrella of *agent-based computational economics*. The key components of the analysis are agents, which may be cognitively active units such as individuals, households, and firms, or inanimate components such as institutions for processing transactions or stocks of natural resources (Tesfatsion 2006). Agents may respond mechanically to inputs on the basis of physical laws or behavioral rules, or they may be sophisticated and forward-looking. They may be intertemporal optimizers employing the same dynamic programming methods used in orthodox models, but subject to private beliefs rather than mutually consistent expectations (Sinitskaya and Tesfatsion 2015). The key difference is that “events are driven solely by agent interactions once initial conditions have been specified. ... [R]ather than focusing on the equilibrium states of a system, the idea is to watch and see if some sort of equilibrium develops over time” (Tesfatsion 2006).

Typically, agent-based models of financial markets involve a population of traders who make transactions based on their privately known and heterogeneous

⁵There is a tragic but informative postscript suggesting that the new system may have lacked resilience. In 2015, over 2,400 people were killed in a stampede on the Hajj, reportedly due to the closing of two of the five pedestrian routes to allow for the passage of important visitors invited by the royal family.

trading strategies. The payoffs to individual strategies are determined by these price dynamics, and successful strategies increase their presence in the population at the expense of less-successful ones. Such models have been able to replicate patterns in the data such as excess and clustered volatility, short-run momentum, and mean reversion over longer horizons. For surveys of how this approach has been used to understand patterns in asset price data, see LeBaron (2006) and Hommes (2006).

Leijonhufvud (2006) argued that agent-based process analysis “will finally make it possible to tackle the central problem of macroeconomics, namely, the self-regulating capabilities of a capitalist economy,” but that the method remains in its “technical infancy.” This assessment remains valid. Despite recent ambitious models of macroeconomic dynamics (Delli Gatti, Gaffeo, Gallegati, Giulioni, and Palestrini 2008; Sinitskaya and Tesfatsion 2015), financial fragility (Mandel, Landini, Gallegati, and Gintis 2015), and the housing bubble (Geanakoplos et al. 2012), there does not yet exist a canonical agent-based framework within which fundamental questions at the core of the discipline can be systematically explored.

The Verdict of the Market and the Verdict of History

The average size of firms in capitalist economies has been steadily increasing recently; indeed, there is a strong correlation between the average size of firms and income per capita. Gabaix (in this journal, 2016) argues that the increasingly skewed size distribution of US firms has led to some of these firms now becoming so important that changes in their performance can constitute major shocks to the macroeconomy. Given the vast scope of economic activity taking place within large firms, what this private and entirely apolitical discovery process reveals is the virtues of planning, albeit in private hands and subject to competitive forces.

Perhaps not surprisingly, Ronald Coase reported that much of the regular debate between himself and Hayek at the London School of Economics back in the 1930s centered on the subject of the firm as a centrally planned economy in miniature. In Coase’s 1937 paper, he wrote that “the distinguishing mark of the firm is the suppression of the price system” in favor of a system in which a workman does what he does “because he is ordered to do so.” Or more poetically, Coase quoted Dennis Robertson who said that firms were as “islands of conscious power in this sea of unconscious cooperation.”⁶

But how could the suppression of the price system in favor of firm-based centralized planning possibly be a good thing? Kirzner (1992, p. 162) suggests a

⁶Herbert Simon (1991, p. 27) made the same point in this journal when he imagined “a mythical visitor from Mars” approaching earth in a spaceship “equipped with a telescope that reveals social structures. The firms reveal themselves, say, as solid green areas ... Market transactions show as red lines connecting the firms, forming a network in the spaces between them. ... A message sent back home, describing the scene, would speak of ‘large green areas interconnected by red lines.’ It would not likely speak of ‘a network of red lines connecting green spots.’”

reconciliation between Hayek's opposition to any form of planning and letting the market do the work when he says:

In a free market, any advantages that may be derived from "central planning"... are purchased at the price of an enhanced knowledge problem. We may expect firms to spontaneously expand to the point where additional advantages of central planning are just offset by the incremental knowledge difficulties that stem from dispersed information.

In this version of Coasean thinking, market competition among firms will determine the appropriate extent of the market; the very process of entrepreneurial discovery that is the hallmark of Hayek's theory of competition is also the process that determines the boundary of the hierarchically organized firm. The verdict of the market, by this reasoning, substantially constrains the scope of activities that are conducted through markets rather than hierarchies.

Just as the verdict of the market constrains the sizes of individual firms, the verdict of history demarcates the boundary between state and market in the organization of economic activity. In *The Constitution of Liberty* Hayek argued that that "the value of freedom consists mainly in the opportunity that it provides for the growth of the undesigned, and the beneficial functioning of a free society rests largely on the existence of such freely grown institutions." By this logic, freely grown institutions that constrain the scope of the market in favor of public administration in resource allocation may be presumed to have purpose and value, even if these benefits cannot be deduced by rational reflection.

As it happens, most high-income countries have grown institutions that sharply constrain the operation of markets in many spheres, with the delivery of childhood education, health, and old-age pensions being prime examples. Economies with strong trade unions, large welfare states, and substantial regulation of the economy—all of which Hayek vociferously opposed—score well on measures of democracy, civil liberties, and innovativeness developed by the World Bank, Freedom House, and Bloomberg (World Bank 2017; Freedom House 2017; Jamrisko and Lu 2017). Indeed, the Nordic social democracies do slightly better by these measures, for example, than do the more *laissez faire* nations such as the United Kingdom and the United States.

The Road to Laissez Faire

Hayek believed that his economic vision provided the foundation for his support for free markets, but a careful reading of *The Road to Serfdom* (1944) suggests that he advocated minimal government involvement in economic activity because he saw hierarchical and collectivist political systems as a threat to individual liberty, not because his economics *per se* had demonstrated the superiority of unregulated

markets. The examples on his mind at the time—the Soviet Union under Stalin and Germany under Hitler—were convincing enough exhibits for his case. But, seven decades later, we have a record of sustained liberal democratic values in economies with substantial government involvement, and the evidence does not support Hayek’s most dire predictions.

Fortunately, Hayek’s economics and his political philosophy do not have to be taken as a package; it is possible to appreciate his insights into the functioning of a market economy without following him down the road to *laissez faire*. On this point we find ourselves agreeing with George Orwell (1944), who tempered an otherwise favorable evaluation of *The Road to Serfdom* with the caveat: “Professor Hayek . . . does not see, or will not admit, that a return to ‘free’ competition means for the great mass of people a tyranny probably worse, because more irresponsible, than that of the State.”

We have not attempted here a comprehensive overview of Hayek’s thought, which was extremely wide-ranging and has been ably summarized by others (see, for instance, Caldwell 2004). As noted by Glasner (1985): “Not, perhaps, since the Scottish Enlightenment philosophers for whom Hayek had such a strong affinity, has anyone made important contributions in a comparable range of disciplines.” Hayek’s vision of a decentralized solution to a massive and perpetually changing coordination problem involving autonomous entities will continue to shape the discipline well into the future.

Hayek dedicated *The Road to Serfdom* (1944) to “socialists of all parties” urging them to reconsider their understanding of the relationship between democracy and the organization of the economy. In a similar collegial spirit, we dedicate this modest effort to advocates of *laissez faire* inspired by Hayek, inviting them to reconsider what we have shown to be the tenuous link between Hayek’s extraordinary contributions to economics and his opposition to any but the most minimal economic role for government.

■ *We thank Jeffrey Friedman, David Glasner, Gordon Hanson, and Timothy Taylor for their contributions to this essay and the Santa Fe Institute for providing an ideal environment for the collaboration that resulted in this paper.*

References

- Abreu, Dilip, and Markus K. Brunnermeier. 2003. "Bubbles and Crashes." *Econometrica* 71(1): 173–204.
- Adrian, Tobias, and Hyun Song Shin. 2010. "Liquidity and Leverage." *Journal of Financial Intermediation* 19(3): 418–37.
- Axtell, Robert L. 2016. "Hayek Enriched by Complexity Enriched by Hayek." In *Advances in Austrian Economics: Revisiting Hayek's Political Economy*, edited by Peter J. Boettke and Virgil Henry Storr, 63–121. Bingley, UK: Emerald Insight.
- Bachelier, Louis. 1900. "Théorie de la Spéculation." *Annales Scientifiques de l'E.N.S.* 17(3): 21–86.
- Banerjee, Abhijit V. 1992. "A Simple Model of Herd Behavior." *Quarterly Journal of Economics* 107(3): 797–817.
- Bayer, Patrick, Hanming Fang, and Robert McMillan. 2014. "Separate When Equal? Racial Inequality and Residential Segregation." *Journal of Urban Economics* 82: 32–48.
- Bikhchandani, Sushil, David Hirshleifer, and Ivo Welch. 1992. "A Theory of Fads, Fashion, Custom, and Cultural Change in Informational Cascades." *Journal of Political Economy* 100(5): 992–1026.
- Bikhchandani, Sushil, David Hirshleifer, and Ivo Welch. 1998. "Learning from the Behavior of Others: Conformity, Fads, and Informational Cascades." *Journal of Economic Perspectives* 12(3): 151–70.
- Boettke, Peter J. 1997. "Where Did Economics Go Wrong? Modern Economics as a Flight from Reality." *Critical Review* 11(1): 11–64.
- Brunnermeier, Markus K. 2009. "Deciphering the Liquidity and Credit Crunch 2007–2008." *Journal of Economic Perspectives* 23(1): 77–100.
- Brunnermeier, Markus K., and Lasse Heje Pedersen. 2009. "Market Liquidity and Funding Liquidity." *Review of Financial Studies* 22(6): 2201–38.
- Caldwell, Bruce J. 2004. *Hayek's Challenge: An Intellectual Biography of F. A. Hayek*. University of Chicago Press.
- Card, David, Alexandre Mas, and Jesse Rothstein. 2008. "Tipping and the Dynamics of Segregation." *Quarterly Journal of Economics* 123(1): 177–218.
- Coase, Ronald H. 1937. "The Nature of the Firm." *Economica* 4(16): 386–405.
- Crawford, Vincent P., and Joel Sobel. 1982. "Strategic Information Transmission." *Econometrica* 50(6): 1431–51.
- Cutler, David M., Edward L. Glaeser, and Jacob L. Vigdor. 1999. "The Rise and Decline of the American Ghetto." *Journal of Political Economy* 107(3): 455–506.
- Debreu, Gérard. 1984. "La Supériorité de l'Économie Libérale Est Incontestable et Mathématiquement Démonstrable." *Le Figaro*, March 10.
- Delli Gatti, Domenico, Edoardo Gaffeo, Mauro Gallegati, Gianfranco Giulioni, and Antonio Palestrini. 2008. *Emergent Macroeconomics: An Agent-Based Approach to Business Fluctuations*. New York, NY: Springer.
- Epstein, Joshua M. 2007. *Generative Social Science: Studies in Agent-Based Computational Modeling*. Princeton University Press.
- Epstein, Joshua M., and Robert Axtell. 1996. *Growing Artificial Societies: Social Science from the Bottom up*. Washington, DC: Brookings Institution Press.
- Evans, George W., and Seppo Honkapohja. 2001. *Learning and Expectations in Macroeconomics*. Princeton University Press.
- Fisher, Franklin M. 1983. *Disequilibrium Foundations of Equilibrium Economics*. Cambridge University Press.
- Fisher, Franklin. 2011. "The Stability of General Equilibrium—What Do We Know and Why Is It Important?" In *General Equilibrium Analysis: A Century after Walras*, edited by Pascal Bridel, 34–45. London, UK: Routledge.
- Freedom House. 2017. *Freedom in the World 2017*. Washington, DC: Freedom House.
- Gabaix, Xavier. 2016. "Power Laws in Economics: An Introduction." *Journal of Economic Perspectives* 30(1): 185–206.
- Garcia-Schmidt, Mariana, and Michael Woodford. 2015. "Are Low Interest Rates Deflationary? A Paradox of Perfect-Foresight Analysis." NBER Working Paper 21614.
- Geanakoplos, John. 2010. "The Leverage Cycle." In *NBER Macroeconomics Annual 2009*, edited by Daron Acemoglu, Kenneth Rogoff, and Michael Woodford, 1–65. University of Chicago Press.
- Geanakoplos, John, Robert Axtell, J. Doyne Farmer, Peter Howitt, Benjamin Conlee, Jonathan Goldstein, Matthew Hendrey, Nathan M. Palmer, and Chun-Yi Yang. 2012. "Getting at Systemic Risk via an Agent-Based Model of the Housing Market." *American Economic Review* 102(3): 53–58.
- Glasner, David. 1985. "F. A. Hayek: Philosopher of the Open Society." *Michigan Quarterly Review* 24(4): 523–43.
- Glasner, David, and Paul R. Zimmerman. 2014. "The Sraffa–Hayek Debate on the Natural Rate of Interest." Available at SSRN: <http://ssrn.com/>

abstract=2221695.

Gorton, Gary B. 2012. *Misunderstanding Financial Crises: Why We Don't See Them Coming*. Oxford, UK: Oxford University Press.

Haase, Knut, Habib Zain Al Abideen, Salim Al-Bosta, Mathias Kasper, Matthes Koch, Sven Muller, and Dirk Helbing. 2016. "Improving Pilgrim Safety during the Hajj: An Analytical and Operational Research Approach." *Interfaces* 46(1): 74–90.

Hammond, Peter J. 1979. "Straightforward Individual Incentive Compatibility in Large Economies." *Review of Economic Studies* 46(2): 263–82.

Hayek, Friedrich A. 1937. "Economics and Knowledge." *Economica* 4: 33–54.

Hayek, Friedrich A. 1944. *The Road to Serfdom*. University of Chicago Press.

Hayek, Friedrich A. 1945. "The Use of Knowledge in Society." *American Economic Review* 35(4): 519–30.

Hayek, Friedrich A. 1948. "The Meaning of Competition." Chap. 5 in *Individualism and Economic Order*. University of Chicago Press.

Hayek, Friedrich A. 1960. *The Constitution of Liberty*. University of Chicago Press.

Hayek, Friedrich A. 1968 [2002]. "Competition as a Discovery Procedure." *Quarterly Journal of Austrian Economics* 5(3): 9–23. (Article was in 2002; original lecture was in 1968.)

Hayek, Friedrich A. 1979. *Law, Legislation and Liberty: A New Statement of the Liberal Principles and Political Economy*. Vol 3: *The Political Order of a Free People*. University of Chicago Press.

Hayek, Friedrich A. 1994. *Hayek on Hayek: An Autobiographical Dialogue*. University of Chicago Press.

Hommers, Cars H. 2006. "Heterogeneous Agent Models in Economics and Finance." In *Handbook of Computational Economics*, vol. 2, edited by Leigh Tesfatsion and Kenneth L. Judd, 1109–86. Amsterdam: Elsevier.

Hong, Harrison, and Jeremy C. Stein. 1999. "A Unified Theory of Underreaction, Momentum Trading, and Overreaction in Asset Markets." *Journal of Finance* 54(6): 2143–84.

Howitt, Peter. 1992. "Interest Rate Control and Nonconvergence to Rational Expectations." *Journal of Political Economy* 100(4): 776–800.

Hurwicz, Leonid. 1984. "Economic Planning and the Knowledge Problem': A Comment." *Cato Journal* 4(2): 419–25.

Jamrisko, Michelle, and Wei Lu. 2017. "These Are the World's Most Innovative Economies." *Bloomberg Markets*, January 17. <https://www.bloomberg.com/news/articles/2017-01-17/sweden-gains-south-korea-reigns-as-world-s-most-innovative-economies>.

Jordan, James S. 1982. "The Competitive Allocation Process Is Informationally Efficient Uniquely." *Journal of Economic Theory* 28(1): 1–18.

Kirman, Alan, Rainer Schulz, Wolfgang Härdle, and Axel Werwatz. 2005. "Transactions That Did Not Happen and Their Influence on Prices." *Journal of Economic Behavior and Organization* 56(4): 567–91.

Kirzner, Israel M. 1984. "Economic Planning and the Knowledge Problem." *Cato Journal* 4(2): 407–418.

Kirzner, Israel M. 1992. *The Meaning of Market Process: Essays in the Development of Modern Austrian Economics*. New York: Routledge.

Kirzner, Israel M. 1997. "Entrepreneurial Discovery and the Competitive Market Process: An Austrian Approach." *Journal of Economic Literature* 35(1): 60–85.

LeBaron, Blake. 2006. "Agent-Based Computational Finance." In *Handbook of Computational Economics*, vol. 2, edited by Leigh Tesfatsion and Kenneth Judd, 1187–1233. Amsterdam: Elsevier.

Leijonhufvud, Axel. 2006. "Agent-Based Macro." In *Handbook of Computational Economics*, vol. 2, edited by Leigh Tesfatsion and Kenneth Judd, 1625–37. Amsterdam: Elsevier.

LeRoy, Stephen F., and Richard D. Porter. 1981. "The Present-Value Relation: Tests Based on Implied Variance Bounds." *Econometrica* 49(3): 555–74.

Makowski, Louis, and Joseph M. Ostroy. 2001. "Perfect Competition and the Creativity of the Market." *Journal of Economic Literature* 39(2): 479–535.

Mandel, Antoine, Simone Landini, Mauro Gallegati, and Herbert Gintis. 2015. "Price Dynamics, Financial Fragility and Aggregate Volatility." *Journal of Economic Dynamics and Control* 51: 257–77.

Marcet, Albert, and Thomas J. Sargent. 1989. "Convergence of Least Squares Learning Mechanisms in Self-Referential Linear Stochastic Models." *Journal of Economic Theory* 48(2): 337–68.

Maskin, Eric S. 2015. "Friedrich von Hayek and Mechanism Design." *Review of Austrian Economics* 28(3): 247–52.

Mount, Kenneth, and Stanley Reiter. 1974. "The Informational Size of Message Spaces." *Journal of Economic Theory* 8(2): 161–92.

Nobelprize.org. 1974. Press Release, October 9. http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/1974/press.html.

Orwell, George. 1944. "Review: The Road to Serfdom by F. A. Hayek/The Mirror of the Past by K. Zilliacus." *Observer* 9: 117–19.

Poincaré, Henri. 1908. *Science et Méthode*. Paris, France: E. Flammarion.

- Rosser, J. Barkley, Jr.** 2012. "Emergence and Complexity in Austrian Economics." *Journal of Economic Behavior and Organization* 81(1): 122–28.
- Schelling, Thomas C.** 1971. "Dynamic Models of Segregation." *Journal of Mathematical Sociology* 1(2): 143–86.
- Sethi, Rajiv, and Rohini Somanathan.** 2004. "Inequality and Segregation." *Journal of Political Economy* 112(6): 1296–321.
- Shiller, Robert J.** 1981. "Do Stock Prices Move Too Much to be Justified by Subsequent Changes in Dividends?" *American Economic Review* 71(3): 421–36.
- Simon, Herbert A.** 1991. "Organizations and Markets." *Journal of Economic Perspectives* 5(2): 25–44.
- Sinitskaya, Ekaterina, and Leigh Tesfatsion.** 2015. "Macroeconomics as Constructively Rational Games." *Journal of Economic Dynamics and Control* 61: 152–82.
- Tesfatsion, Leigh.** 2006. "Agent-Based Computational Economics: A Constructive Approach to Economic Theory." In *Handbook of Computational Economics*, vol. 2, edited by L. Tesfatsion and K. L. Judd, 831–80. Amsterdam: Elsevier.
- Vriend, Nicolaas J.** 2002. "Was Hayek an Ace?" *Southern Economic Journal* 68(4): 811–40.
- White, Lawrence H.** 1999. "Why Didn't Hayek Favor Laissez Faire in Banking?" *History of Political Economy* 31(4): 753–69.
- Woodford, Michael.** 1990. "Learning to Believe in Sunspots." *Econometrica* 58(2): 277–307.
- World Bank.** 2017. World Governance Indicators. <http://databank.worldbank.org/data/databases/rule-of-law>.