Well before Amazon.com Inc. was a gleam in Jeff Bezos’s eye; comfortably before Jeff Yang and David Filo ever uttered the exclamation, “Yahoo!”; and long before eBay Inc. was bid into existence, economist Hal Varian already knew that the Internet was a provocative marketplace for provocative ideas about marketplaces.

Way back in ancient, pre-World Wide Web 1989, he points out, a trio of academics created the “Santa Fe Double Auction,” an Internet marketplace based on rules used by the Chicago Board of Trade. They decided to invite rival researchers to contribute software that would “compete” against others’ programs in this digital auction house. The International Business Machines Corporation agreed to sponsor a $10,000 prize for the designer of the most successful software agent. Some 30 programs were entered: 15 from economists, nine from computer scientists, three from mathematicians, and one each from an investment broker, a team of cognitive scientists and a marketing professor. The virtual gavel for this auction tournament dropped in March 1990.

Who won? A clever graduate student in economics, Scott Kaplan. “When I asked why he thought his program did so well,” says Mr. Varian, dean of the School of Information Management and Systems at the University of California, Berkeley, and one of most world’s most influential theorists on the Network Economy, “he responded that all the other contestants wanted to show their theory was correct. As a poor graduate student, he really wanted to win the $10,000!”

The prize-winning auction agent was, Mr. Varian says, "simple, non-adaptive, non-predictive, non-stochastic and non-optimizing." Its strategy was to lurk patiently in the background while others did the negotiating. But when the "bid" and "ask" prices got close, the program jumped in to steal the deal. It achieved this through a formula that waited until rival bids and asks came within 10 percent of each other, and then snuck in a bid slightly greater than the previous ask. After 28,000 plays, the graduate student’s software strategy achieved almost total domination of the auction market.

But the victorious strategy had an unfortunate downside. Before long, the market crashed. "The reason," Mr. Varian says, "is that a ‘wait-in-the-background’ strategy only works if there are many other active traders. When the student’s strategy took over the entire market, it could no longer get a free ride on price discovery by other bidders."

Was the experimental auction software a model of ingenious simplicity, or a dark vision of the future of the Internet Economy? On such questions hangs the prosperi-
ty of little dot-coms and brand Goliaths alike.

No one doubts any more that the Internet has promoted a radical convergence in business. Distinctions between content and transaction have vanished; advertising and promotion have blurred; back-office activities and customer relationship management have become almost indistinguishable; it is no longer clear where “products” end and “services” begin. Bricks-and-mortar businesses are rapidly co-evolving into clicks-and-mortar business models. Even the General Electric Company — the last company from the original Dow Jones index — is reengineering itself around the Internet-facilitated convergence of customers, suppliers and business units.

But, Mr. Varian argues, there is another convergence going on — a convergence every bit as profound as the e-commerce revolution. This convergence entwines previously distinct strands of economic thought as disparate as the theory of the firm and behavioral finance. This convergence brings simulation, empirical analysis, game theory, and evolutionary and experimental economics into a digital alignment that cannot help but enable future generations of business transformation. There are world-class economists who now view the Internet with the same lust for discovery and innovation that world-class molecular biologists bring to the human genome. Hal Varian is at the white-hot center of that intellectual convergence.

Mr. Varian works from a Berkeley, Calif. office that is cluttered with the kind of books and technologies that make it indistinguishable from that of a computer scientist or an engineer. In fact, Mr. Varian is a mathematician-turned-economist with an intellectual appetite for “information” markets. He is the first person to hold the deanship at Berkeley’s School of Information Management and Systems, and has positioned his institution as a conduit for technology, economics and business.

With his quantitative background in the economics of information, Mr. Varian’s skill is building simple but powerful economic models to explain information marketplaces. His work is widely cited, and — perhaps more importantly — attracts interest from computer scientists and financial engineers who derive inspiration from his observations.

For example, a recent Varian paper explores why it makes more sense — and even more dollars — for software developers to invest the bulk of their design efforts in making their programs friendlier to new users rather than more valuable to existing users. In rapidly growing software markets, the additional new user is far more valuable than a happier existing user. As Mr. Varian’s differential equations counterintuitively affirm, software vendors rationally grow their marketplace at the expense of an installed base — a conclusion sure to confound advocates of relationship marketing, even as it helps explain the success of your friendly neighborhood software giant.

These kinds of insights comprise the bulk of “Information Rules” (Harvard Business School Press, 1999), co-written by Mr. Varian and his Haas Business School colleague Carl Shapiro. A value-added Economics 101 primer that views straightforward economic thought through the prism of an Internet Economy, “Information Rules” explains how economic theory and Internet marketplaces are colliding.

Talking with Mr. Varian, however, provides a more interactive perspective on the future of Internet economics. Where C.E.O.’s once devoted their energies to cutting costs, clever marketing and enhanced innovation, says Mr. Varian, in the Network Economy, their efforts must focus on creating compelling and cost-effective market mechanisms. Designing the right kind of auction will have as big an impact on the brand, customer loyalty and profit margins as designing the right kind of products. Tomorrow’s marketplaces, in short, will be every bit as dynamic, customizable and innovative as tomorrow’s products. “Everything’s negotiable,” Mr. Varian asserts cheerfully.

Mr. Varian predicts with equal good humor that the economic era of posted prices is rapidly coming to an end. If you want to know what pricing will mean in your business, he says, try buying an airline ticket. When you buy matters as much as how you buy. Price is no longer the place where supply intersects with demand; it’s a vast continent of potential, where optional opportunities interact with multiple inquiries. You can use human agents, deploy software agents, or do it yourself on the Internet. You can create your own ticket auction or participate in someone else’s. A single coach-class airline ticket may spawn a thousand different price points in the span of a single week.

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As we move into a new millennium, dynamic pricing has become the rule. “Yield management,” says Mr. Varian, “is where it’s at.”

Yield management refers to those irritating algorithms that explain why four weeks ago a coach ticket cost your seatmate $299, but cost you $1,852 the day before yesterday. Yield management is the science of segmenting the price-sensitive customers from their price-insensitive counterparts.

Say you’re an airline C.E.O. If there are 180 seats on that Boeing 737 from Chicago to Washington, D.C., what is the optimal allocation of seats between the price-insensitives, who will pay a premium, and those time-insensitive bargain hunters who purchase 21 days in advance? Do you price to maximize market share per route, or to maximize profit per plane? How quickly can you reconfigure the pricing system to flip from one profit paradigm to the other? Literally billions of dollars ride on the answers to those questions.

In the Internet Economy, these calculations and counter-measures are fast becoming part of the purchasing process for practically all businesses and all customers. Even the Coca-Cola Company is trying to launch vending machines that will charge you a dime more for a can of Coke when it’s really hot outside.

But consider a more realistic hypothetical from one of the Internet’s most successful e-tailers: the Dell Computer Corporation. Suppose Dell will give you a 15 percent discount on the purchase of a Pentium V microprocessor-based PC if you agree to buy within the next 12 hours. After that, the discount vanishes. Or Dell will sell you a custom-configured machine for a 20 percent discount, if you agree to accept delivery in 30 days instead of five. How about a 30 percent discount if you promise never to call the customer-service line and only to use Web-based technical support?

Yield management thus gives Dell’s individual and institutional customers the chance not only to customize their computers, but also to customize how those computers are purchased. Dell, in turn, has the opportunity to brand its customers’ purchasing experience. Everything’s negotiable.

“The Internet is a terrific medium for any company that wants to use yield-management techniques to manage its pricing and segment its customers,” Mr. Varian says. The Net is the place where “operations research and economics are going to be reunited” — where economic theory meets business practice.

But does the Internet really let companies segment their markets? Or does it empower the customers to segment themselves? An excellent case can be made for either proposition. Mr. Varian sees this tension around “segmenting segmentation” as a real opportunity for companies to allow their customers to customize. “The company sets the menu,” he says. “The user chooses.”

That answer, however, may be a bit too glib even for the Internet Economy. Take auctions. EBay runs them; so do a swarm of other entrepreneurial dot-coms. More recently, established giants such as G.E., Boeing and Ford have begun looking to import auction mechanisms online. But that creates all kinds of questions that intrigue Mr. Varian. Just what kind of auction should it be? Should the auction be “open-cry” or “sealed-bid”? Should the style be English, with bids increasing in an open format; Dutch, with the opening price continually discounted until the available goods are gone, or Vickrey, a sealed-bid auction where the winner offers the highest amount, but pays only the second-highest amount? Should there be a human auctioneer? A software auctioneer? No auctioneer at all?

What makes these questions especially provocative is that they run smack into “The Revenue Equivalence Theorem,” which argues that most of the popular auction formats will yield the same revenues, on average. After all,
If one kind of auction consistently yielded higher revenues than the others, why on earth would anyone bother to conduct a Dutch auction? But if, in theory, all auction formats yield the same revenues, then why are there so many different genres and styles of auctions? There must be rational reasons. In other words, what is the best mechanism for which auctions?

This turns out to be one of the more interesting questions in both economic theory and practice. Economists are well aware of how the heat of emotions rather than cool logic can drive auction-market behavior. Auctions are microcosms of both rational marketplaces and less-than-

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**FOCUS: ONLINE GROCERS**

*From Homeruns to Webvan to Peapod*

by Victoria Griffith

With the buzz about the Web at a fever pitch, it is hard to believe that bricks-and-mortar companies could find themselves caught in a replay of the Amazon.com scenario. Yet the David and Goliath story may be poised to repeat itself in online grocery delivery.

Web grocery delivery would seem to be a promising Internet business. After all, some 41 percent of Americans say they hate supermarket shopping, according to a 1996 AT&T Corporation e-commerce study. Moreover, it’s something people do once or twice a week, on average. Hence the competition, with startups and existing grocers battling for online market share. The very different strategies of companies like Webvan, Peapod, Streamline.com and Homeruns show the sector has not yet converged on a single formula.

For the most part, large grocery chains remain outside the fray. Gary Rhodes, spokesman for Cincinnati, Ohio-based Kroger Company, has difficulty imagining how online grocery delivery might work. “What happens if you get a bad apple?” he asks. “What happens if you’re not there for the delivery? Does the guy have to come back? And what if the food is spoiled by then?”

Delivery and service are indeed the key hurdles for Web grocers. Most have committed to building their own warehouses and distribution networks to ensure customers get the quality goods they want. Streamline.com Inc. and the Hannaford Brothers Company’s Homeruns service, both operating in the Boston area, are also looking to expand nationally using their own distribution warehouses. And Peapod Inc., an early entrant, has rethought its original formula of partnering with local supermarkets. “We’re operating warehouses in San Francisco, and plan to move the rest of our business to that model,” says Dan Rabinowitz, chief financial officer of Peapod. The stunning stock-market debut of the Webvan Group — whose initial public offering in November 1999 yielded the company a market capitalization of about $8 billion — shows that investors like this model. Webvan plans to use most of the I.P.O. proceeds to create a vast network of automated warehouses to facilitate distribution of groceries and supermarket products.

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Victoria Griffith is a correspondent specializing in management issues for the Financial Times.
Innovative solutions to the logistical challenges faced by Web grocers are illustrated by the Boston-area Streamline.com and Homeruns services. The two companies, taking a cue from courier companies like the Federal Express Corporation and the United Parcel Service of America Inc., have invested heavily in good service people to make sure the customer gets as few bad apples as possible. Homeruns, for example, pays its delivery folk starting wages of $13.50 per hour.

Yet the differences between the companies are immediately noticeable. Homeruns believes the highest profits lie in the city. Its average order size is over $100, and its sales are at high margins. At the same time, the group's warehouses are located in the suburbs, so it doesn't pay high rents. "We've been shocked at the demand in the city for items like free-range chicken, which is out of all proportion to the demand we've seen in our suburban (physical stores)," says Alison Berglund, vice president of marketing and sales. These urban customers select a two-hour window during which they'll be home to receive delivery.

By contrast, Streamline.com concentrates on suburban deliveries, which it says saves it money. The company stocks refrigerators that its clients have placed in their garages; Streamline.com personnel never enter the house, and their customers need not be in when the truck pulls up.

Both companies have achieved real success. Some 8,000 customers use Homeruns on a regular basis in the Boston area alone, while Streamline.com has a 10 percent market share of total grocery sales in many of the suburbs where it does business.

Nonetheless, traditional supermarkets, with the notable exception of Hannaford, remain skeptical. Some have been convinced by their own experiments that online grocery delivery is a non-starter. Kroger, for instance, recently canceled a six-month experiment in Huntsville, Ala., because of lack of interest in the service. "It's easy to draw the wrong conclusions from a half-hearted trial," says Thomas Eisenmann, a professor at the Harvard Business School and e-commerce expert. "It may be wishful thinking, trying to prove to yourself that it can't be done."

But supermarket executives say the business models themselves are flawed. "Even if some of the (logistical) questions have been resolved," says Kroger's Mr. Rhodes, "we are not convinced this can be done at a profit."

Indeed, most Web grocers currently are loss-makers, and few have had much impact, even after several years in business, a fact that may have lulled traditional supermarkets into complacency. Homeruns, for example, was shut down for months in 1998 while it sorted out problems from damage to its warehouse and kinks in its Internet site. And Peapod saw its share price plummet in November 1999 amid rumors it was running out of cash.

Online grocers will need higher volume to put themselves in the black. Webvan has ambitious expansion plans. Homeruns is hoping to enter new markets to boost its business. Streamline.com has set up shop on the outskirts of Washington, D.C., and will open for business in the bedroom communities of Chicago, Ill. and New Jersey soon. Streamline.com has also added other services such as dry cleaning to its mix, and plans to offer others.

rational human behavior. In the real world, there are multiple reasons why some auction genres are more desirable than others. Maximizing revenue is certainly the primary objective. However, managing perceived fairness, maximizing the number of participants, and making sure the winning participant can afford the prize also are all legitimate auction-design criteria.

For Mr. Varian, the Internet is the greatest medium in the history of economics for testing all manner of hypotheses about which auctions work best under what circumstances. The challenge of profitably matching auction formats with industry structure or organizational culture
or financial behavior may well launch a thousand doctoral theses — and several hundred Internet consultancies and startups, as well — although Mr. Varian concedes this was an area he had not anticipated would take off the way it has. “Ebay was a blind spot for us economists,” he acknowledges. “We don’t think in terms of flea markets.”

Intriguingly, one of Varian’s favorite examples of how auction-flavored market mechanisms can transform a more traditional market was launched the year before the Santa Fe competition. Back in June 1988, several Iowa academics introduced the “Iowa Presidential Market” to trade shares in the candidates for the 1988 Presidential election. Instead of conducting polls seeking statistically significant feedback about which candidate would win, the I.P.M. insisted that its traders put up or shut up. People literally bid for the right to “vote” for their candidates.

“Marketizing” the poll utterly transformed its accuracy. “On the eve of the election, it forecast a vote share for Bush of 53.2 percent, which was exactly right, and a share for Dukakis of 45.2 percent, which was only 0.2 percentage points less than the share he actually received. This is substantially better performance than any of the opinion polls,” explains Varian.

When this auction market was created out of something that was once a forum for freely expressed opinions, market forces made the poll more accurate. Why? Because of a very obvious phenomenon, says Mr. Varian: professional traders. Ordinary traders — that is, people who were biased toward Mr. Bush or Mr. Dukakis — bid differently for shares than those traders who actually wanted to make money. As Mr. Varian notes, “If their candidate’s price got too high, they would sell him in a minute!”

The bottom line was the bottom line: Markets lure professional investors who believe their dispassionate analysis will yield greater returns on their investments. Indeed, says Mr. Varian, this has proven to be the case, as the original Iowa Presidential Market has evolved into the Iowa Electronic Markets, which currently run markets on a range of political events as well as on derivative securities on technology stocks.

And when markets scale up in size and opportunity, they attract a different kind of investor. It’s inevitable that such investors will soon be drawn to all manner of Internet-enabled markets. Right now, there is a huge gap between the time, thought and investment that goes into bidding on an eBay or Priceline.com item versus, say, on cellular telephone licenses, oil drilling licenses or Impressionist paintings. “But that gap will narrow,” Mr. Varian predicts. “Internet auction markets will become far more sophisticated. You’ll be able to buy the counterparts of derivatives and stock portfolios. We’re going to be seeing ‘quants’ come into auction markets. You’ll see smart software agents bidding against smart humans and market participants won’t be able to tell one from the other.”

“Who’s really threatened by this?” I ask. He half-jokes. “I claim Las Vegas.”

Humor about extraordinary popular delusions and the madness of crowds aside, Mr. Varian believes the Internet does, in fact, represent a fundamental discontinuity in how society creates and manages economic value. He unhesitatingly compares the Internet Revolution to the Industrial Revolution. However, where other pundits emphasize the distinctions between an era powered by coal and a period driven by silicon, Mr. Varian sees common patterns of innovation.

“During the American Industrial Revolution,” he says, “the big idea was standardized parts. You had the ability to tinker with something and then, because the parts were standardized, you could make lots of those things pretty fast and cheap. So where are we at now? Standardized parts: the Internet, CGI scripts, TCP/IP, Javascript. The Internet is filled with innovations built with standard parts that get globally scaled because of what the Internet is. We’re putting them together in different ways. We have people putting things together in garages and basements. It’s craft; it’s art; it’s experimentation. It’s doing a lot of crazy things and seeing what works. That’s the right kind of innovation model for where we are right now, but it won’t persist forever.”

That raises the question that Varian the economist and connoisseur of economic history finds so vexing. Two rival theories of the economic future are ruthlessly competing for tomorrow and Mr. Varian doesn’t yet know how to bet. One completely logical theory predicts that organizations will get smaller. The technology enables more project teams to form to solve specific problems and/or exploit explicit opportunities — just as a Hollywood movie is made by a coalition of skilled, autonomous profession-
als. To use the felicitous phrasing of Professor Thomas W. Malone of M.I.T.’s Sloan School of Management, the Internet encourages an economy of “e-lancers” freed from the shackles of Weberian corporocracies. Network economies will prove so disruptive that economies of scale are consistently overwhelmed by the costs of coordination. Size is more often a hindrance than a competitive advantage.

Then again, warns Mr. Varian, the same set of technologies argue for exactly the opposite conclusion. Technology enables coordination and collaboration on a scale undreamt of by global conquerors from Alexander the Great on. The Command-and-Control Corporation can come back with a vengeance. It’s back to the future, courtesy of the Internet. Virtual cartels and zai-batsus become once again the natural order of things.

“History favors the second model,” says Mr. Varian flatly. “History likes ‘thick’ markets and ‘thick’ institutions. EBay is an excellent example. So is Yahoo. They’re both about returns to scale.”

However, he cautions, we’re still in a transition phase. It seems far too early to say which model will prove triumphant — or even whether the future will feature a relentless yo-yo-ing from one to the other as the Schumpeterian process of “creative destruction” gets compressed into Internet time. This competition between consolidation and entrepreneurship may even prove to be a false dichotomy that requires a new economics of industrial organization.

But Mr. Varian doesn’t think so. In fact, he shows his cards about tomorrow’s Internet Economy with his prediction that “antitrust law will become more important.” Why? Because he strongly believes in “the network effect.” That is, in the same way producers can get increasing returns to scale on the products and services they offer, networks can provide “demand-side” returns to scale that effectively lock customers in and create exorbitant switching costs. Open standards, policed by governments and courts, is one way to mitigate the risks of monopoly associated with the network effect, says Mr. Varian.

“How do you create the rules?” he asks rhetorically. “Legislation and litigation. We’re going to get lots more of both. We’re also going to see companies try to arbitrage the differences between legislation and litigation in different countries. I’m very comfortable predicting that Internet law and Internet lobbying will be growth industries for the foreseeable future.”

But there’s no disguising the belief that the Internet represents a breathtaking opportunity for economists and economics to drive innovation and entrepreneurship in a manner that is almost without precedent since Adam Smith penned “The Wealth of Nations.” Not since the Nobel-Prize-winning equations of Black-Scholes and Merton in finance has there been a fusion of technology, financial capital and human ingenuity that made economic insights and algorithms so valuable.

“What’s phenomenal is that all this theory that was once regarded as the purest of the pure is now becoming the basis for new business models,” says Mr. Varian, with a mix of disbelief and satisfaction. Economic theory is accelerating from the descriptive to the prescriptive at an Internet-driven pace.

The Internet and the electronic markets it enables have created a new world for economists. New theories can be empirically tested and new empirical data can be tested for theories. New market innovations can be simulated, analyzed and launched into cyber-markets in minutes or months. The opportunity costs of not being economically savvy are increasing over time, not decreasing.

“This is a very good time,” says Hal Varian, “to be an economist with lots of ideas.”

“The Creative Mind”

EBay was a blind spot for us economists. We don’t think in terms of flea markets.”