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The Triumph of Bits

Mental Models for Successful Investment

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- The key to the Digital Revolution is that knowledge has replaced physical capital as the fundamental driver of value.
- This tectonic shift has rendered many old rules of thumb obsolete. Investors must adopt new mental models in order to understand current developments.
- A decentralized mindset is most suitable for understanding capital market behavior, adaptive management structures, and technological diffusion.
- Globalization will transform many industry structures. Leading companies will get the best the world has to offer: large markets, the latest technology, responsive suppliers, and able talent.

Executive Summary

As we enter the new millennium, information technology is driving change in the world around us at an ever-increasing pace. Old rules of thumb that once accurately represented the past have just as rapidly lost their accuracy. New mental models, or frameworks, are needed to allow investors to best understand the circumstances they face. Those that can adapt to the brave new world will reap disproportionately higher rewards. Those that don't will struggle.

This report broadly outlines the key forces that are reshaping the world of the 21st century:

- *Revolutionary economic shifts.* We are currently undergoing our second revolutionary shift in as many centuries. Improvements in “software”—the instructions, recipes, or means by which humans manipulate the physical world around them—are the main driver. As knowledge replaces tangible capital as the fundamental driver of value creation, future economic growth relies more on the manipulation of “software” than on the manipulation of physical capital. There is already ample evidence of this shift in knowledge over capital in aggregate return on capital data for the U.S. economy. Unfortunately, the current accounting system was developed to measure tangible capital and is inelegant at keeping the financial score for the information revolution.
- *Decentralization.* In an ever-connected world, distributed knowledge becomes more and more valuable than individual knowledge. As an investor, this mindset allows a better understanding of how securities are priced in the capital market, dictates adaptive management structures, and explains the diffusion of technology.
- *Globalization.* Currently, a mere 20% of global output is consumed in global markets. However, in 30 years' time it is estimated that 80%, or \$90 trillion, in global output will be consumed in global markets. This 9% compound average growth rate in global market consumption is roughly double the actual growth in output expected over the same period. Capital, raw materials, labor, and land are all costs of production. Taking advantage of global disparities among these various elements of the capitalist calculus are going to be a source of tremendous opportunity in the future. Particularly, labor productivity and labor cost arbitrage will become a key source of value in the years ahead.
- *The triumph of bits over atoms.* The revolutionary shift to a knowledge-based economy has radical implications for valuation. Knowledge-based businesses enjoy certain characteristics not found in their bricks-and-mortar brethren. For example, most knowledge-based businesses have high upfront costs but relatively cheap incremental costs. This “scalability” makes intellectual capital easy to reproduce and disseminate, allowing businesses to grow with negligible incremental costs. This leads to even more rapid change, as dominant companies or industries are always at risk of being unseated by a new technology, driving future returns on invested capital higher than they have ever been.
- We believe it is important to allocate a meaningful amount of time to the building and fortification of mental models.

Introduction

Investing is a context-dependent activity. Change is inevitable. Rules of thumb that accurately represented the past have lost their validity. Investors more concerned with consistency of approach than evolution of approach are falling out of sync with the markets.

What to do? We believe the best way to approach the investing task is one proposed by Charlie Munger—Warren Buffett’s sidekick at Berkshire Hathaway. Munger advocates the use of so-called “mental models.” Mental models are frameworks—typically drawn from various disciplines—that allow an investor to best understand the circumstances he or she faces. Mental models help shape accurate representations of reality, and are as valid for assessing a company’s competitive position as they are for rational decision-making in stock picking.

Munger likes to point out the risk of having too few mental models or models that are too rigid. He repeats the well-worn phrase “to a man with a hammer, every problem looks like a nail” to stress that mental models must constantly be built and fortified. We believe the mental models required for the 21st century are very different from those that dominated even one generation ago. Investors today must adapt, as they have in the past. History has shown that those quickest to adapt reap disproportionately higher rewards. Change is the only constant.

In this article, we build on four themes: revolutionary economic shifts, decentralization, globalization, and bits over atoms. There is one common and powerful thread linking each theme: the speed and increasing ubiquity of information technology. Information technology is changing many of the rules of the game, both for companies and investors. This is not to say the laws of financial economics have changed. It *does* suggest, however, that mental models must be updated.

Revolutionary Shifts: Agricultural to Industrial to Information

We are currently undergoing our second revolutionary shift in as many centuries. The first shift was from a largely agricultural society to an industrial society. This occurred in the 19th century. The second shift is from an industrial society to an information society. This shift started around the middle of the 20th century, and remains a powerful force today. Table 1 shows the percentage of employment in agricultural, manufacturing, and service jobs in the United States over the past 200 years. The data clearly show the shift in economic emphasis.

Table 1
Percentage of Americans Employed in Various Jobs

	1800	1850	1900	1950	2000E
Agriculture	94%	60%	45%	18%	3%
Manufacturing	3	24	27	37	27
Services	3	16	28	45	70
Total	100%	100%	100%	100%	100%

Source: *Myths of Rich and Poor*, W. Michael Cox and Richard Alm; CSFB estimates.

Some pundits have argued that there is really very little new about the New Economy, citing prior periods of outsized wealth for countries during specific times. Examples include Holland in the 17th century and the United Kingdom in the 18th and 19th centuries. On one level, this is valid. On another level, it is a gross underestimation of the pace of change and how we experience it as humans.¹

What features do these revolutions have in common? In each case, innovation—or the application of “technology”—has been key. For example, the jump from a nomadic to an agrarian society was spurred by the domestication of plants and animals.² This was a meaningful innovation, as it allowed for the creation of larger communities and introduced specialization of tasks. The transition from an agricultural to industrial society was paced by technological breakthroughs such as steam engines, electricity, rail transportation and mass production lines.³

Improvements in “software” are the root of these revolutionary shifts. Software is defined as a set of instructions, recipes, or means by which humans manipulate the physical world around them.⁴ In this regard, the current Information Revolution is similar to the revolutions that preceded it.

So what’s different about the Information Revolution—the basis for the heralded New Economy? There has been a shift in emphasis in what drives economic growth. Economic output is a function of labor, capital, and software. Historically, improved software drove better use of capital and labor. The key difference between the current revolution and the prior two is that they were largely about manipulating *physical capital*, while the current revolution is about manipulating *software*. Now, for the first time, software has become the *defining* determinant of value.

This is important because software is a nonrival economic good. A rival economic good is one that can be used by one person or one entity at a time. A manufacturing plant, a pen, a car are all rival goods. In contrast, a nonrival economic good—instructions, recipes, ideas—can be passed on to others without any congestion. In fact, the cost of replicating and distributing knowledge-based products is close to zero.⁵ And the rapidity with which value-creating ideas are spread is accelerating the rate of change. Good ideas are still hard to come by, but are cheap and quick to pass along.

So in prior periods, those that controlled physical capital captured the most value. Today, those that control intellectual capital capture the value. (See Tables 2 and 3.) The mental models needed to assess intellectual capital are different from those needed for physical capital. Investors who are slow to transition from one set of models to the other will be at a significant disadvantage in the new millennium.

Table 2
The Richest Americans in History Owned the Means of Production

Rank	Tycoon	Source of Fortune	Wealth as a % of GNP
1	John D. Rockefeller	Oil	1.53%
2	Cornelius Vanderbilt	Steamboats and railroads	1.15
3	John Jacob Astor	Fur trade, NY real estate	0.93
4	Stephen Girard	Shipping	0.67
5	Andrew Carnegie	Steel	0.60

Source: *The Wealthy 100*, Michael Klepper and Robert Gunther.

Table 3
The Richest Americans Today Own Equity in Knowledge Companies
in \$ billions

Rank	Name	Worth	Source
1	Bill Gates	\$58.4	Microsoft Corp.
2	Warren Buffett	29.4	Berkshire Hathaway
3	Paul Allen	22.0	Microsoft Corp.
4	Michael Dell	13.0	Dell Computer
5	Steve Ballmer	12.0	Microsoft Corp.

Source: “The Forbes Four Hundred, The 1998 Richest People in America.” *Forbes*, October 12, 1998.

Here are a few of the mental models we think will be important in the 21st century:

- *Increasing returns.* We count at least five definitions of the term, but two are important here. The first is the idea that knowledge begets knowledge.⁶ Almost all innovations are the result of recombining existing technologies in a novel way. Accordingly, the more building blocks of knowledge that exist, the more potential combinations, and hence the greater the levels of innovation. This means that the companies (and countries) with the biggest pools of knowledge will actually be able to grow the fastest in the future.

The second sense of the phrase relates to returns on capital. Neo-classical economic theory holds that competitive forces drive returns on capital down to the cost of capital over time. This is true for most industries, notwithstanding the short-term benefit of traditional economies of scale. However, knowledge-based products often have high up-front costs and modest costs of replication and distribution. As more and more units are sold, per-unit costs drop and returns on capital rise as incremental units are amortizing off of the high up-front cost. Increasing returns are replacing diminishing returns in parts of the economy.

- *Intellectual property.* One fundamental building block of free market economies is strong property rights. Property rights assure that the owners of capital and resources generate and retain appropriate returns on that capital. And the fact that capital and resources are rival goods means that it is a relatively straightforward task to track ownership.

The link between returns on capital and capital ownership becomes much fuzzier when intellectual capital is the source of advantage. There are a couple reasons for this. First, the process for claiming intellectual property is less developed and less clear-cut than property rights. While the patent process is viable, questions abound about what is novel and unobvious, two criteria for receiving a patent. Further, precedent suggests that ideas cannot be patented.⁷ Second, software can be disseminated—quickly, cheaply and without congestion—in a way that capital can not. This makes software inherently difficult to protect. We believe that investors should carefully watch how the U.S. government deals with the issue of intellectual capital. The current case against Microsoft may provide important precedent—especially for companies that enjoy increasing returns.

- *Accounting.* Our current dual-entry accounting system was developed roughly 500 years ago. It was largely built to track the movement of physical goods for the benefit of creditors. In a world dominated by tangible capital, our currently employed accounting system worked fine. As the source of value creation shifts to intangible capital, however, the system becomes less and less reflective of economic reality. Examples include capturing intellectual capital, large employee stock-option claims, and the expensing versus capitalizing of investments. Investors must be aware that the financial score for the Information Revolution is kept with an outdated system.

As the new millennium begins, it remains the early stages of the Information Revolution. Investors need to evolve their mental models to incorporate the surging role of software as the source of competitive advantage. This strategic task is complicated by the fact that traditional accrual accounting does a poor job of mirroring economic reality.

Decentralization

The human mind loves cause and effect.⁸ This evolutionary adaptation has been useful for most of human existence. Eat something toxic and you get sick. Fail to

protect yourself from a predator and you die. But the usefulness of this neat causality will be much more limited in the future. In an ever-connected world, distributed knowledge is becoming more and more valuable than individual knowledge. The new millennium will see a decentralized mindset triumph over a centralized mindset.⁹

Let's step back. From where did the centralized view emerge? There are really two interrelated sources. The first is scientific and the second social.

First, a scientific perspective. For the vast majority of human tenure, there was very little understanding of how things worked: why the sun rose, why it rained, how babies were created. Humans closed the cause and effect loop by looking to the supernatural. Gods and spirits dictated the goings-on. Every question could be answered by defaulting to a higher force.

Human understanding of the world changed dramatically during the Renaissance (14th through 17th centuries) as modern science started to take shape. Science started to eclipse the role played by religion in its explanation of a great number of physical phenomenon. There was perhaps no more influential scientist than Sir Isaac Newton (1642-1727). Newton described many of the basic physical laws, emboldening scientists to believe, if only tacitly, that any physical phenomenon could be explained if given enough information.

This deterministic approach satiates human desire for cause and effect in a different way. Rather than looking to the supernatural for explanation, it offers (or promises) fundamental determinism in the world. Effects have causes, and they can be described through science.

The centralized mindset also came from the social reality that historically a handful of people controlled information. Those that did—feudal lords, kings, dictators, and industrialists—typically had power. In the absence of efficient means of communication or widespread education, these people had pronounced informational advantages. The holders of information helped shape the destiny of many people. Cause and effect *were* linked.

Over the past century or so, social and physical scientists have been waking to the realization that organization in systems need not be the result of direct cause and effect.¹⁰ The specific observation is that the interaction of many agents, each with local information, often leads to an aggregate system that is smarter than the sum of its parts. These are known as complex adaptive systems (CAS) and a new field of complexity has sprung up to study it.¹¹ Complex adaptive systems are ubiquitous in nature—ant colonies and immune systems are but two examples—and can also be found in structures erected by man. This includes the capital markets in which investors compete every day.¹²

Centralized systems have a great advantage over decentralized systems because they are generally easier to understand. So when economists create their explanations of the world, they have one of two choices: defined models with clean mathematical solutions, or more complicated models with either no answer or many solutions. By and large, economists have chosen models more akin to Newtonian physics than biological reality. Alfred Marshall, often called the father of modern economics, said it this way:

*The Mecca of economics lies in economic biology rather than economic mechanics. But biological conceptions are more complex than those in mechanics; a volume of foundations must therefore give a relatively large place to mechanical analogies, and frequent use is made of the term equilibrium which suggests something of a static analogy.*¹³

We believe there is a widespread move to decentralization. This is not to say that centralized systems do not have a place. Numerous phenomena are still best described by centralized theories. It *is* to say that decentralized thinking has not been given its proper due.

The decentralization march is occurring on multiple levels. The grease on the skids is free markets and a precipitous drop in communication costs. And even though the mental transformation from centralized to decentralized thinking will be hard for many investors, we believe it will be a key investment theme.

We explore decentralized thinking at three levels:

- *Capital markets.* The development of modern portfolio theory over that past 50 years or so represented a significant leap in understanding of how capital markets work. However, equilibrium economics remains at the core of the theory. And in explaining how markets work, many economists have indulged in the “lead steer” theory, a decidedly centralized notion.

The lead steer theory is a metaphor for how stock prices are set. If you want to understand the direction of a herd of cattle, you need not interview each cow. You only have to talk to the “lead steer.” Similarly, in the stock market you need not understand the motivations of the average investor, as they are considered price-takers. It is only the well-capitalized, informed lead steer that matters.¹⁴

We believe the lead steer metaphor, for all of its intuitive appeal, is wrong. There are simply too many stocks and too few lead steers. The setting of stock prices cannot be understood using a centralized framework.

This is not to say that markets are not well functioning mechanisms. They are. But they can best be understood as decentralized systems—more accurately, complex adaptive systems. CAS are comprised of many agents, each with local, or limited, information. A market emerges from the dynamic interaction of these agents. CAS are often called emergent phenomenon. Importantly, the market that emerges has properties and characteristics separate and distinct from the sum of the underlying agents. Additivity does not apply. Order arises spontaneously from the interplay of the agents.

Economists have long observed CAS without formally having a name to attach to it. Adam Smith called it the “invisible hand.” The Austrian school of economics called it “subjectivism.” No matter the moniker, a decentralized model better describes markets.

- *Companies.* For the better part of the past century, companies were organized in hierarchical fashion. Managers had whatever information there was, and they essentially dictated the tasks that needed to be completed. Further, many of the industry’s value-chain activities were done within the corporation. Vertical integration assured control of all phases of production.

The old order is rapidly changing for two fundamental reasons. The first reason relates to a change in corporate emphasis because of the evolution in the economy from capital-based to knowledge-based. Traditional businesses typically focus on optimization: doing what we did yesterday better today, and better yet tomorrow. New Economy businesses are in a constant search for the “next big thing”—the killer application that will dismantle the status quo.

Centralized, hierarchical structures are typically suitable for optimizers. But the quest for the next big thing requires a leaner, flatter organization. Employees need to have incentives to think out of the box (which are usually in the form of stock options). Decentralization is the best organizational structure.¹⁵

The second reason for corporate decentralization is plummeting transaction costs. In a seminal paper written in 1937,¹⁶ economist Ronald Coase noted that firms should perform internally any activity that cannot be performed more cheaply externally. The cost differentials between internal and external activities are attributable to transaction costs, including search, information, bargaining, decision, policing and enforcement costs.

Coase noted that lower costs of performing activities, spurred by innovations such as the telephone and telegraph, would encourage larger firms. And for years that was true. But the rules are changing: transaction costs are dropping so dramatically that it is now cost effective for companies to *outsource* more and more activities. It's not that companies are abdicating responsibility for delivering their goods or services: they remain tethered to their partners through an umbilical cord of information technology. So companies can avoid the costs of largeness, most notably bureaucracy, while still providing the best product possible.¹⁷

One clear illustration of this trend is Dell Computer. Dell effectively out-sources the activities that do not add value. However, the company maintains close ties to suppliers and front-end customer support, creating the look and feel of a large company from a customer's perspective. The company captures the benefit of size without much of the cost of size.

Corporate downsizing is happening fast. (See Table 4.) And an increasingly wired world virtually assures that decentralization will remain a key corporate trend.

Table 4
U.S. Job Creation by Firm Size
1991-95; in thousands

Firm Size (number of employees)	Net Change in Employment
1-4	3,843
5-19	3,446
20-99	2,546
100-499	1,011
500-4,999	193
5,000 or more	-3,375
Total	7,664

Source: *Myths of Rich and Poor*, W. Michael Cox and Richard Alm.

- *Technology.* Technology is also rapidly moving toward a decentralized world. One need look no further than the Internet: a huge, interconnected system with no centralized authority. The extraordinary growth of the Internet, which occurred without the benefit of any planning, is itself a testament to self-organizing principles.

A more mundane example is the evolution in computing power. The modern era of computers can be said to have started in 1959, the year the integrated circuit was introduced. The first creatures to roam the computing landscape were the mainframes, which dominated from the early 1960s to the early 1980s. Mainframes were more of the centralized ilk: they were expensive, had few operators, and few users. The 1970s saw the advent of minicomputers—not as powerful as mainframes but more flexible. Personal computers burst on the scene in the early 1980s, allowing everyone to have a computer on their desk cost-effectively. But decentralization did not kick into high gear until the era of networking, which started in earnest about one dozen years ago.

The future of technology looks heavily decentralized. As broadband Internet protocol services become diffused, there will be little institutional control over technology. Individuals will be connected to one another through a decentralized Web, with no center. Biological metaphors will describe the world better than Newtonian ones. Cause and effect will be more ephemeral than ever.

Globalization

Today, roughly 20% of global output—\$6 trillion of the \$28 trillion world gross domestic product—is produced and consumed in global markets. Within 30 years, 80% of the \$90 trillion-plus in output will be in global markets. This represents a compound annual growth rate of almost 9%, or better than double the rate of anticipated global output growth.¹⁸ Globalization is obviously a significant issue for the new millennium.

Slowly but surely, democracy has been on the rise, and regulation has been declining around the world. These developments, paired with the surge in ever-cheaper information technology, mean that companies will have opportunities in the future that they could have only dreamed of in the past. Specifically, leading companies of the future will have the best the world has to offer: talented labor, large customer markets, the latest technology, and the most efficient suppliers.

The more sober downside is that many businesses, used to competing in largely local or sheltered markets, will be competing against the world's elite. Data from the World Bank and McKinsey suggest that roughly one-third of all industries are globally defined, one-third nationally defined, and one-third locally defined. The integration of global markets, given their magnitude and ferocity, will inevitably create significant volatility and uncertainty.

McKinsey consultant Lowell Bryan and his colleagues offer an interesting framework for considering globalization. They note that arbitrage—the purchase and sale of goods to exploit price inefficiencies—is ubiquitous in financial markets. They argue that arbitrage is going to become mainstream in product markets as well.

Arbitrage in the real economy is based on the exploitation of varying production costs. There are four major factor costs of production: raw materials, capital, labor, and land. Of these, only commodity-based raw materials and capital are priced in global markets. That is, there is one price for the goods around the world (adjusted for transaction and transportation costs).

These real economy arbitrage opportunities are huge. Differences between capital and labor productivity remain significant across various geographies. For example, the capital productivity of Germany and Japan is roughly two-thirds that of the United States. Table 5 shows labor productivity and labor costs across a host of countries. Further, McKinsey estimates that roughly 90% of the world market share and capacity is controlled by companies that have limited capabilities to capture these arbitrage opportunities.

Table 5
Labor Productivity and Costs across Various Countries—1992
 weighted average of four industries: steel, food, retail banking, and telecom

Country	Labor Productivity	Labor Cost
U.S.	100	100
Argentina	46	41
Colombia	38	17
Brazil	32	31
Mexico	31	27
Venezuela	30	14

Source: McKinsey Global Institute.

Accordingly, companies should build strategies based on cross-geographic arbitrage. While capturing these arbitrage benefits will undoubtedly be aided by information technology, the transformation of many sectors will take years, if not decades, to unfold. Further, these arbitrage opportunities require scale. The companies with the best global scale will be the ones that benefit most directly.

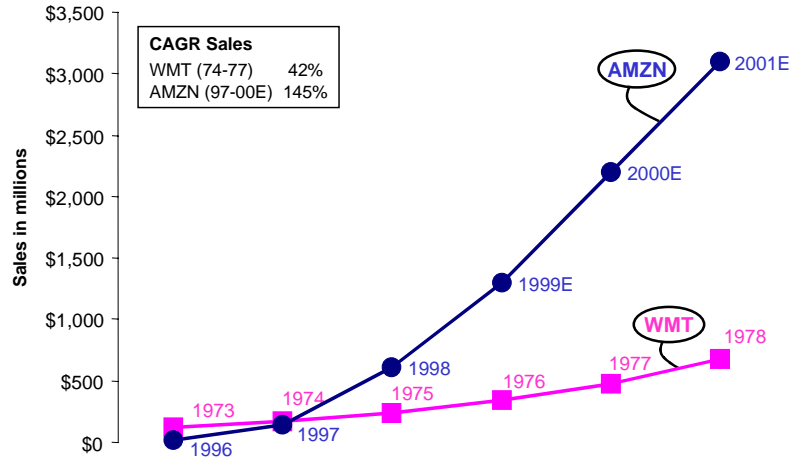
Triumph of Bits over Atoms

There is a mantra of productivity growth that some Wall Street strategists love to chant: capital is replacing labor. While this is an obvious truth in parts of the economy, it obscures the real story of the new millennium: *knowledge is replacing capital as the fundamental driver of value creation.*

Some of the key characteristics of software—costly to produce but cheap to replicate and distribute—were discussed above. Investors need to be sensitive to a few additional points:

- **Scalability.** Scalability refers to the ability to grow sales at a much more rapid rate than costs—including the capital investment needed to support the business. Business models based on the deployment of substantial capital—retailers, for example—have physical barriers to growth. Managers must rapidly, and skillfully, deploy hard assets in order to generate brisk sales growth. Capital-intensive businesses do benefit from economies of scale, but competitive forces generally assure that returns on capital are similar to the cost of capital.
- In contrast, knowledge-based businesses are much more scalable. As intellectual capital is inexpensive to reproduce and disseminate, these businesses can grow rapidly with negligible incremental costs. In the language of economists, marginal costs continue to decline as output increases.
- The result is that intellectual-capital-based businesses are more scalable than are their capital-laden brethren. Some New Economy companies will achieve growth rates well beyond what was conceivable even a half-century ago.
- To illustrate the point, we compared the anticipated growth rates of Amazon.com to the growth posted by Wal-Mart in the early- to mid-1970s. Wal-Mart's sales gains were (and are) tied to new store openings to a large degree. Amazon, in contrast, has relatively modest capital needs and a scalable, front-end Web site. While Wal-Mart posted an impressive 42% compound annual sales growth rate from 1974-77, AMZN is expected to show an even more notable 100%-plus compound annual top-line improvement from 1997-00E. See Figure 1.

Figure 1
Bits Scale Better than Atoms—Growth of Wal-Mart versus Amazon.com

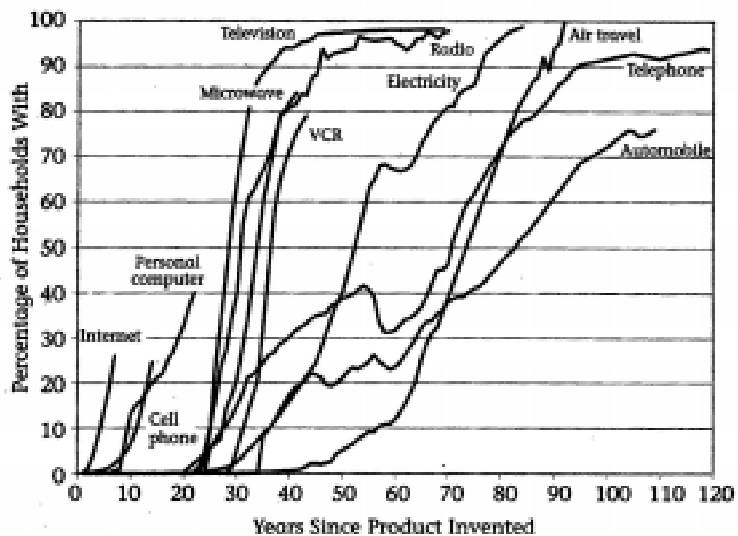


Source: Company published data, CSFB estimates.

- Accelerating rate of economic discontinuity.* Economist Joseph Schumpeter made famous the phrase “creative gale of destruction.” What Schumpeter stressed was that the interesting part of capitalism is the never-ending *change*, a point not sufficiently underscored by equilibrium-based econometric models. That is, dominant companies or industries are always at risk of being unseated by a new technology.

There are two important takeaways. The first is that the speed of change is increasing.¹⁹ In large part, increasing speed has been fed by Moore’s Law, which says that computing power doubles approximately every 18 months. In fact, if Moore’s Law continues to the year 2015 as many experts expect, there will be a staggering 137 billion-fold increase in computing power 55 or so years since the introduction of the integrated circuit. So long as information can be accessed, analyzed, and recombined dramatically quicker and cheaper than before, change will continue at a breakneck pace.

Figure 2
Spread of Products into American Households



Source: *Myths of Rich & Poor*, W. Michael Cox and Richard Alm; Basic Books, 1999.

The second takeaway is that investors in the future should expect higher returns on invested capital (ROIC) than they have ever seen, but for shorter time periods. The elevated ROICs are a function of our accounting system, which fairly portrays tangible assets but does a poor job capturing intangible assets. The shorter time periods, quantified by what we call “competitive advantage period,” reflect the accelerated rate of discontinuous innovation.²⁰ This is in contrast to more traditional businesses, where ROICs tend to be more modest but the franchise more durable. So investors face a new analytical hurdle: higher ROICs for shorter periods of time versus lower ROICs for longer periods of time.

- Harder working physical capital. Our preliminary analysis shows that working capital and fixed capital turnover ratios are increasing steadily in the United States for the largest companies (S&P 500). This means that a given sales level can be attained with a lower capital requirement than in the past. We believe this improvement reflects the implementation of technology. This advancement is being offset, however, by a significant increase in the amount of goodwill on U.S. corporate balance sheets as the result of unprecedented mergers and acquisition activity. Knowledge, then, is showing up in two ways. It is helping use capital better, but it is being capitalized in M&A.
- *More equity-based compensation.* People are the source of competitive advantage in a knowledge-based world. And people want something that physical capital never asked for—a piece of the action. In a market-based society, that means equity ownership.

Equity-heavy compensation is already apparent in some parts of the economy, most notably technology. In Silicon Valley, stock option grants are today the primary form of remuneration. We believe that stock-based compensation will march in lockstep with the evolution to a knowledge-based economy. So while options are not significant for certain industries and geographies today, they will be in the 21st century.

There is also a significant valuation implication. Employee stock options are not thoroughly treated in the standard financial statements. Given that options are a significant employee claim, they must be appropriately valued and treated as the economic liability that they are. For many New Economy companies, employee stock options are worth 10% or more of the equity capitalization.²¹

Practical Takeaways

So what should the practical investor do given these themes? We summarize a few thoughts:

- Be aware of the wide (and growing) chasm between economic reality and accounting convention. As the world economy hurtles from capital-based to knowledge-based, investors are left with outdated tools to assess financial performance. The solution to this is to focus on measures of *cash flow*. In addition, we believe that understanding options—both employee stock options and the real options companies have—will be increasingly important in deciphering value.²²
- Investors must understand technology for a couple of reasons. First, it has become a meaningful component of the investable universe. Thirty years ago, technology comprised about 5% of the S&P 500. Today it is 22% and growing dynamically. So the sector is too large to ignore. Second, technology is affecting *all* businesses, and generally exacerbates the advantage of large companies at the expense of their smaller competitors. Strategic phenomena

such as network effects, increasing returns, high up-front costs and lock-in are also becoming increasingly important to recognize and understand.²³

- Beware the “red queen effect.” Evolutionary biologists dubbed the phrase (based on a scene in Lewis Carroll’s *Through the Looking Glass*) to underscore that evolutionary “advancements” by one species would be competed away by offsetting advancements by its predators or prey. The same holds true in the corporate ecosystem. We believe that much of the value from information technology-driven efficiency will flow to customers, not to shareholders.
- “You can observe a lot by watching.” This line, attributable to Yogi Berra, should always be on the minds of investors. In well-developed capital markets, capital flows to its highest use by industry or geography. While such flows are not always precise, they give a good indication of where future opportunities lie. By this criterion, there appear to be a handful of secular industry winners: technology, health care, and financial services. Each is global, on-trend demographically, and knowledge-based. We believe that the successful investor in the new millennium will have to be well versed in at least two of these groups.

The new millennium promises ongoing, fascinating developments. Most investors spend too much time on day-to-day, noisy activities—conference calls, meetings, and refining outdated models. We believe it is important to allocate a meaningful amount of time to the building and fortification of mental models. This requires wading into various disciplines and a constant search for applicable analogies and metaphors.

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Amazon.com Inc (AMZN, 103.625, Buy)
Dell Computer Corp (DELL, 42.75, Strong Buy)
Wal-Mart Stores (WMT, 62, Buy)

Followed by another CSFB analyst.

¹ Steward Brand, *The Clock of the Long Now*, Basic Books, 1999.

² Jared Diamond, *Guns, Germs and Steel*, WW Norton, 1997.

³ The evolution from agricultural to industrial to information has also provided for improved living standards for successive generations. There is a lot available to a middle-class American today, including health care, housing and transportation, that would have been unthinkable to even the wealthiest people at the turn of the 20th century. By some standards, the quality and quantity of life is better today than it has ever been.

⁴ Federal Reserve Chairman Alan Greenspan recently noted that while today's GDP *weighs* about the same as it did a century ago, it is more valuable by multiple factors.

⁵ Paul M. Romer, "Endogenous Technological Change," *Journal of Political Economy*, 1990.

⁶ Ibid.

⁷ Bill Gurley, "Patent here, patent there, patent, patent everywhere," *Above the Crowd, Fortune*, June 14, 1999.

⁸ Joseph LeDoux, *The Emotional Brain*, Simon & Schuster, 1996.

⁹ Mitchel Resnick, *Turtles, Termites and Traffic Jams*, MIT Press, 1994.

¹⁰ In fact, this idea was well articulated by Adam Smith in the *Wealth of Nations*, originally published in 1776.

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