



Motley #14

Jim Benford

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I took the above photo at the Tate Britain gallery in London last fall. They were redecorating the northern entrance. I used a panorama mode on my cell phone to take this picture, which I call “Hilary in a Cubist world.”

Last issue featured a piece by Gregory Benford called ‘Economics and Science Fiction’. Here’s a rebuttal by Stephen Postrel, economist and business strategy professor:

**‘ An Underutilized Resource – Economics in Science Fiction:
A Response to Gregory Benford
*Stephen Postrel***

As someone who started out doing industrial organization economics – monopoly, oligopoly, antitrust policy, and all that – and then quickly migrated to teaching business strategy over in the management schools, one thing that has jumped out to me about science fiction is that there isn’t usually much space or thought given to the hard problems of management.

Operational stuff, maybe, like how to turn the inputs into outputs, but almost nothing about marketing or strategy, figuring out what we should be doing and what we should stay out of, how to design and position our products given what everybody else is doing, etc. But one of the biggest problems that planned economies and cooperatives both tend to have is making good decisions about products and strategies, because the role of “corporate politics” is orders of magnitude stronger in such systems than inside actual corporations (which can be plenty political).

With respect to the moral dimensions of hostility to capitalism among many left-oriented SF writers – and it really pops out at times in Kim Stanley Robinson’s work – there is a useful framework due to an anthropologist at UCLA named Alan Fiske. He and his many students and coworkers have come up with an “relational model theory” that describes the four modes with which people mentally classify any relationship: Authority Ranking (A tells B what to do), Equality Matching (A and B alternate providing like services or direction), Communal Sharing (from each according to his ability, to each according to his need), and Market Pricing (A and B agree on a common ratio scale by which they exchange dissimilar things). The last of these is the only one found in humans but not in other animals.

Different societies (and individuals within societies) have different beliefs about which sorts of things ought to be governed in which mode, and these disagreements can cause strong political conflict. For example, I’ve noticed lots of people who find the idea of providing medical care by anything

other than communal sharing to be repugnant. Others (like me) see it more as an ordinary service like getting your car fixed that ought to be governed by market pricing. But even people like me think that interactions within our families ought to be governed by communal sharing (or maybe equality matching, depending on the subject). So we might at least be able to agree on what people are disagreeing about by adopting Fiske's framework.

In most science fiction, economics is not part of the science and plays only a small role in the fiction. Firmly in the background, commerce and production follow whatever sketchy analogies with the past or present the author finds congenial: Something like contemporary business life, perhaps, or a variation on feudalism. But whether the barons in question be of the corporate or lordly type, problems of scarcity and resource allocation don't intrude much on the story's characters or action.

On those occasions when the economic aspects of a science fiction scenario do take center stage, they tend to do so in terms of what economists call "comparative systems." Authors, intending pointed commentary on the real economies in which they live, spin out their utopian, dystopian, or satiric visions of how some fictional society might answer the classic economic questions: what is to be produced, how it is to be produced, who is to get what, and how will it all be decided?

I find this state of affairs a bit disappointing. Even when such visions don't violate known economic principles, *the greatest thematic and storytelling resources of economics are not being used*. Most of what economic science comprehends isn't about holistic matters of political economy, where historical irreversibility makes each case unique, but rather about more-generalizable, less grand-scale, patterns of resource allocation and distribution. That's why "comparative

systems" is not a high-prestige subfield in economics, despite some very fine theoretical and empirical work. Since the fall of communism (and the intense interest in "transition economies" it engendered), one would be hard pressed today to find an article on the subject in a top journal.

There are some examples of science fiction, though, where speculations about economics do play a central role, creating an economic subspecies of "hard" science fiction. In standard hard science fiction, a typical move is to imagine something (an environment or technology or phenomenon) that has not been discovered but that also does not directly contradict known empirical laws, and then to play out the implications of that thing for a story's characters, society, or ecosystem. "Hard economic" science fiction does a very similar thing.

In order to understand these sorts of sf stories, it's helpful to grasp in broad terms how economists organize their thinking. The general structure of an economic model includes three sets of "exogenous" elements (things assumed rather than explained) and a set of "endogenous" variables that get determined by the interaction of gain-seeking agents who take the exogenous elements as given. The canonical example would be the endogenous emergence of equilibrium price and quantity in a supply and demand model, taking as given the *preferences* determining demand, the *technology and input prices* determining supply, and the *institutions* of property rights and free competition that allow the equilibrium to emerge.

- These three sets of exogenous elements –
- 1) Technology and the relative scarcities of primary (unproduced) inputs,
 - 2) Individual preferences and social norms, and
 - 3) Institutional rules for agent interaction

– provide the raw material for speculative fiction. Hard economic sf works by positing some interesting change in one of these areas, then tracing out its impact on human behavior. That behavior includes relative prices and quantities (what becomes scarce and what becomes abundant), organizational structures, careers, foci of innovation, etc., all traced out in accordance with standard economic principles.

The most obvious type of speculation for hard economic sf is to imagine a new technology and then to trace out its economic effects. Damon Knight's *A for Anything*, also published as *The People Maker* (1959), is a classic example. The Gismo can costlessly, instantly duplicate any inanimate object, including another Gismo. As a result, shortly after its viral release to society by its idealistic inventor (overcoming the apparently villainous forces that seek to suppress it), all material objects lose their scarcity value and most productive industry becomes superfluous. With characteristic ironic bite, Knight presents this new material Eden as a social catastrophe (validating the concerns of the “villain”): In this new world where anyone can have any inanimate object at a near-zero price, the only things that have value are animate objects, namely human slaves, and the most far-seeing and ruthless individuals quickly enslave the majority population of more-docile and fearful folk, forming the basis of a new aristocratic class. The old order collapses within the first few hours of the introduction of the Gismo; apparently Knight believed (or postulated) that people only conform to moral norms and perform their social roles in order to meet their material needs, under the expectation that others will do so as well. Once those needs and expectations vanish, it's every man for himself and all institutions disintegrate. (Neal Stephenson's *The Diamond Age* [1995] employs a related premise, where pervasive nanotechnology somehow hollows out the nation-state, with

human loyalty and identification shifting to tribes and “phyles.”)

Another ought-to-be touchstone story of new technology overturning the economic order is Bruce Sterling's “The Beautiful and the Sublime” (1986). Here the postulate is that a form of narrow artificial intelligence has enabled the automation of almost all work in science and technology. As a result, except for the surviving older inventors of this AI (who were able to cash in), the wages and social status of technologists have collapsed – their skills are now superfluous. In this new world of material and technical abundance, what is relatively scarce is the ability to create art and narrative and to make the world seem interesting, beautiful, and meaningful. Those with status and access to resources are thespians and artists and writers; the remaining engineers are relegated to the social margins, much as starving artists have been in our world. The mores and virtues of the artistic class (which Sterling amusingly portrays as a version of 19th-century European romanticism, replete with grand gestures and displays of emotion) are the “respectable” ones. Prudence, practicality, attention to detail, and scientific curiosity are embarrassing traits to be kept out of polite society. “The Beautiful and the Sublime” lays out an inversion of cultural status norms as a result of changing the relative scarcity of “practical” and “artistic” goods.

While these specific new institutions and norms may not be accurate predictions about how things would play out, they do reflect what I believe is a general principle about economic change: *Merit tracks value with a lag*. By “merit” I mean the kinds of personal characteristics and actions that people find laudable. By “value” I mean what is scarcest relative to demand. A historical example¹ occurred after the decline of the Western Roman Empire, as bandits and brigands

roamed the countryside. Anyone who was willing and able to use violence to provide physical security to the local population was highly valuable. Such individuals displayed a lesser fear of death in combat, a greater commitment to martial prowess and glory, a pugnacious determination to defend their territory, and a lack of squeamishness in enforcing discipline and inflicting punishment on friend and foe. These traits, unlovely as they may have been at the time when they first became so important, soon became central to the perceived merit of what evolved into the noble class, eventually being refined into concepts of honor and chivalry. Centuries later, when local bandits and Viking raiders were no longer a major threat but local prosperity depended on growing more food per acre, making higher-quality and lower-cost goods for trade, assembling capital, and finding good trading partners, what became scarce and hence valuable were the characteristics of the bourgeoisie – productivity, industry, frugality, honesty, ingenuity. These characteristics gradually grew in perceived merit, largely (but not completely) replacing the older esteem for aggressive bullyboys offering protection.

We can see similar, though less sweeping, changes within our own market (“capitalist”) system over the decades. The economic value of creative and entrepreneurial executives waxed, waned, and then waxed again in the United States from 1870 to 2018, and we saw the picture of the meritorious businessperson track that value with a lag: The innovative Carnegies and swashbuckling Vanderbilts were gradually replaced in esteem by the loyal and responsible Organization Men, only to be superseded by the creative, disruptive Information Age technology and media operators of the late twentieth and early twenty-first centuries. Because of the value-merit lag, the newly scarce, valuable class tends to be resented at first, not only because of envy but also for their

seeming lack of merit – why do these people deserve to get rich and powerful when they conspicuously lack the virtues we’ve come to hold dear? A new understanding of what is meritorious has to be fashioned to conform to the new realities of economic value and relative scarcity.

Turning to the second type of hard economic sf story, one that starts from a shock to preferences rather than technology, another clear example also comes from Damon Knight: “The Big Pat Boom” (1963). Here we have enigmatic advanced alien visitors who start buying up ordinary cowpats at high prices. This injection of demand for a previously zero or negatively priced item leads to a massive shift in economic resources toward manufacturing, collecting, and merchandising them. Secondary and tertiary markets develop, a form of connoisseurship springs up classifying and valuing cowpats according to their color, texture, and curl, and people’s lives become devoted to working in the industry. So we can see how a shift in preferences not only affects resource allocation but also induces change in market organization within the broader exogenous institutional structure.²

Knight probably had the famous Dutch tulip mania in mind when he wrote this story. (Interestingly, modern scholarship has greatly reduced estimates of the size of this bubble and its financial impact). His depiction of eventual ruin for many when the aliens cease their “experiment” (portrayed more as a practical joke) parallels what really happens when surges of demand enter and leave a market, particularly when resale is an important possibility.

It turns out that in markets for *assets* (objects that are not consumed but used to generate income, where the possibility of resale is important), bubbles are perfectly normal, unlike ordinary consumption goods. We know this because of economic experiments, where people are put in a lab and

allowed to buy and sell things for real money. Vernon Smith, an economist now at Chapman University, won the Nobel Prize partly for showing that in experimental markets for consumption goods, supply and demand not only works as the textbooks say, it works better! Forget all that stuff about perfect competition, perfect information, large numbers of buyers and sellers, etc. Markets converge quickly to the theoretical equilibrium with just a few buyers and sellers making bids and offers, even when these experimental subjects only have very limited information – in fact convergence to equilibrium tends to get screwed up if they have too much information.

But with experiments on assets, where, say, you have a simple, tradable security that pays a certain amount to its owner each period, with a known finite number of periods so that the “fundamental” value of the asset is known to all, you see bubbles almost every time. The price goes above the value of its remaining payment stream and then crashes. Why is that? My favorite guess is that it has to do with a lack of “common knowledge,” the technical term in economics for infinite repetition of an “I know that you know that I know...” sequence. With a finite number of “I know that’s” about the true remaining value of the asset, traders may think that “overpaying” for the asset is sensible if someone else is going to “overpay” even more later in hopes of in turn finding a still “greater fool.” And it turns out that the people who make the most money in these experiments are not the ones who only trade based on the fundamental value, but rather the ones who guess most accurately when the bubble will burst (while the worst performers are the ones who try to time it and fail).³

But asset bubbles are far from the only way in which economic outcomes depend on preferences. If a change in exogenous norms and preferences were drastic enough, lots of

products and practices we take for granted today would disappear and other new ones arise. Suppose people started reading Epicurus (not the hedonistic caricature but the original text) and decided that he was right about how to live the good life, that is, in small communes of good friends eating simple food together, wearing simple clothes, and having great conversations. How would that affect what was relatively scarce, and how would people apply technology and management to get more of it? What would happen to the supply of skilled labor? What would happen to the people and resources previously dedicated to making luxuries and other products whose demand had collapsed? What new products and services would evolve?

Thinking about these questions while keeping them firmly embedded within a modern market economy, rather than following the lazy analogy of “simple material life = Arcadian or feudal past,” is what makes for a hard economic sf approach.⁴ In an American context one can well imagine that this Epicurean turn might entail a great deal of commercial and technical innovation aimed at improving the convenience, status differentiation, and authenticity of the experience. Epicurus’s emphasis on avoiding discomfort and mental distress would mesh nicely with our society’s health, therapy, and self-help obsessions, and the industries focused on those areas would likely see a great efflorescence, though focused more on feeling good than living longer, as the great philosopher disdained the fear of death itself. All sorts of different communal/residential setups would be attempted, with rules varying as much as do those for today’s condominiums and master-planned communities, to cater to the wide range of tastes for individual privacy vs. interaction, levels and styles of “simple” physical facilities, etc. These might be branded and form chains, with self-selecting

population types becoming associated with each brand, much as Internet dating services do now. Others might have boards that selected applicants, and there might be elaborate status distinctions (not necessarily jointly agreed by all groups) associated with which type or specific commune one lived in. Some might even specialize in people interested in science, or even a specific area of science, and then the whole vexed question of work-life balance, as well as the degree to which laboratories ought to be treated as proper professional workspaces rather than personal tree houses would take on new dimensions.

Positing a shock to the last of the three exogenous parts of an economic model – basic institutions and rules of economic interaction – resembles most the utopian, dystopian, and satiric tales to which I referred above. But in a hard economic sf story, the impact of such changes in the rules has to be traced through somewhat realistic implications for how resources get directed, where innovation appears, what sources of new value are stimulated, and how the distribution of that value is affected. Something like Jerry Pournelle's CoDominium Series, with its assumption that a global U.S.-Soviet alliance has prohibited technological innovation outside of its control, could have generated such a story, but the author's interests lay elsewhere.

To some extent, William Gibson and Bruce Sterling's *The Difference Engine* (1990), the alternate history that famously "invented" steampunk, pursues this course.⁵ The novel sticks to the technology that existed when Charles Babbage⁶ proposed his mechanical computers, and changes history by having him complete his machine. This changes the institutions that allocate resources, putting into power a faction of "Industrial Radicals" who direct R&D into pre-electronic computing and raise technologists to political power. From

there, some of the economic implications are spun out in the background of the picaresque plot – the Radicals form an alliance with rising industrial labor unions, while ruthlessly crushing the resistance of non-mechanized workers, causing an even more rapid industrialization than happened historically. This advanced rate of investment at an earlier period, before electricity, leads to a great flowering of advanced steam-powered technology (along with even more enormous pollution problems). But the definitive institutional-innovation hard economic sf story is still to be written, in my (possibly ignorant) opinion.

Economic science could also be used in science fiction without forming the mainspring of the action. There are a host of clever mechanisms and ideas developed by economists, often ones not especially central to everyday research, that create intriguing thought experiments and paradoxes. Game theory, for example, tosses out all sorts of conundrums about what it means to be "rational" when interacting with other thinking people in contexts that combine cooperation, coordination, and competition. Many educated people have heard of the Prisoner's Dilemma (PD), in my opinion one of the more overused models, but one which presents the problem of cooperation most starkly: Payoffs are arranged such that each player ought to "defect" rather than "cooperate" *regardless of what the other player does* (so defecting is what is called a "dominant strategy") but the players would both be better off if they could restrain themselves from defecting – both of them cooperating gives each one a higher payoff than they receive when both defect. The PD is a metaphor for a variety of collective action problems, such as the instability of a world where nuclear first strikes are decisive, or individuals deciding whether to pollute the commons when each one's damage is small and the private cost of not polluting is high.

Philosophers have wasted countless words trying to explain why it is somehow “rational” to cooperate here, but in a one-shot PD game it simply is not – defecting always pays better. But what if the same two players play a Prisoner’s Dilemma for a known finite number of periods, say 100 times? Surely they could find a way to cooperate given the “shadow of the future,” where playing nice might induce the other player to reciprocate – and in fact, in experiments, they do. But this presents a logical paradox, because in the 100th period we are back to a one-shot game, which means defecting is the dominant strategy. Then in the 99th period, both players know that both will defect next period, so they may as well defect now. Repeating the argument – what game theorists call “backward induction” – leads to the conclusion that defecting is the only “rational” strategy in every period, starting from the first. Being completely “rational” appears to lead to worse outcomes than when one eschews backward induction.

The fundamental equilibrium concept in standard game theory, though, is not the dominant strategy equilibrium found in the Prisoner’s Dilemma (because it fails to be possible in most games). Instead the workhorse is the Nash equilibrium, which won John Nash a belated Nobel award in economics, as depicted in the movie *A Beautiful Mind* (2001). (Interestingly, the film completely botched the description of Nash equilibrium, even though it is a simple concept that is easy to explain. My supposition is that the concept’s fundamentally selfish character wasn’t congenial to the Hollywood mindset, which wanted to turn the actually quite-competitive Nash into a paragon of dreamy romanticism.) A Nash equilibrium is simply an assignment of strategies to the players where no one wants to change his strategy given what the others are doing.⁷ Once you’re at such a point, no one wants to unilaterally deviate from what they’re doing.

Fine so far, but this simple concept doesn’t always fit with the observed outcomes. These conundrums of rationality (and many others that could be mined from game theory) seem to present great possibilities for science fiction. Can a world of Big Data enable analysts to better characterize individuals’ choices in order to manipulate their behavior? If the end of the world is ever convincingly predicted some years ahead, at what point before that end would backward induction kick in and cooperative norms collapse when defection is one-shot dominant?⁹

Economics as a science has many such corners where fundamental questions about human capacities and how people interact could be spun into science fiction stories. Moreover, the practice of economics as a science could be as easily cast into the center of a science fiction plot as could a biology lab or a physics experiment. What if someone discovered a way to exactly predict the effect of taxes on prices and output? What if a hidden, long-term quasi-periodic attractor were discovered to exist in economic data, so that seemingly unrelated aspects of the economy were actually bound together in long-wave cycles?

There is even plenty of experimental economics nowadays, along with “field experiments” where researchers recruit subjects over the Internet or intervene in real online markets to test hypotheses and estimate the size of different effects. Maybe an imaginative writer could conceive of one of these field experiments somehow getting out of control in an interesting way.

So, perhaps optimistically, I look forward to sf writers perusing *The Journal of Economic Perspectives* much as they do *IEEE Spectrum* or *Quanta*, *Econometrica* much as they do *Physical Review*.

The opportunities for the entrepreneurial writer are there. We economists tend to believe that dollar bills don't lie on the sidewalk for long.

Notes

1. This is obviously a very simplified caricature.

2. Gregory Benford says: "I talked once about that with Damon. He had heard that cowpats were a commercial commodity in India. When I went to India, I saw it in the large scale because they were used for cooking fuel or heating. There was a market, and once carefully pancaked, they were plastered to a wall to dry out. When they fell off, they were marketable. So it wasn't that sciffy after all."

3. Repeating the game with the same players doesn't make the bubble go away, although it tends to pop sooner and at a lower price. But if one then makes any tweak to the experiment, say, changing the size of the dividend paid, that tends to reestablish the bubble at its original larger size.

For more information about bubbles, see Virginia Postrel, "Pop Psychology: Why Asset Bubbles Are a Part of the Human Condition That Regulation Can't Cure," *Atlantic Monthly*, 302:5 (December, 2008), 40-43, available at <https://www.theatlantic.com/magazine/archive/2008/12/pop-psychology/307135/>.

4. Neal Stephenson's *Anathem* (2008) tries out a post-apocalyptic scenario containing philosophy-and-math-but-no-tech simple-life communes scattered about a shabby materialist outer world that has technology but no philosophy or science, but it doesn't do much with the economic implications.

5. Though Gregory Benford informs me that Tim Powers and Jim Blaylock, as well as K.W. Jeter, wrote steampunk before the publication of Gibson and Sterling's megahit.

6. Interestingly, Babbage himself was an insightful writer on economics and industrial organization, making contributions to understanding the division of labor and how mechanization affected cost functions.

7. This is a weaker requirement than dominant strategy equilibrium; every dominant-strategy equilibrium is Nash, but most Nash equilibria are not dominant-strategy equilibria.

8. For more information about k-rationality, see Colin F. Camerer, Teck-Hua Ho, and Juin-Kuan Chong, "A Cognitive Hierarchy Model of Games," *The Quarterly Journal of Economics*, 119:3 (August, 2004), 861-898, and the papers presented at a session held January 5, 2018 on "Bounded Rationality, Level-k Reasoning, and Cognitive Hierarchies" at the Annual Meeting of the American Economic Association, posted at

<https://www.aeaweb.org/conference/2018/preliminary/2087?q=eNqrVipOLS7OzM8LqSxIVbKqhnGVrAxrawGICArI>.

9. Economic theory is full of paradoxes of self-reference, where agents' knowledge of the theory that explains the system affects their behavior and makes the theory either true or false. The proposition that the stock market is efficient in the weak sense, i.e. that the past pattern of prices cannot be used to predict future prices, is based on the notion that any such theory would be a self-negating prophecy – those seeking to exploit the pattern would destroy it if it previously existed, as they bid up the price of what the theory claimed to be undervalued. But the strong sense of market efficiency, that there is also no trading gain to be had from fundamental research into company prospects, cannot be strictly true because if taken seriously there would be no one doing such research and then research would pay – nobody doing research is not a Nash equilibrium.