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THE BIG IDEA

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That must change.*

The Judgment Deficit

by Amar Bhidé

Included with this full-text *Harvard Business Review* article:

- 1 [Article Summary](#)
Idea in Brief—*the core idea*
- 2 [The Judgment Deficit](#)

Insurance Evolved



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The Judgment Deficit

Idea in Brief

Decentralized individual judgment and initiative are essential to the success of the modern capitalist economy.

At the same time, rules and centralized systems are needed to bring order and prevent waste. Getting the balance between these two modes of decision making right is a constant struggle. But managers, policy makers, and others are aware of the conflict and have experience managing it.

In recent times, though, a new form of centralized control has taken root that is the work not of old-fashioned autocrats, committees, or rule books but of statistical models and algorithms.

This has been especially true in finance, where risk models have replaced the judgments of thousands of individual bankers and investors, to disastrous effect. The problem with the statistical approach is that it cannot adequately account for the uncertainty and idiosyncrasies inherent in economic decisions.

What finance in particular needs is a return to judgment.

Statistical models have deprived the financial sector of the case-by-case judgment that makes capitalism thrive. That must change.

THE BIG IDEA

The Judgment Deficit

by Amar Bhidé

The modern economy creates and spreads unprecedented prosperity by drawing on the resourcefulness and enterprise of the many, not by blindly following the dictates of a few. Individuals today make and act on their own judgments to a degree that would have been unimaginable to our forebears. Indeed, many of us value this humanization of our work as highly as we do the material comforts that the work secures. (The great virtue of a dynamic capitalist economy, the economist Edmund Phelps argued in his 2006 Nobel prize lecture, lies in the opportunities it provides for more engaging work rather than for more leisure.)

This triumph of independent initiative and judgment—of what I call the venturesome economy—is, however, far from absolute, nor should it be. Yes, the collapse of the Soviet Union and of top-down, Soviet-style management in monolithic corporations liberated millions from mindless, unproductive toil. But we are all subject to traffic laws telling us which side of the road we can drive on, and that's a good thing. The designers of the iPhone and

iPad (and of their apps) defer in matters large and small to the dictates of Steve Jobs, to the benefit of Apple consumers and shareholders alike. Discerning the appropriate balance between top-down command and control, on the one hand, and individual initiative and judgment, on the other, will always be a challenge for our society and our organizations. But at least we're aware of the conflict and have experience managing it.

In recent times, though, a new form of centralized control has taken root—one that is the work not of old-fashioned autocrats, committees, or rule books but of statistical models and algorithms. These mechanistic decision-making technologies have value under certain circumstances, but when misused or overused they can be every bit as dysfunctional as a Muscovite politburo. Consider what has just happened in the financial sector: A host of lending officers used to make boots-on-the-ground, case-by-case examinations of borrowers' creditworthiness. Unfortunately, those individuals were replaced by a small number of

very similar statistical models created by financial wizards and disseminated by Wall Street firms, rating agencies, and government-sponsored mortgage lenders. This centralization and robotization of credit flourished as banks were freed from many regulatory limits on their activities and regulators embraced top-down, mechanistic capital requirements. The result was an epic financial crisis and the near-collapse of the global economy. Finance suffered from a judgment deficit, and all of us are paying the price.

As we rebuild from the economic crisis, we must renew the search for the appropriate balance—in finance and in other endeavors—not just between centralization and decentralization but also between case-by-case judgment and standardized rules. The right level of control is an elusive and moving target: Economic dynamism is best maintained by minimizing centralized control, but the very dynamism that individual initiative unleashes tends to increase the degree of control needed. And *how* to centralize—whether through case-by-case judgment, a rule book, or a computer model—is as difficult a question as how much. But these are questions that we cannot afford to stop asking.

The Case for Decentralization and Individual Judgment

The great twentieth-century thinker Friedrich Hayek made the classic argument for decentralized choice in his essay “The Use of Knowledge in Society.” The stability of the economy depends on constant adjustments to small changes, he believed—“B stepping in at once when A fails to deliver.” No single individual has the knowledge to make those adjustments; rather, it is widely dispersed across many individuals. But information about “the circumstances of the fleeting moment” cannot be quickly and accurately communicated to a central planner. Therefore, individuals who have on-the-spot knowledge must be allowed to figure out what to do.

Published in 1945, this treatise was a critique of central planning, then seen as an attractive solution to the economic and political problems capitalist societies faced during the Great Depression and the Second World War. Over the years, the sledgehammer style of central planning has fallen out of favor. Nevertheless, Hayek’s case for decentralization remains relevant.

Adaptation to changes—the focus of Hayek’s article—is only part of the story. The success of the modern economy also depends on innovation. As it happens, decentralization beats central planning here, too. Innovations are unprecedented, one-of-a-kind developments. Even incremental ones require imagination. An innovator cannot simply rely on historical patterns in placing bets on future opportunities. Knowing what has worked before and what hasn’t is but a starting point. Innovation also requires considerable trial and error. Unforeseen technical problems—or customers not doing what they had told market researchers they would—demand recalibrations that combine on-the-spot observations and historical knowledge with leaps of imagination.

Envision a centralized innovation process: Organizations like the National Science Foundation and the Food and Drug Administration might convene panels of experts to screen proposals and decide which new products merit sale to consumers. Such a formal, remote process would limit innovators’ ability to communicate the wide range of on-the-spot knowledge that continually informs their judgments. And communicating their hunches and imaginative leaps would be virtually impossible, as would resubmitting data and proposals when innovators encountered unexpected problems. Moreover, because innovators’ judgments combine facts, past experiences, and imagination, different individuals faced with the same situation would respond differently—no panel could predict whose judgment would be best.

In a decentralized capitalist economy, innovators are not restricted by their track records or qualifications, or by expert panels saying yea or nay. They are free to act on their judgments, if they can muster the necessary resources. As a result, the system summons forth a considerable variety of innovations. The process does involve duplication of innovative effort. But it eliminates the favoritism and aversion to unconventional ideas that a centralized system would entail.

Symmetrically, individual consumers rather than expert panels choose among alternative innovations in the marketplace. And consumers’ choices aren’t robotic: When offered something new, users have to make imaginative, venturesome judgments.

Independent, case-by-case judgments are crucial throughout a dynamic economy, not

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Mechanistic decision making has value, but when misused it can be every bit as dysfunctional as a Muscovite politburo.

just in high tech. Faced with a spike in raw material prices, for instance, a metal fabricator cannot simply repeat what worked the last time prices were high. She has to make a judgment on the basis of how she thinks customers and competitors will respond, given changes in technologies and tastes since the last spike in prices. As a neighborhood becomes gentrified, restaurateurs have to adjust their menus and decor. Consumers, too, are constantly forced to make new judgments: Should I buy a hybrid car to reduce my fuel costs, or reinsulate my home? Give the new restaurant a chance, or stick to the tried-and-true?

Dialogue and relationships. Effective decentralization demands mechanisms to coordinate independent initiatives. And so dynamic societies and organizations rely on dialogue and relationships to a greater degree than do top-down systems, in which a few tell the many what to do.

An ecosystem encompassing dozens of semiconductor companies, scores of printer manufacturers, hundreds of PC makers, and thousands upon thousands of software developers has helped Windows dominate the operating system market. When Microsoft is developing a new version of Windows, it consults closely with these players so that compatible hardware and software are available as soon as the operating system is released. Similarly, as the other players develop new features for their products, they benefit from discussions with Microsoft.

Established relationships complement dialogue in sharing information and facilitating coordination. Doing business repeatedly with the same parties reduces the ambiguities and misunderstandings that exist even in carefully negotiated contracts, for instance. No matter how much discussion takes place, gaps in agreements cannot be eliminated because words are not always precise. What is a “best effort”? Diligence in the eyes of one party may be seen as sloppiness by another. The same medium-rare steak can be just right for one patron and overcooked for another. Repeated transactions help each party learn what the other means and expects.

Relationships can also smooth the way for making adjustments when things go wrong. A vendor may fail to meet the promised delivery date of a next-generation hard drive. The buyer has the contractual right to cancel the order,

which might be sensible if the delay is due to a design flaw that will take a long time to fix. But an extension would be in order if the problem lay in a temporary holdup in the production line. Without a relationship in place, a buyer is less likely to take the circumstances of the situation into account and more likely to default to a prescribed response.

The Case for Centralization

Technologically advanced societies couldn't function without some centralized control, of course. Governments need to regulate how businesses drill for oil, develop genetically modified crops, and pick the paints they use in toys, for instance. In fact, technological advances usually broaden what most people would regard as legitimate constraints on independent choice. The invention of the automobile made driving rules and vehicle inspections necessary. The growth of air travel required a system to control traffic and certify the mechanical condition of aircraft. Radio and television airwaves had to be regulated to avoid the collision of competing broadcasters' signals. The development of petrochemicals necessitated rules to control pollution.

Besides submitting to the coercive power of the state, individuals also voluntarily subject themselves to the authority and rules of private organizations. Bosses exercise control not only over their employees but also over subcontractors and outside lawyers and consultants. Below the apparently freewheeling open-source development of the Linux operating system lie elaborate processes and rules and—gasp—a hierarchy headed by founder Linus Torvalds. Internet entrepreneurs conform to specifications established by a labyrinth of standard-setting bodies.

The origins of modern organizational controls date back to efforts to realize economies of scale and scope during the nineteenth and early twentieth centuries. Rail transportation, for instance, was an innovation that offered huge advantages but posed coordination problems that could not be solved purely by the kind of sequential, ad hoc adaptation Hayek celebrated. Building a Pacific-to-Atlantic railroad starting from both coasts required considerable advance planning and ongoing monitoring by a centralized authority, as did the safe operation of the railroad after it was built. (The outcry after the collision of two passenger trains in 1841, the his-

Statistical models reveal broad tendencies and recurring patterns, but in an ever-changing world, they cannot make reliable predictions.

torian Alfred Chandler records, “helped bring into being the first modern, carefully defined, internal organizational structure used by an American business enterprise.”)

The specialization and consciously directed coordination of labor has now been brought, to great advantage, from the production line to the development of new products. In the nineteenth century, new products were developed by a few individuals. Thomas Edison brought forth a remarkable cornucopia—incandescent bulbs, motion pictures, and gramophones—from a small facility in New Jersey with fewer employees than the typical Silicon Valley startup. When he invented the telephone, Alexander Graham Bell had one assistant. Such small organizations couldn’t quickly develop good products at affordable prices, so many inventions were, at the outset, playthings for the rich. Now large teams come up with cheap, reliable smartphones and netbooks for mass markets from the get-go. Product development, which involves a wide range of team members with broad expertise, has to be tightly controlled, with well-defined tasks and timetables. To play in the big leagues, even companies that start off with no management to speak of, such as Microsoft and Dell, have to routinize their approach—and sometimes hire managers from large companies to oversee the new development processes.

Eventually, however, big business ran up against the limits of extreme centralization. Telling workers exactly what to do was demotivating—Henry Ford famously paid workers high wages, but that did not buy him great loyalty. And, as Hayek would have predicted, centralization was wasteful: Workers who had knowledge of specific circumstances weren’t empowered to make adjustments or undertake initiatives. Organizations therefore began to adopt what Tom Peters and Robert Waterman call “loose-tight” controls, with structures that centralize some activities and decentralize others.

The Rise of Mechanistic Decision Making

How top-down decisions are made matters as much as what is centrally controlled. Bosses can make case-by-case judgments—think of Henry Ford’s or *Vogue*’s Anna Wintour’s idiosyncratic decrees about product design. Alternatively, codified and mechanistic rules can be

imposed to exercise control: Rate cards or formulas can replace a salesperson’s discretion and judgment about prices.

Dynamic societies and organizations blend case-by-case judgment with more or less fixed rules, just as they learn to balance authority and autonomy. In deciding on bonuses, for instance, organizations usually take into account a mix of supervisors’ assessments of their subordinates and employees’ performance against measurable targets. The legal system relies on precedents and codified rules together with a consideration of the facts specific to each case. Physicians must make on-the-spot judgment calls, but they have also found that adhering to simple checklists can dramatically reduce operating-room errors.

The information technology revolution has shifted the balance between judgment and rules, giving a strong economic and psychological boost to judgment-free decision making. If IBM’s Deep Blue computer can be programmed to beat the world chess champion and its Watson computer can learn to crush the competition at *Jeopardy!*, what else could they do? In some cases, computers have clearly proved their superiority over human judgment. Computers waste less material in cutting fabric and leather to make shirts and shoes. They are also better at managing the deployment of large fleets of trucks, laying out circuits in chip design, and controlling refineries.

The superior ability of computers to rapidly perform mathematical calculations and simulations typically provides advantages in controlling passive or inanimate objects, which obey the laws of nature (or in some cases geometry or deductive logic) and do not try to undermine what the computer programs are intended to achieve. Effective automated control of human affairs is far more elusive.

Because natural laws and mathematical inferences cannot predict behavior, algorithms are built upon statistical models. But for all their econometric sophistication, statistical models are ultimately a simplified form of history, a terse numerical narrative of what happened in the past. (The simplifying assumptions of most statistical models are in fact so great that they can almost never be used successfully to reconstruct the very historical data used to construct the models.) They reveal broad tendencies and recurring patterns, but in a dynamic society shot through with willful

and imaginative people making conscious choices, they cannot make reliable predictions.

It is common to mock Pollyannas who hope “things will be different this time,” but in a venturesome economy, things actually are different every time. Statistical models disregard the uniqueness of events, treating them like balls in a jar that vary only by diameter or color. What’s more, statistical models of human behavior tend to focus on a small number of variables. Ignoring the one-off characteristics and richness of individual situations, though, is fundamentally incongruent with what makes a decentralized economy tick. As Hayek pointed out in 1945, the inability to cope with context-specific information makes centralized organizations inflexible.

Even companies whose procedures work well at the outset can become victims of their own success, because others will quickly imitate their successful innovations. Yield-management programs to fill airplanes or “by the numbers” sabermetrics methods to manage a baseball team (as described in Michael Lewis’s *Moneyball*) can work wonderfully for the first airlines and baseball teams that use them but tend to lose their potency with widespread adoption. Moreover, unlike airplane fleets or chess pieces, people don’t passively submit to control. They learn to game programs that seek to direct their behavior. The half-life of an effective mechanistic model to control human action is quite short.

This doesn’t mean statistical controls and data-mining programs are useless in human affairs. They can debunk false assumptions and stereotypes or suggest new rules of thumb. Faced with a large number of choices (as when thousands apply for one job), they can provide a quick, objective first-cut screen. But predictions of human activity based on statistical patterns are dangerous when used as a substitute for careful case-by-case judgment. They nonetheless continue to gain ascendancy. Nowhere has this been more apparent—or more dangerous—than in the financial industry.

Robotic Finance

In a venturesome economy, the decentralized, subjective choices of developers and consumers of innovations call for decentralized, subjective judgments by those evaluating their funding requests. Financiers should play the role of English teachers helping improve stu-

dents’ essays, not of math teachers grading algebra tests—much less an automated SAT scoring machine. In the financial sector, though, funding mechanisms have become increasingly centralized and mechanistic. They no longer reflect the decentralized real economy they were meant to serve.

The lack of judgment has been destructive not just in the economy’s cutting-edge outskirts: The interconnections that make the modern economy so dynamic leave financiers with few places where they can count on history to repeat itself or events to follow predictable rules. Seemingly mature and untrendy industries are frequently buffeted by innovations elsewhere.

The housing market is a stark example. As Japanese companies figured out how to make more desirable cars than those of GM, Ford, and Chrysler, housing prices in Detroit sank. The average price of a home there fell to \$15,000 in October 2009 from almost \$98,000 in 2003, making a mockery of estimates of mortgage defaults based on historic rates.

The traditional lending model was built around case-by-case judgment. Home buyers would apply for loans from their local bank, with which they often had an existing relationship. A banker would review each application and make a judgment, taking into account what the banker knew about the applicant, the applicant’s employer, the property, and conditions in the local market. The banker would certainly consider history—what had happened to housing prices, and the track record of the borrower and other similarly situated individuals. But good practice also required forward-looking judgments—assessments of the degree to which the future would be like the past. Dialogue and relationships were also important: Bankers would talk to borrowers to ascertain their beliefs and intentions. And staying in touch after the loan was made facilitated judgments about adjusting terms when necessary.

Over the past several decades, centralized, mechanistic finance elbowed aside the traditional model. Loan officers made way for mortgage brokers. At the height of the housing boom, in 2004, some 53,000 mortgage brokerage companies, with an estimated 418,700 employees, originated 68% of all residential loans in the United States. In other words, fewer than a third of all loans were originated by an

Banning mass-produced derivatives or supervising them closely would be unwise: Blanket prohibitions rarely work.

actual lender. The brokers' role in the credit process is mainly to help applicants fill out forms. In fact, hardly anyone now makes case-by-case mortgage credit judgments. Mortgages are granted or denied (and new mortgage products like option ARMs are designed) using complex models that are conjured up by a small number of faraway rocket scientists and take little heed of the specific facts on the ground.

The securitization and sale of mortgages has meant that financial companies' loan origination is no longer limited by their deposit base or capital, allowing some institu-

tions to capture a very large share of the market. Countrywide Financial, which was started in 1969, grew from a two-man operation into a mortgage behemoth with approximately 500 branches. Before it imploded, in 2007, it was issuing nearly a fifth of all U.S. mortgages. The government/private hybrids Fannie Mae and Freddie Mac made Countrywide's role seem small. When they were taken over by the Treasury, in 2008, the two enterprises owned or had guaranteed about half of the country's \$12 trillion worth of outstanding mortgages. Since then, their share of the market has only gone up.

The buyers of securitized mortgages don't make case-by-case credit decisions, either. For instance, buyers of Fannie Mae or Freddie Mac paper weren't, and still aren't, making judgments about the risk that homeowners would default on the underlying mortgages. Rather, they were buying government debt—and earning a higher return than they would from Treasury bonds. Even when securities weren't guaranteed, buyers ignored the creditworthiness of individual mortgages. They relied instead on the models of the wizards who developed the underwriting standards, the dozen or so banks (the likes of Lehman, Goldman, and Citicorp) that securitized the mortgages, and the three rating agencies that vouched for the soundness of the securities.

Dispensing with judgment has also helped funnel the mass production of derivatives into a few mega-institutions, posing systemic risks that their top executives and regulators cannot control. (See the sidebar "Derivatives for Robots.")

The fallout. Little good has come of this robotization of finance. Reduced case-by-case scrutiny has led to the misallocation of resources in the real economy. In the recent housing bubble, lenders who, without much due diligence, extended mortgages to reckless borrowers helped make prices unaffordable for more prudent home buyers.

The replacement of ongoing relationships with securitized, arm's-length contracting has fundamentally impaired the adaptability of financing terms. No contract can anticipate all contingencies. But securitized financing makes ongoing adaptations infeasible; because of the great difficulty of renegotiating terms, borrowers and lenders must adhere to the deal that was struck at the outset. Securitized mortgages

Derivatives for Robots

Robotic methods have opened new frontiers in dangerous speculation, touted as innovations in risk sharing and control. The notional value of over-the-counter derivatives grew more than sixfold, from \$95 trillion to \$684 trillion, between 2000 and mid-2008—in the process helping bring on (or at least exacerbate) the financial crisis. Derivatives that insure against loans gone bad—the now infamous credit default swaps (CDSes)—gave purchasers of bundles of subprime mortgages a false sense of security, thus enabling the spectacular and ultimately disastrous growth of the subprime market. Because CDSes were also a vehicle for highly leveraged—and opaque—speculation, fear that financial institutions faced large losses on them spread, helping freeze credit markets in the fall of 2008.

The modern view asserts that situation-specific factors can be diversified away.

Derivatives themselves have been with us for centuries and can serve useful economic purposes. The modern derivatives explosion, though, has been built around a mechanistic and flawed approach to risk. The traditional view of risk heeded its numerous facets, several of which elude quantification, and accounted for the uniqueness of individual situations. The modern view asserts that situation-specific factors can be diversified away,

and that risk can be reduced to a single number whose value can be derived from statistical analyses of historical data.

The models that generate prices for stock options using just a handful of variables are the simplest case in point. The key variable is volatility—a measure of how much the stock will fluctuate in the future. Its correct value can be known only by an omniscient being. Traders therefore plug in historical volatility, shading it a bit to reflect their guesses about the future. Estimates of volatility made mainly on the basis of historical values can be wildly wrong, and at the most inopportune times. But because these models don't require labor-intensive, on-the-spot analyses of real companies or borrowers, they quickly caught on after being introduced in the early 1970s. Since then the same basic approach has been used to generate purportedly fair prices for all manner of derivative contracts. Such highly abstracted, top-down conceptions of risk—the "delta" of a derivatives book or the "beta" of a stock portfolio—allow the CEOs of financial behemoths, at least in principle, to manage a wide range of activities with little knowledge of the details of any one. Regulators, who once focused on loan-by-loan examination of banks, have also embraced the top-down approach to risk control. The scrutiny of individual risks has been abandoned.

—A.B.

are more likely than mortgages retained by banks to be foreclosed if borrowers fall behind on their payments, as recent research shows.

When decision making is centralized in the hands of a small number of bankers, financial institutions, or quantitative models, their mistakes imperil the well-being of individuals and businesses throughout the economy. Decentralized finance isn't immune to systemic risk; individual financiers may follow the crowd in lowering down payments for home loans, for instance. But this behavior involves a social pathology. With centralized authority, the process requires no widespread mania—just a few errant lending models or a couple of CEOs who have a limited grasp of the risks taken by subordinates.

There is a categorical difference between the age-old securitization of debt by railroads and electric utilities and the newer securitization of mortgage and consumer loans. The issuance of railroad and utility bonds does not eliminate holistic, case-by-case judgment. Rather, a few underwriters and rating agencies play a pivotal role in making these judgments, usually after extensive dialogue with the borrowers. Furthermore, the economies of scale in the railroad or power plant being financed compen-

sate for the concentration of decision-making power. When housing and auto loans are securitized, by contrast, the concentration is not accompanied by any detailed analysis of the ultimate borrowers' circumstances. The supposed benefit of cookie-cutter credit decisions is the lower cost of automated lending. But low-cost lending to borrowers who can't repay is no bargain for anyone. The mass production of consumer loans isn't like the mass production of consumer goods. The long-term consequences of excessive lending can be disastrous for borrowers, creditors, and society at large.

As lawmakers and regulators respond to the financial crisis, they are not evaluating the practice of securitization thoughtfully, asking when and whether it beats traditional bank lending; they are merely striving to restore securitization to its precollapse levels. Yes, there are a few stabilizing improvements: New laws require banks to keep 5% of securitized subprime mortgages. Beleaguered credit rating agencies promise to improve their models and provide more transparency. But policy makers are ducking the question of whether loans made to home buyers and consumers based on computerized credit scores should be securitized and rated at all, given the absence of any firsthand scrutiny of the borrowers.

I'm not arguing that Congress or regulators should decide how much or what kind of securitization is right. Banning mass-produced derivatives or supervising them closely would also be unwise: Blanket prohibitions rarely work, and nuanced restrictions just create more work for regulators, lobbyists, and lawyers. Reforms should focus on restoring judgment to those institutions where its absence does the greatest harm—namely, banks. (See the sidebar "Fixing Financial Services.")

A Balancing Act

"Face it," the Silicon Valley savant Paul Saffo declared recently, "innovation is an elite activity." It isn't, though. Steve Jobs may orchestrate the development of iPhones and iPads, but the success of these products requires the contributions of thousands of engineers, designers, marketers, and copyright lawyers—employed by Apple and its wide network of suppliers and developers of applications and add-ons—as well as the venturesomeness of millions of consumers. The modern economy makes change routine and ubiquitous. Many

Fixing Financial Services

What can lawmakers and regulators do about the rise of computerized, standardized credit and its attendant dangers? More rules that make black boxes work better aren't the answer. Rather, we need to just say no to judgment-free risk-taking by banks (whose recklessness affects us all).

I propose that we reinstate old-fashioned banking, in which bankers know their borrowers. This could be accomplished by tightly limiting what banks can do: Specifically, they should do nothing besides make loans to individuals and nonfinancial businesses—after conducting boots-on-the-ground due diligence—and conduct simple hedging transactions. The standard for making a loan or hedge would simply be whether it could be monitored by bankers and examiners who don't have PhDs in finance, and whether the risk is one that bankers

would take if it were their own money—a "prudent lender" rule, in other words.

These rules would apply to any entity taking short-term deposits from the public, whether or not it was called a bank. All others—investment banks, hedge funds, trusts, and the like—could innovate and speculate to the utmost, free of additional oversight. But they would not be allowed to trade with or secure credit from regulated banks, except perhaps through loans collateralized by liquid, high-quality securities. No lending against or purchasing of collateralized debt obligations, and no financing of warehouses of loans awaiting securitization, for instance.

Mechanistic finance wouldn't disappear, but it wouldn't imperil our livelihoods as it so palpably has in recent years.

—A.B.

For Further Reading

To learn more, consult the following:

The Venturesome Economy: How Innovation Sustains Prosperity in a More Connected World, by Amar Bhidé (Princeton University Press, 2008)

“The Use of Knowledge in Society,” by Friedrich Hayek (*American Economic Review*, September 1945)

The Visible Hand: The Managerial Revolution in American Business, by Alfred D. Chandler, Jr. (Harvard University Press, 1977)

“Securitization and Distressed Loan Renegotiation: Evidence from the Subprime Mortgage Crisis,” by Tomasz Piskorski, Amit Seru, and Vikrant Vig (Chicago Booth School of Business Research Paper No. 09–02, September 30, 2009)

Understanding Technical Change as an Evolutionary Process, by Richard R. Nelson (North-Holland, 1987)

have the opportunity to advance; few can afford to stay still. Whether they like it or not, the makers of potato chips and of semiconductor chips—along with their financiers, regulators, and customers—all have to figure out what comes next.

Paradoxically, the great advances realized by giving so many an opportunity to use judgment and imagination engender a need for more centralized control. The negligible authority of governments or private organizations possible in a Jeffersonian society of yeoman farmers is inconceivable in an advanced economy with complex, large-scale activity.

So the challenge is to keep control by human authority—or computer models—within judicious limits. I can think of some

broad guidelines: Computerized controls work best with inanimate products or processes that can be physically shielded so that variations in conditions (such as the temperature or humidity inside a plant or product casing) can be minimized and when feedback from measured outcomes can be continuously used to adjust or improve the decision-making algorithms. Computers also shine when, as with the configurations of pieces on a chessboard, the number of possible outcomes is vast (in fact, this vastness often gives the computer its edge) but they all conform to well-specified rules. Conversely, human judgment is favored when shielding is difficult, outcomes are ambiguous, and the possibilities are open-ended.

Ultimately, however, the “right-sizing” of judgment is itself a matter of judgment. Long experience has taught us how to strike a sensible balance in the area of centralized human control. We no longer blindly trust scientific management, time-and-motion experts, or the wisdom of corporate executives and committees; but we do rely on bosses and rules to provide some order. Black-box econometric models are harder to blend with human judgment. Their dictates, which can be as rigid and stultifying as those of time-and-motion experts, are invisible and disembodied and thus more difficult to confront. Yet if we are to preserve the primacy of human judgment, we must learn to harness and control these models, not submit to them.

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