

## The Information Revolution Wars

Fighting for share of "Digitizable GDP"

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### Highlights

- The quantity of global GDP that ultimately will be "digitizable" will likely surpass today's wildest speculation. Major technological revolutions are *always* bigger than anyone ever thinks: railroads grew 10,000% between 1860 and 1910; car/truck production rose 2,400% between 1908 and 1916.
- Ongoing U.S. GDP shift will see the virtual disappearance of the agriculture, mining and construction sectors, the continued shrinkage of the manufacturing sector, and further growth in the service sector. Services to reach 80-85% of private-sector GDP, 75% of employment over the next 50 years.
- **Information Age versus Industrial Age.** In the era of DGDP, creation, distribution and manipulation of information is central wealth-creating activity.
- **Entrenched versus start-up.** Those resistant to change are most vulnerable.
- **Producer versus distributor.** Internet increases the power of producers, threatens distributors and middlemen that don't add value.
- **E-tailing versus brick and mortar retailing.** Although Net facilitates new entrants, the biggest barrier to entry is distribution.
- **New versus established brands.** Net makes brand-building more difficult. "Infomediaries" threaten some established brands.
- **Gorillas versus monkeys.** While some small Internet "monkeys" will survive, most will be overpowered by the handful of Net "Gorillas."
- **Commoditized information versus proprietary content versus specialized insight.** *Commoditization* of information will be bearish for many traditional providers of information. *Proprietary content* will be valuable *if* consumers pay for it—companies that offer free or low-cost proprietary content on Net risk cannibalizing other revenue sources. Consumers will be willing to pay for *insight* tailored to their specific needs.
- **Paper versus paperless.** Convenience of paper, human nature to prevent a paperless world. *Selective printing* to replace *mass storage* of paper-based content.
- **Cyber space versus real estate.** Net likely results in *lower* demand for *retail* space, *higher* demand for *warehouse* space, unchanged demand for *office* space.

Table 1

**Winners and losers in the Information Revolution Wars****INFORMATION AGE VERSUS INDUSTRIAL AGE**

<b>Winners</b>	Information infrastructure builders	Cisco Systems, IBM, Lucent, Microsoft, Sun Microsystems	Huge demand for info-infrastructure for foreseeable future. WCOM dominates data and Internet backbone. In residential telecom, expect protracted war: ATT + cable allies vs. RBOCs. In near term, owners of both systems to benefit from explosive growth in transmission of content.
	Owners of the network, leading Internet portals	AT&T, AOL, Level 3, MCI WorldCom, Microsoft, Nextel, Qwest, Time Warner, Yahoo	
<b>Losers</b>	Commodity producers	Coal, gasoline, glass, iron, lumber, rubber, steel companies	Information revolution making economy less commodity-intensive.

**ENTRENCHED VERSUS START-UP**

<b>Winners</b>	Early adopters; firms with strong brand but limited geographic reach	Amazon.com, AOL, Costco, Dell, eBay, Gap, Mattel, Office Depot, Priceline.com, Sotheby's	Start-ups understand capabilities; entrenched firms must leverage their market power but be willing to cannibalize their business.
	<b>Losers</b>	Firms with heavy legacy costs	
	Newspapers	Central Newspapers, Dow Jones, Knight Ridder	Web facilitates expansion of capacity at relatively low cost. Newspapers lose classified ads to the Net.

**PRODUCER VERSUS DISTRIBUTOR**

<b>Winners</b>	Manufacturers and service providers with strong market positions	Carnival, Dell, Disney, Estee Lauder, Tommy Hilfiger	Manufacturers can sell directly over the Web or use Web intermediaries. Even if they choose latter option, their bargaining power rises. But only strongest brands benefit as Web-based "infomediaries" are gaining market influence by acting as "brand arbiters." Airlines and auto insurers save by selling directly over Web.
	Efficient auto insurers and airlines	Allstate, AMR Corp, Geico (Berkshire Hathaway), Progressive, Sabre Group	
<b>Losers</b>	Appliance & PC retailers; department stores with weak market positions	Best Buy, Circuit City, CompUSA, Sears	Distributors and middlemen risk being disintermediated.
	Broadcasters	For big broadcasters, potential weakness at TV networks offset by strength elsewhere: ABC (Disney's proprietary content), CBS (radio), NBC (GE's diversified businesses)	Distributors of entertainment, such as TV networks and video rental stores, will lose control of distribution and face more competition.
	Consumer lenders	Household Intl, MBNA	Net makes loans cheaper, easier to originate.
	Catalog-based industrials	Sigma Aldrich, W.W. Grainger	Internet will sharpen competition, reduce prices.

**E-TAILING VERSUS BRICK AND MORTAR RETAILING**

<b>Winners</b>	Companies with strong brands and sophisticated distribution systems.	Abercrombie & Fitch, Ann Taylor, Costco, FDX Corp, Gap, Home Depot, Lowe's, Office Depot, Staples, Talbots, Tiffany, Victoria's Secret (Intimate Brands), Wal-Mart, Zale	Retailers with strong brands can use the Web as yet another channel to serve customers, who can order goods either for home delivery or pickup at a store. The real barrier to entry is the "back-end"—fulfillment—not the Web site itself. Catalog retailers that already have "pick-and-pack" technology are likely to be acquired.
	Companies with fragmented supplier bases		
	Catalog Retailers	Lands' End, Lillian Vernon, Spiegel	

<b>Losers</b>	Retailers with weak brands (relative both to competitors and to suppliers); retailers that are hard to shop	Charming Shoppes, Federated Dept Stores, Gadzooks, K mart, Ross Stores, Saks, Sears, TJX Companies	Stores with weak brands, that are perceived by consumers to add little value, may be disintermediated by suppliers and should face more competition as Web increases industry capacity. Hard-to-shop and hard-to-get-to (e.g., mall-based) stores will be less successful in taking orders on the Web for pick-up at the store.
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## NEW VERSUS ESTABLISHED BRANDS

<b>Winners</b>	Radio  Lifestyle brands	Clear Channel, Infinity Broadcasting, Yahoo  Gap, Gucci, LVMH, Starbucks, Tiffany	Web companies are building brands by advertising on radio. And Web radio's commerce and advertising revenues should grow rapidly. Infomediaries will act as "brand arbiters" that help consumers pick the best products. Lifestyle brands are less at risk because consumers have a visceral affinity for them.
<b>Losers</b>	Product-based brands, retailers of product-based brands	Federated Dept Stores, Saks	When consumers use infomediaries to help them pick products (rather than accepting what retailers offer), they will be introduced to products that are better / cheaper than the "leading brand."

## GORILLAS VERSUS MONKEYS

<b>Winners</b>	Net Gorillas	AOL, Microsoft, Yahoo	Gorillas' dominance is only likely to increase as they acquire or co-opt some competitors, others drop out.
<b>Losers</b>	Net Monkeys	Hundreds of ".com" IPOs	

## COMMODITIZED INFORMATION VERSUS PROPRIETARY CONTENT VERSUS SPECIALIZED INSIGHT

<b>Winners</b>	Proprietary content cos Selected consumer banks Processing banks Top-tier brokers and insurance firms	Disney, Time Warner Bank One, Citigroup, Wells Fargo Bank of New York, State Street DLJ, Hartford Life, Merrill Lynch, Morgan Stanley Dean Witter, Nationwide Financial	Web aggregators will become info-utilities, dispensing huge amounts of data for free. Certain banks will lead the way in consumer cyber-banking, leaving competitors behind. Financial processors will benefit as Web reduces costs. Top-tier insurance firms and brokers will get paid for services tailored to each client's needs, while Web cuts costs.
<b>Losers</b>	Information vendors	Dow Jones, Reuters	As information becomes a free commodity, traditional vendors and newspapers will be hurt. Most banks will fall behind the leaders in cyberspace, and will be hurt by much sharper pricing for mortgages, credit cards, etc.

## PAPER VERSUS PAPERLESS

<b>Winners</b>	Computer printers, digital copiers	Lexmark, Xerox	Paper consumption is slowing as information is stored as bits and bytes, and printed out as needed, off of the Web and other networks. This is bullish for digital printers and copiers but bearish for commercial printers.
<b>Losers</b>	Commercial Printers	Bowne, R.R. Donnelley	

## CYBER SPACE VERSUS REAL ESTATE

<b>Winners</b>	Warehouse REITs	AMB Property, EastGroup Properties	Manufacturers selling directly to consumers will need warehouses scattered around the country.
<b>Losers</b>	Retail REITS	Developers Diversified Realty, Glimcher Realty	E-tailing puts "power centers" selling commodity products (such as books, music, cheap clothing) at risk. But large "destination" malls will still be popular.

## Digitizing GDP

There's a lot more to the Information Age, and a lot more substance too, than the multitude of ".com" IPOs that have been flooding the market. More than just a communication tool, the Internet is a revolutionary new technology that redefines the concept of "content." "Content" is no longer just the information that heretofore has been delivered via traditional media—i.e., in books, movies, recordings, etc. Thanks to the Net, "content" is becoming any portion of global GDP that can be digitized. In the process, the Net is empowering both the *creators* and the *distributors* of "content." And the Net is also facilitating the easy delivery of "content" to anyone who can access the Web.

"Content" that includes:

- Communication between people and people, between people and organizations, between organization and organization.
- Information about a manufactured good: the size, color, style of an article of clothing; the voltage, frequency, wattage of an electronic device; the specifications of *any* manufactured product.
- The location of a shipload of goods in transit: from manufacturer to distributor, from distributor to end-user or, for that matter, from *any* source of output to *any* recipient.
- Any and every aspect of the global output of goods and services that can be digitized.

As global output of goods and services is bifurcated into "digitizable" and "non-digitizable," the amount of digitization that ultimately takes place will likely surpass even today's wildest speculation. This process of digitizing a substantial portion of the global output of goods and services—hereafter referred to as DGDP (Digitizable GDP)—will create opportunities for those companies that facilitate the digitization, as well as for those companies whose portion of GDP makes the transition to DGDP.

Digitization will *not* be positive for the companies threatened by the growth of DGDP, or that are outmaneuvered by competitors who seize the digitization opportunity. In other words, get ready for the Information Revolution Wars, as companies fight for share of DGDP.

### The Information Revolution . . .

The Internet represents Phase II of the Information Revolution. Phase I consisted of the *digitization of individual enterprises*, which created networks of increasingly ubiquitous computers—mainframes in the 1950s and 1960s, mini-computers in the 1970s and 1980s, and PCs in the 1980s and 1990s.

Table 2

### Results of The Information Revolution Wars

1. Creation, distribution and manipulation of Digitizable GDP is central wealth-creating activity.
2. Information is commoditized, but proprietary content and specialized insight are scarce resources.
3. Technological progress fosters benign deflation.
4. Most industries' capacity can be expanded at relatively low cost.
5. A less commodity-intensive economy.
6. A new, more efficient business model: low volatility, low margins, high turnover.
7. Excess inventories need never exist.
8. A further/finer division of labor, combined with international labor arbitrage.
9. A 24-hour global work-day.
10. A "silicon age" of higher productivity, rising *global* living standards.

Source: PaineWebber.

Though extremely important, this process mainly sped up *traditional ways of doing business*. Executives might save time by drafting a document on a PC rather than a typewriter, but then they dropped it in a mailbox as they always had, rather than e-mailing it.

In Phase II of the Information Revolution, electronic devices will proliferate and will all be digitally linked. And, as we wrote in "Converging Technologies" (September 1, 1997), in the information age "it is *the creation, distribution and manipulation of information that is the central wealth-creating activity*."

The U.S. GDP shift involving the shrinkage of the agricultural economy, the decline of the manufacturing economy and the growth of the service economy will continue (Chart 1). That ongoing shift will see the virtual disappearance of the agriculture, mining and construction sectors, the continued shrinkage of the manufacturing sector, and further growth in the service sector. Private-sector employment trends will mirror GDP trends (Chart 2). Agricultural employment will almost disappear, while manufacturing employment will shrink as technological progress creates fewer but ever more efficient and higher-value-added/higher-paid jobs. The Information Age is the era of the ever-higher-value-added worker.

### . . . and its two industrial predecessors

The best way to appreciate the sweeping impact of the Information Revolution is to glance back at two earlier

revolutions that created the modern industrial economy as it existed at the time of World War II.

The **First Industrial Revolution** erupted in England in the late 18th century and spread to the U.S. and other countries during the 19th century. The essence of the Revolution was, in the felicitous phrase of Harvard historian David Landes, “the substitution of machines—rapid, regular, precise, tireless—for human skill and effort.” Its emblematic achievements were the mechanized factory driven by water or steam power; the coal-burning steam engine; the railroad; and the rise of a modern steel industry that permitted the wholesale substitution of metal for wood.

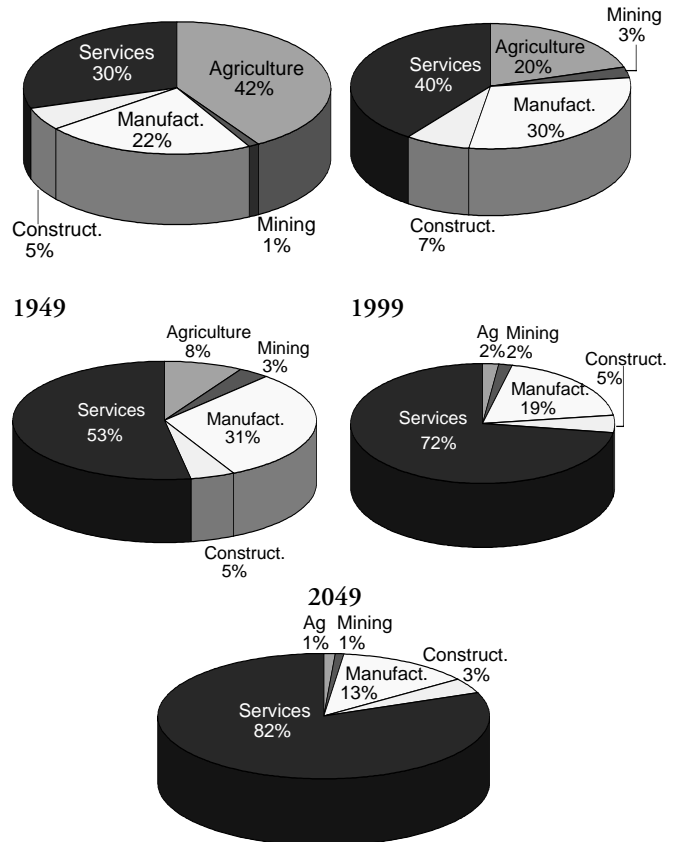
Railroads did to the industrial economy what the Internet is doing to the information economy—making it faster and more efficient.

Particularly in the U.S., where a vast economy was divided by mountain ranges, the rise of the railroad was a critical component of the First Industrial Revolution. *Railroads did to the industrial economy what the Internet is doing to the information economy—making it faster and more efficient.* Entrepreneurs grew rich by using the rails to devise more productive business models in areas such as grain marketing, retailing and manufacturing.

The railroad left few industries unaffected as it carried the First Industrial Revolution across the continent. During the second half of the 19<sup>th</sup> century, manufacturing’s share of U.S. GDP rose from 22% to 30% while agriculture’s share shrank dramatically, from 42% to 20%. On the other hand, this does *not* mean that the U.S. suddenly became an “industrial” society. In 1899, fully 43% of American workers still labored in agriculture. Presumably, farming’s share of output fell faster than its share of workers because productivity growth lagged in farming.

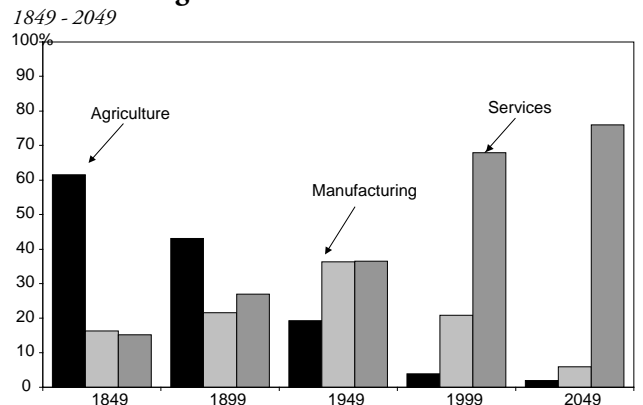
In the **Second Industrial Revolution**, which occurred between 1880 and 1930, the U.S. economy shifted from steam engines and water power to gasoline and electricity. As a consequence, mechanical power became ubiquitous in most dimensions of daily life, including communications (the telephone), lighting (the electric light replaced kerosene and coal oil), refrigeration (electric refrigerators replaced ice), entertainment (radio, phonographs, and motion pictures), and transportation (autos and electric streetcars replaced horses in local transportation and began to supplant railroads in long distance travel). In addition, factories gradually shifted from steam power to electricity, which increased flexibility and efficiency and led to the modern assembly line. As a consequence, there was a quantum leap in manufacturing productivity during the 1920s.

Chart 1  
**Share of private-sector U.S. GDP**  
Current prices; excludes government  
1849



Source: U.S. Bureau of Economic Analysis and *Historical Statistics of the United States*, p. 239; PaineWebber estimates.

Chart 2  
**Share of U.S. employment: agriculture, manufacturing and services**



Source: U.S. Bureau of Labor Statistics and *Historical Statistics of the United States*, p. 139; PaineWebber estimates.

## Lessons from the First and Second Industrial Revolutions

In the Appendix to this report, we describe in detail the First and Second Industrial Revolutions. Here are seven key lessons to be learned from them:

- ***Bigger than anyone thought.*** It is easy to underestimate the magnitude of Revolutions. By 1910, railroads were hauling *99 times* as much freight as in 1860 (i.e., they grew by about 10,000%), and their employee count increased by a factor of 23. And investors underestimated the popularity of autos, which were initially considered playthings of the upper class that would have limited economic impact. When Billy Durant, founder of General Motors, remarked that the auto industry would be producing 500,000 cars within a few years, George W. Perkins, a senior partner in J.P. Morgan and Co., exclaimed that such an idea was preposterous. Perkins advised Durant to stop mouthing such nonsense if he wanted financial aid. In 1908, the year that Perkins dispensed this piece of wisdom, 65,000 cars and trucks were produced; eight years later the figure was 1,617,708—more than three times Durant’s forecast.

Revolutions are bigger than anyone ever thinks. Railroads grew by about 10,000% in 50 years; car and truck production rose 2,400% in just eight years.

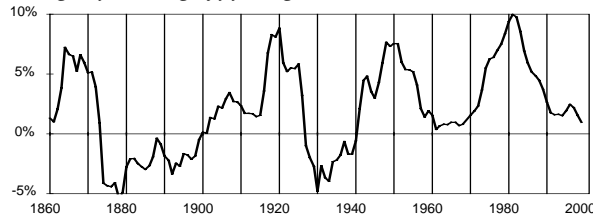
- ***Even revolutions take time.*** Railroads were introduced in the U.S. in 1826, but their full impact was not evident until the 1880s, fully 60 years after they were introduced. And although electricity was commercialized in the 1880s, the real payoff in terms of raising industrial productivity came in the 1920s. The Information Revolution fits this mold; computers were commercialized in the 1950s, but the most dramatic productivity improvement is coming from the commercialization of the Internet in the 1990s.
- ***Unexpected side effects.*** The ultimate impact of industrial revolutions is remarkably pervasive and multifaceted. Who would have thought that the introduction of railroads would reshape Wall Street, give rise to Chicago’s commodity futures market, change the organization of retailing, and lead to the creation of four “time zones” in the U.S.? Or that the introduction of electricity would eventually lead to the invention of the assembly line?
- ***Benign deflation.*** It is no coincidence that inflation was remarkably low, or even negative, in the 1880s, 1920s, and 1990s (Chart 3). In each period the U.S.

economy benefited from an Industrial Revolution that drove down prices for two reasons. In the revolutionary industry itself, the unit price of a key product—overland transportation in the 1880s, electricity and roadway travel in the 1920s, computing power in the 1990s—plummeted. By expanding markets and raising productivity, this in turn reduced costs in other parts of the economy, which lowered the price level further. This was *benign deflation* that fostered *rising living standards*.

Chart 3

### Wholesale prices in the U.S.

Rolling 10-year average of y/y changes



Source: U.S. Bureau of Labor Statistics and *Historical Statistics of the United States*, p. 200.

- ***Bigger, better markets.*** In a capitalist economy, the most profound changes are those that alter the way markets function. The Industrial Revolution occurred first in England because its manufacturers served the largest, most prosperous markets. Railroads transformed the U.S. economy by slashing transport times and expanding markets, which in turn created a host of business innovations, ranging from mail-order retailing (Sears, Roebuck) to mass-produced cigarettes (American Tobacco) to long-distance trade in refrigerated meat (Swift Premium). The Net will transform markets as much or even more.
- ***Greater division of labor.*** Better markets do not only restrain inflation by improving price competitiveness; they *unlock resources* that are unemployed or underemployed. As Adam Smith pointed out, “The Division of Labour is Limited by the Extent of the Market.”
- ***New corporate models.*** The railroad enabled manufacturers to accelerate the flow of raw materials into, and finished product out of, factories, which in turn forced entrepreneurs to cultivate a mass market that could absorb the torrent of goods. Shorter transport times cut inventory/sales ratios, thereby raising return on capital. Entrepreneurs like Andrew Carnegie who perfected this new model could cut costs, boost market share, and make a lot of money. Similarly, electrification of factories led to assembly lines because shop floors could be geared to optimize labor productivity rather than energy use.

### The Information Revolution creates a new model

Like its predecessors, the Information Revolution will create a different and better economy—a genuinely new model, not just a more efficient version of the old model. Instantaneous, low-cost, digital communication *will make markets much more efficient, leading to lower inventories and greater division of labor*. More and more products will be “made to order” (as **Dell** now makes computers), reducing the need of manufacturers to guess what demand will be. And the Web will render “unsold inventory” nearly obsolete; goods that sell poorly in a store, or cabins on a cruise ship that is about to set sail, will be auctioned over the Web to a global market.

The Information Revolution will lead to a finer division of labor; in addition, excess inventories need never exist.

This will prove to be a boon to emerging economies; all sorts of merchandise that is hard to unload in developed economies—ranging from used machinery to unfashionable or out-of-season clothing—will find buyers, at much reduced prices, in countries where customers are poorer but less picky. In the wired economy, better markets mean minimal waste.

Just as important as better product markets is more efficient *labor* markets. As noted, Adam Smith observed, “the Division of Labour is Limited by the Extent of the Market.” As the Internet connects them with a global market, “knowledge workers” will be able to specialize in their area of greatest expertise, meaning that customers pay less for the best:

- A cardiologist who currently treats many types of heart disease but is particularly expert in ventricular arrhythmias will be able to focus on that problem, interpreting digital data that is e-mailed to her from doctors around the world.
- An accountant who is expert at leveraged leasebacks of office buildings can specialize in such transactions.
- The Web will also permit extensive international labor market arbitrage with, for example, a software firm in Seattle drawing on the services of software programmers in India and Ireland.

Just as the railroads created the novel concept of a “time zone,” so will the Information Revolution change our conception of time by replacing the traditional “9-to-5 local workday” with “a 24-hour global workday.” You can review blueprints at 1:00 A.M. in New York, e-mail your proposed revisions to your colleague in London, go

to sleep, get into the office by 8:30 the next morning, and immediately review the e-mailed response of your co-worker (who has had five hours to review your comments after getting to work at 8:30).

These various benefits of the Information Revolution will produce a multifaceted productivity explosion that may elude economists because “productivity growth” is usually defined as increases in output *per hour worked in the workplace*. Much of the Internet’s payoff comes from reducing inventories, eliminating the waste of unsold goods, and enabling service workers to specialize in what they do best—i.e., improve the quality, as well as the quantity, of output.

Yet another key benefit is to make *consumers* (not just workers) more efficient because they can easily shop, compare prices and retrieve information from the Web. Though these various benefits will make the economy more efficient, less inflation prone and less cyclical, they are not likely to be accurately measured in the Labor Department’s official productivity figures.

Yet another key benefit is to make *consumers* (not just workers) more efficient because they can easily shop, compare prices and retrieve information from the Web.

From a corporate perspective, the Information Revolution will reconfigure corporate operations, likely changing key financial ratios as follows:

- A lower ratio of inventories to sales.
- A higher ratio of sales to assets.
- Higher sales per employee.
- A lower ratio of profits to sales (i.e., profit margin) as markets become more competitive.
- Less earnings volatility, as inventory swings become less pronounced.
- Slightly more financial leverage, as a less cyclical economy renders debt less risky.

How these various changes affect such ratios as return on assets and return on equity will vary from firm to firm. However, it is instructive to compare the ratios of the S&P Industrials with those of the preeminent Web-based manufacturer at the present time, **Dell Computer** (Chart 4). What is most striking is that Dell’s asset turnover (i.e., sales divided by assets) is three times that of the S&P Industrials; mainly for this reason—but also because of a somewhat higher profit margin—Dell’s return on equity is much higher.

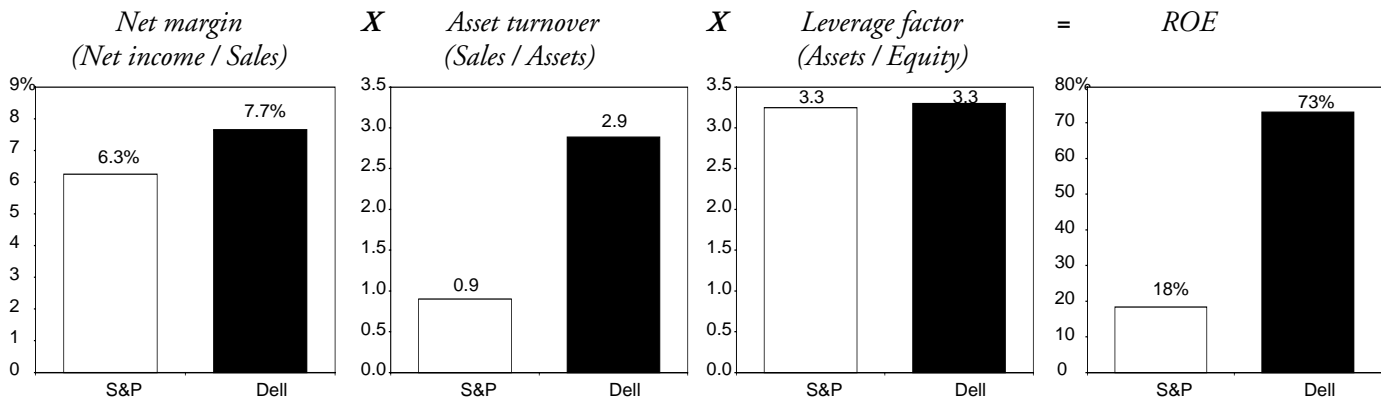
**The Information Revolution wars**

The First and Second Industrial Revolutions were violent upheavals marked by many simultaneous “wars” between competing interests, technologies and business models (Table 3). So too will the Information Revolution witness many wars in which some firms perish while others flourish. In the pages that follow, we analyze the wars of the Information Revolution; key outcomes are summarized in Table 2.

Chart 4

**A new model: High asset turnover gives Dell a much higher ROE than the S&P Industrials**

Analysis of profitability



Source: PaineWebber.

Table 3

<b>The wars of the First and Second Industrial Revolutions</b>			
<b><u>The First Industrial Revolution</u></b>		<b><u>The Second Industrial Revolution</u></b>	
Wood	Iron	Coal gas light	Electric light
Iron	Steel	Direct Current	Alternating Current
Decentralized sweatshops	Centralized factory	Steam-powered factory	Electricity-powered assembly line
Turnpike	Canal	Horse-drawn "omnibus"	Electric streetcar
Canal	<b>Vs.</b> Railroad	Electric streetcar	<b>Vs.</b> Automobile and bus
4 ft. 8½ inch gauge railroad	5 ft. gauge railroad	Steam-powered car	Electric car/ gas-powered car
Mail	Telegraph	Telegraph	Telephone
Country store	Catalog retailer	Newspaper	Radio
Urban shopkeeper	Department store	Vaudeville show	Motion picture

Source: PaineWebber.

## 1. Information Age versus Industrial Age

The Information Revolution is pushing the economy into the Information Age, when capturing and effectively exploiting information is the key to improving customer service, and therefore corporate performance. By revolutionizing the way businesses interact with customers, the Internet is transforming business models and the competitive position of industries and companies.

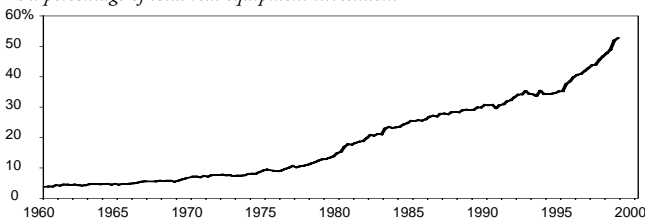
The Information Revolution contrasts with the First and Second Industrial Revolutions, when the competitive landscape was altered by innovations in transportation, not communication. The difference has enormous implications for *commodity producers*. Building the railroad, streetcar and auto industries generated enormous incremental demand for materials, ranging from lumber (for railroad ties) to iron and steel (for rails, rolling stock and, later, autos) to coal (to power railroads and steel mills) to gasoline, glass and rubber.

By contrast, the rise of the information economy is not generating much *incremental* demand for most commodities. And information devices are getting smaller, which makes them even less commodity-intensive. To be sure, the creation of the DGDP economy *is* the driver of capital spending; in 1998 over 50% of business fixed investment in equipment involved data processing (Chart 5). However, nearly all the value-added resides in the technology itself, not the commodities. In this sense, too, we are truly in an era of DGDP, with most of the value-added in capital goods tied up in R&D rather than materials. This decline in the importance of commodities in the economy is reflected in the changing composition of the Dow Jones Industrial Average (Chart 6).

Chart 5

### Information processing

As a percentage of total real equipment investment

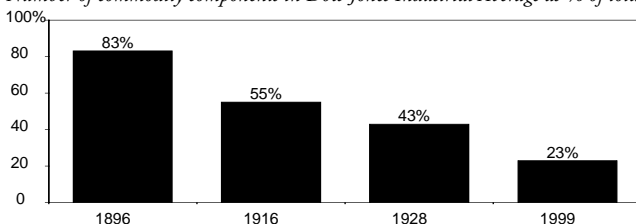


Source: Bureau of Economic Analysis.

Chart 6

### Commodity companies as a % of DJIA components

Number of commodity components in Dow Jones Industrial Average as % of total



Source: Dow Jones, PaineWebber.

Information devices are getting smaller, which makes the information economy even less commodity-intensive.

### The New Industrials

The companies that are building the DGDP economy are the “new industrials.” Like Carnegie Steel, Ford Motor Company and General Electric, they are *building the infrastructure for the DGDP economy*. The New Industrials are one of the very best ways to invest in the DGDP Revolution. There is not a large retailer, manufacturer, financial institution or government agency that can avoid moving onto the Web—whether or not the investment is profitable in the near term.

Companies that build the DGDP infrastructure should enjoy explosive unit growth over the next decade. Among the best positioned: **Cisco Systems, IBM, Lucent, Microsoft and Sun Microsystems**. These are all powerful and profitable companies with strong positions in fast-growing markets.

### The owners of the network: Cable versus copper

The New Industrials are involved in building networks; at the end of the day a large part of America’s data network is likely to be controlled by a handful of firms including:

- **MCI WorldCom**, the leading provider of network services to business. (Some observers expect WCOM to jettison its consumer telecom business in order to focus on the faster-growing and more lucrative business data segment. In addition, WCOM has been in talks to buy **Nextel**, the remaining independent national wireless company.)
- A few large RBOCs.
- **AT&T**, which will own or be allied with a number of cable companies. AT&T is buying MediaOne, has acquired Tele-Communications Inc., entered into a joint venture with **Time Warner’s** cable operation and forged an alliance with **Microsoft**.
- A number of large cable companies.

AT&T and the cable operators will be competing head-to-head with the RBOCs over the household sector, with each firm offering a bundle of services including:

- Local and long-distance phone service.
- Wireless phone service.
- Internet access.

Today, households choose among communications providers for these services, with their decisions being influenced by factors such as cost, availability and speed of a service (Table 4).

Table 4

**Six routes to the Internet**

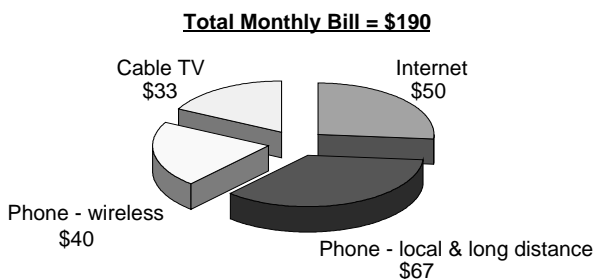
<i>Service</i>	<i>Availability</i>	<i>Typical monthly cost</i>	<i>Typical maximum performance (downstream/upstream)</i>	<i>Pros</i>	<i>Cons</i>	<i>Recommended for</i>
<b>Dial-up</b>	Universal	\$20	56 kbps/ 33.6 kbps	Cheap, easy to install, available everywhere	Slow service that ties up a phone line while you surf the Web	People who can't obtain or afford other options; notebook-toting travelers
<b>ISDN</b>	Widespread	\$50-\$130; may require extra per-minute and/or per-hour charges	128 kbps/ 128 kbps	Twice the speed of 56-kbps modems—plus fancy phone service features like call handling	Costly, relatively slow, and prone to setup hassles; usually does not support always-on connection	Small-office and home users who need better-than-dial-up speed and can't get DSL or cable
<b>Satellite</b>	Widespread	\$50 (for 100 hours)	400 kbps/ 33.6 kbps	Good downstream speed, available to anyone with a clear view of the southern sky	Uses dial-up for upstream connections; installation is complex	Business and home users who can't get other high-speed connections, especially in rural areas
<b>Cable</b>	Limited	\$30-\$65	1-5mbps/ 33.6 kbps-2.5 mbps	Where available, it's currently the cheapest way to get a continuous high-speed connection	Most businesses aren't wired for cable, you can't choose your ISP, and shared-node system may lead to security and speed problems	Telecommuters, home-office types, and Web surfers; companies in areas where business-specific plans are offered
<b>DSL</b>	Very limited	\$49-\$1,200	144 kbps-8 mbps/ 64 kbps-8 mbps	Turns your ordinary phone line into a fast connection that's always on	Still very sparsely deployed and often costly; most versions require installation by a technician	Small offices that can't justify frame relay or T1, and for home users who can't get cable
<b>Frame relay and T1/T3</b>	Widespread	\$300-\$3,000	56 kbps-45 mbps/ 56 kbps-45 mbps	Business-oriented high-speed services backed by speed guarantees and quick repair	Too expensive for most small companies and residential users; requires costly, complex hardware	Medium-size to large businesses that can afford the cost—and can't afford service problems

Source: *PC World Magazine*.

Chart 7

**Sticker shock**

Potential monthly bill for typical household



Source: PaineWebber estimates.

Ultimately, the companies hope that, when customers are receiving all these services from just one provider and receiving just one bill per month, “churn” rates will decline. Currently, the churn rate (i.e., percentage of customers lost each quarter) is 10% in the long-distance market and 8% in the wireless market, and customer acquisition costs amount to 15% of the providers’ total costs.

One risk in bundling is sticker shock. At today’s prices, a household with typical service for local, long distance, and wireless telephony, as well as standard cable and high-speed Net access, could well receive a monthly bill of close to \$200 (Chart 7). However, the economies of scale that come from bundling should mean that a package of these services from one particular provider will

cost less than if a consumer buys each of the services from a separate supplier, hence the likely emergence of a few dominant suppliers of these bundled services.

A key issue for many observers today is which system is better for sending high-speed digital data into the home: the phone companies (i.e., RBOCs) or the cable companies? Some critics argue, for example, that cable is handicapped by the fact that, as more cable modems are added to a neighborhood line, all these users share the same bandwidth. In other words, the on-line habits of your neighbors determine your actual throughput.

Two other issues to consider are:

- The sector is highly regulated, making the success of corporate strategies partly dependent on the decisions of bureaucrats and legislators;
- While demand is growing explosively, so is industry capacity. Young companies such as **Level 3** and **Qwest Communications** are building new, state-of-the-art trunk lines. The carrying capacity of U.S. long-distance trunk lines is forecast to grow 360% between 1999 and 2001.

It seems that, at least for the next few years, there will be no clear winner in the battle of cable versus phone lines, *with the owners of both systems benefiting from explosive growth in the transmission of "content."*

### **PC and TV converge but don't merge; telephony is absorbed into both**

While there will be many smart devices in the Information Age, most of which will perform several functions (compute, communicate, entertain, etc.), the PC will be the only device which performs all of these functions easily and efficiently (Figure 1). But, as we argued in "Converging Technologies," the PC will be used *primarily but not exclusively* for "work," i.e., to *actively* get information rather than to *passively* receive information.

It is for this key reason that, *although they will converge, the PC and TV will not merge.*

- High-quality digital video will be best delivered on large TV screens. You will want to watch multimedia output on large high-definition TVs, with the sound coming from five-speaker, "surround sound" stereo. Consequently, sports, movies and images of the latest news will be viewed on the largest device possible, given the household's constraints of space and financial resources.

The PC and TV converge but don't merge.  
Telephony is absorbed into both.

- Newspapers, e-mails and static images (such as pictures and illustrations) will be displayed on dedicated personal computing and display devices—the natural evolution of today's PC. (You may want to watch a DVD movie on a 42" plasma TV display, but you won't want private e-mail on view.)

However, the TV and the PC will move much closer together in several ways. First, every TV will come equipped with a built-in Web browser. Second, many Web sites will transmit television over the Internet, as presently evidenced by both MSNBC and CNNfn, which are using both audio and video streaming to provide a television-like experience over the Net today.

As for telephony, it will merge with the PC and TV. There will ultimately be just one wire (be it copper or cable) that brings content to the user. Voice-only input/output will be minor functions of both PCs and TVs (telephony functionality is already built into many modems today). Traditional telephone conversations are merely another source of audio input. But it is unlikely that video calling will ever replace voice-only calling. Video invades privacy far more than voice-only.

### **Microsoft versus Everyone**

Microsoft is superbly positioned to prosper in the era of DGDP, because it controls the operating system for the PC and is also a leader in Web content. No wonder it has the largest market value of any U.S. stock. But as Microsoft gets bigger, it becomes a bigger target; Bill Gates certainly does not lack for enemies.

### **Microsoft versus Linux**

Recently, *The New York Times* (February 21, 1999) claimed that if you accept the argument of the global confederation of volunteers behind Linux, the free operating system, then "Microsoft Corp. has no reason to exist." The skeletal code of Linux was created by a student who couldn't afford to buy a commercial version of Unix. The program is constantly being worked on by programmers, hobbyists and other Linux devotees around the world.

While Linux is popular in academic circles, the *Times* noted that it "runs on only about 7 million computers worldwide, [and] has a long, long way to go before it makes a dent in Microsoft's 250-million-plus empire. And despite its growing popularity, Linux is still too complicated for the average nonideologically motivated computer user" (Chart 8).

Figure 1  
A map of the highways to the Information Age

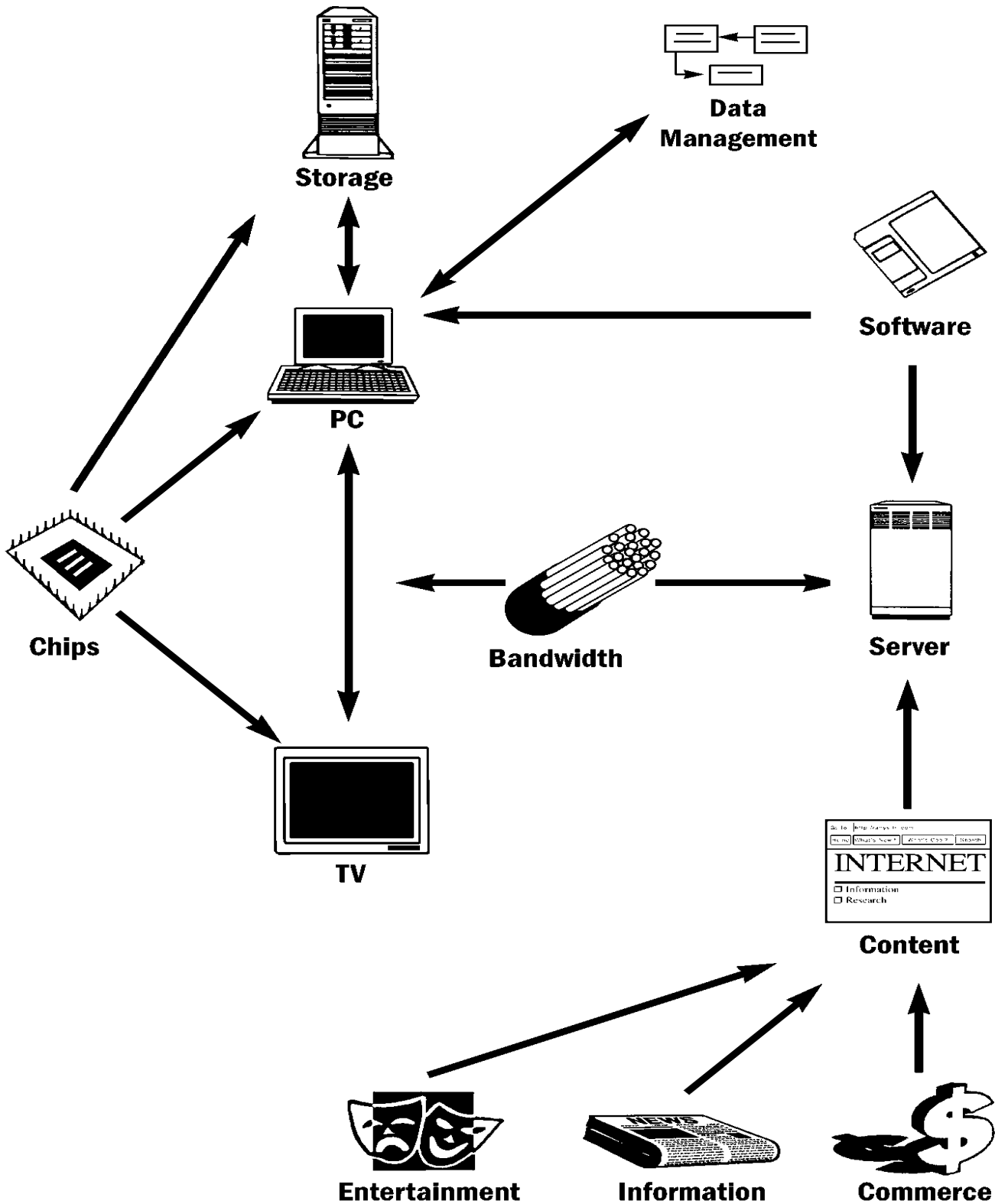
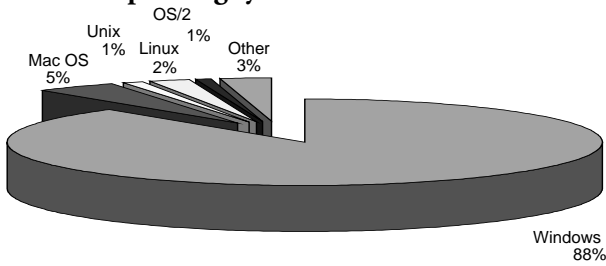


Chart 8  
Share of operating systems



Source: International Data Corporation.

Linux poses less of a threat to Microsoft than does Java, discussed below. Linux is primarily a low-end operating system for PCs, but the trend in the era of the Net is toward more scalability, more reliability and more support. Or, in other words, towards a product like Windows 2000, which will offer Microsoft's powerful NT technology base to both clients (PCs) and servers.

**Microsoft versus Java**

Java's potential threat to Microsoft is that Java software can run on any kind of computer or device, regardless of the operating system. Java fans have envisioned it as the foundation of the NC—or network computer—which would allow users to get on the Internet and download “applets” of information on an as-needed basis from a central server and not require the resources of a fully configured PC.

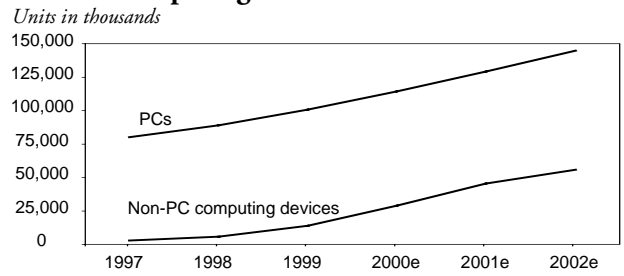
However, as we pointed out in “Converging Technologies,” “given that the evolution of PCs to date has consistently been in the direction of more powerful devices with more memory and increased local storage, a move toward widespread adoption of network appliances would represent a sharp change in direction.”

Obvious deficiencies of a NC include:

- No storage means complete dependence on connection to a network—if the server goes down, the entire network goes dark.
- Lack of portability.
- It costs money to connect to and access programs and data on networks—telephone connection charges, monthly Internet provider fees, and fees for processing and storing data on Internet servers.
- PCs are now cheaper than NCs.

A central fact is that *Microsoft has already won the PC war*, and—because the NC does not present a significant challenge to the PC—this is likely to remain a very valuable franchise for Microsoft. The issue now is who wins the next war over non-PC computing devices, such as set-top boxes for TVs, smart phones, etc. (Chart 9).

Chart 9  
Non-PC computing devices



Source: International Data Corporation.

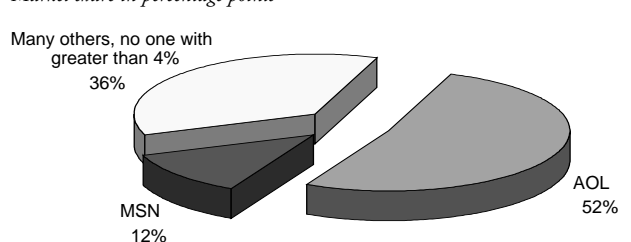
For Microsoft, non-PC computing devices are an important potential source of *incremental* revenues. The company's key offering in this area is Windows CE. Following their recent agreement, **AT&T** will increase its use of Microsoft's Windows CE-based operating system software in its digital set-top boxes, through which AT&T expects to manage its high-capacity cable links to customers.

But even if Java did become a widely used technology, that would not necessarily be a huge negative for Microsoft. The software giant would still enjoy a preeminent position as a PC kingpin, as well as the leading provider of server operating systems—thanks to the growth in e-commerce, this is a very rapidly expanding market. In addition, there is always the very real possibility that Microsoft might simply outmaneuver Java, as it has many other challengers.

**Microsoft versus AOL, YHOO, etc.**

With its potential to attract increasing numbers of eyeballs to MSN.com, Microsoft's status as a leading ISP and Internet portal continues to gain momentum (Chart 10). This initiative could force changes in the business strategies of competing ISPs, portal companies and content providers, as they attempt to stay ahead of the 800-pound gorilla. While Microsoft's Internet model is still evolving, the goal is for MSN.com to become the ultimate destination site for consumers on the Web as well as the preferred location for e-business to set up on the Web, and for Microsoft to become the preferred Web tool supplier. Essentially, the company is attempting to extend its “suite strategy” to the Web by providing a broader solution than anyone else on the Net.

Chart 10  
Internet service providers



Source: International Data Corporation.

In this regard, the company currently offers:

- **E-mail.** *Hotmail* is Microsoft's free e-mail service.
- **Shopping.** Microsoft wants to establish MSN.com as the Web's premiere marketplace, by making the shopping experience effective and convenient. Recent announcements of the *Passport* service (a digital wallet and personalized shopping page) and the acquisition of *CompareNet*—the leading product comparison Website—are big steps towards that end. And *CarPoint* is the leading auto-buying Web site.
- **News.** *MSNBC* is among the leading news sites.
- **Entertainment.** The *Gaming Zone* is the Web's most popular gaming site.
- **Services.** *Expedia* is the leading travel reservation site, while *MoneyCentral* is a popular personal finance site.

The company will likely continue to make acquisitions to expand this portfolio of products and to reinforce MSN.com's position as a site that offers "one-stop shopping" for consumers on the Web. At the moment, only AOL has as broad a product offering. While Microsoft will never dominate the Web as it dominates the PC market, power on the Net is clearly concentrating in the hands of a few players such as Microsoft and AOL.

Unlike AOL, however, Microsoft still has not worked out how to make money from its Web content—even though MSN.com is the second most visited Web site. But—in a classic "razor and razor blade" model—Microsoft *does* make money selling the software to build the Web infrastructure. However, whether it is through an advertising, subscription or e-commerce model, the Web should eventually become a major source of revenue.

### *Microsoft versus the Justice Department*

The Justice Department's antitrust case against Microsoft is set to resume, with Microsoft's rebuttal witnesses getting a chance to speak, followed by closing arguments on both sides. A ruling is expected over the summer. If Microsoft loses the case, it is likely to appeal the verdict, which would then extend the final verdict for years.

Some observers think that Microsoft would win on appeal as it would be very difficult to prove that Microsoft's actions have hurt consumers. But even if MSFT lost, it seems that the courts have limited options as to how to reduce MSFT's "monopolist" status. A theoretical option would be to disaggregate the company into, say, five mini-Microsofts, but this would probably reduce efficiency and hurt consumers. Other possibilities including breaking Microsoft into an operating system company and an applications company. But the more likely outcome is for minor changes in MSFT business policies, such as more public pricing data and OEM contract terms disclosure.

## 2. Entrenched versus start-up

The Internet threatens many existing businesses because:

- New business models can be created that challenge established players. As **Amazon.com**'s success has illustrated, this is particularly true in the case of commodity products (such as books, music and videos), which is bearish for the traditional "bricks and mortar" retailers of these products (such as Barnes and Noble, Borders and Musicland).
- Companies can move into entirely new business lines. For example, manufacturers can sell directly to consumers, which, as discussed below, is bearish for traditional vendors of "white goods" such as department stores.
- The Net eliminates geographic boundaries that kept competitors out of a market. **Costco** has stores in only 24 states, but its Web site has generated sales in all 50 states.
- Companies that skillfully leverage the Web gain a competitive advantage; thanks to its Gap.com Web site, **Gap** is clearly at the forefront in e-tailing.

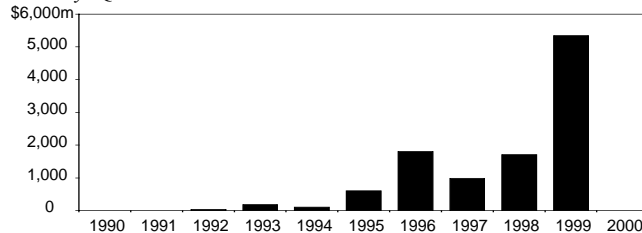
More generally, the Web threatens entrenched businesses because it *facilitates the expansion of industry capacity at relatively low cost*. Web sites are inexpensive to build (though, as discussed below, the warehouses needed for "fulfillment" of e-commerce orders are as costly as ever), and Web start-ups have access to cheap capital (Chart 11).

The Web threatens entrenched companies because it facilitates the expansion of industry capacity at relatively low cost.

Moreover, so far investors don't seem to care whether Web companies fail to make money, but they will clobber the stock of an entrenched competitor whose earnings weaken because of Internet competition. (Interestingly, this is a double-edged sword; financiers are bankrolling so many cyber-startups—four online drugstores, for example—that cyber-industries are fragmented and weaker than if there were only one or two players.) Yet another advantage of Web start-ups is that they do not have huge legacy costs, such as leases.

Chart 11  
Capital raised by Web start-ups

Annually, Q1 1999 annualized



Source: Securities Data Corporation.

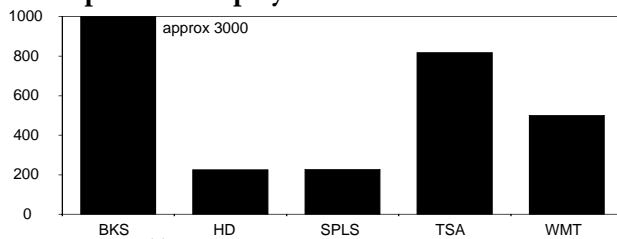
These following five Net advantages explain why Web start-ups pose a threat to many entrenched businesses.

## 1. Better service

The Net enables time-pressed consumers to find exactly what they are looking for at a particular retailer's Web site in a short period of time *and at any time*. In many areas of retailing, huge stores offer overwhelming choices of products, but few salespeople (Chart 12). Obviously, e-tailers that offer comprehensive and easy-to-use Web sites will be at an advantage over those who don't.

Chart 12

### SKUs per store employee



Source: PaineWebber estimates.

## 2. Greater efficiency

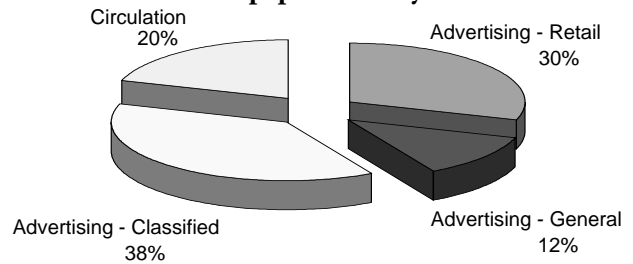
The Net is the perfect medium for matching buyers with sellers. Indeed, in the era of DGDP, *excess inventories need never exist*. The online market will set a price at which a shirt, an electric appliance, an airplane seat, or any good or service will be sold. (And it's not just the makers or suppliers of a good or service that will have an incentive to sell the surplus stock. *The Financial Times* [April 10] reported that one eBay user regularly visits her local furniture store to ask the owners if they have stock that is not selling. If they do, she agrees on a price and asks them to put the goods on hold for a few days. She then posts an offer to sell the goods on eBay with a reserve price *slightly above the deal agreed with the furniture store.*)

Two companies that are exploiting this capability are **eBay**, the online auction site which sells thousands of collectibles, and **Priceline.com**, the company that allows would-be fliers to "name their price" for travel between any pair of cities. By radically lowering transaction costs, both companies are expanding markets and generating transactions that never would have occurred in the off-line economy. (And note that, while it's hardly a Web start-up, venerable auction house **Sotheby's** is using the Net to more efficiently match buyers and sellers of fine art.)

This is bad news for newspapers, which generate about a third of their revenue from classified ads (Chart 13). Thanks to interactive and search capabilities, the Net is an excellent location for a new generation of classified services. Newspaper companies such as Central Newspapers, Dow Jones and Knight Ridder are vulnerable to the Net threat.

Chart 13

### Breakdown of newspaper industry revenues



Source: PaineWebber.

## 3. More information

The abundance of information that the Net makes available offers consumers solutions to problems. For example, a chain such as **Lowe's** can put on their Web site a whole library of informative "how-to" brochures offering step-by-step advice on everything from installing a sink to laying down a kitchen floor. Each brochure would have links to the relevant part of the store catalog, so as you read along you can put the necessary parts in your shopping cart.

## 4. Easy comparison shopping

In the off-line world, the cost (in terms of time and effort) of directly comparing products or services is often very high. The Net vastly simplifies comparison shopping by allowing consumers to either check out products for themselves or use a "neutral broker" such as Microsoft's CompareNet. CompareNet enables consumers to compare products feature for feature and dollar for dollar, as well as read unbiased product reviews and participate in online discussion groups.






## 5. The Zagat effect: When process creates content

Zagat, the popular restaurant guide, is a compilation of the comments of readers. The Zagats "data mine" the experiences of diners in order to generate valuable content. It is this unique process that creates the proprietary Zagat content.

This "Zagat effect" partly explains the appeal of **Amazon.com** and **America Online**. Amazon has figured out how to convert the purchase decisions of customers into proprietary content that appeals to other customers. If you click on a book, you are informed that customers who bought this book also bought these three other titles. Click on that book and you get the same information again. In a few clicks you can find out which are the most widely used books on a subject. Similarly, part of AOL's proprietary content is its own community of chatrooms.

Figure 2

Each time the retailing business model has changed, a new group of leaders has emerged

1950s-1960s	1970s	1980s	1990s	2000
Main Street	Malls	Discounters	Category killers	E-tailers
				

Source: PaineWebber.

### The challenge facing incumbents

Historically, established companies have done a poor job of fending off the threat of new technology. For example, each phase in the development of the computer industry was dominated by a different company—IBM for mainframes, Digital Equipment for minicomputers, Dell and Compaq in PCs.

Similarly, since World War II, with each new generation of shoppers there has been a fundamental shift in the retailing paradigm. Baby boomers' parents shopped on Main Street in the 1950s. The boomers themselves hung out in malls in the 1970s. Boomers' teenage kids headed to the superstores and category killers in the 1990s. Again, *each time the business model changed, a new group of leaders emerged*. Woolworth never really escaped Main Street. Sears, for the most part, remains stuck in the mall. K mart was blindsided by the emergence of the superstore (Figure 2).

The same is happening again today. Of course, the Web won't replace off-line retailing, but it will raise customers' expectations about convenience, speed, comparability, price and service. Retailers who fail to acknowledge consumers' desire for e-tailing will be at a disadvantage. Further, the argument that consumers will not buy goods they cannot see or touch simply isn't valid.

After all, the first virtual retailer is over a century old. One hundred years ago the biggest retailer in the U.S. was Sears Roebuck because, for most rural consumers, mail order was the only way to get quality and variety cheaply. Shopping without touching was part of the culture of the prairie settlers, and it is likely to be common to a great many Americans again soon, *but only under the aegis of a respected vendor or agent*.

Companies in other industries that, for cultural reasons, are resistant to change are vulnerable too. In filmed entertainment, for example, there has also been a paradigm shift in how the generations watch a movie. In the 1950s, baby boomers' parents went to a movie theatre at a specified time. In the 1980s, boomers watched videos via their VCR, at a time that was convenient to them. In the 1990s, the boomers' teenage kids can instantly order a movie via cable or satellite.

Companies that are solely distributors of content, rather than creators of content, are clearly vulnerable.

The Net will not replace going out to a movie, or plunking yourself down in front of the TV for a night of entertainment at home. But it will offer consumers many more choices in how to be entertained. Traditional media companies, which oftentimes are slow-moving agglomerations of businesses, must be open to new technology if they are to compete effectively with Web-based entertainment. **America Online** has already captured many eyeballs during prime-time viewing hours, at the expense of the broadcast networks. Companies that are solely distributors of content, rather than creators of content—such as broadcast TV networks—are clearly vulnerable.

### Authentic revolutionaries versus cannibals

Established companies are at a structural disadvantage when they battle "authentic revolutionaries" who grew up using the new technology. The key decision-makers of most incumbents do not adequately understand either the new technology or the business/consumer culture that grows up around it. The problem is not stupidity or complacency. Very few people can shed a lifetime of experience and acclimate themselves to a radically new way of doing things. And it is hard for incumbents to recruit the workers who understand the new technology.

Entrenched companies should respond to the Web by becoming cannibals, even if they hurt the bottom line in the short term.

So how should entrenched companies respond to the Web? *By becoming cannibals who are willing to embrace innovations even if they hurt the bottom line in the short term.* This seems reckless and irresponsible, but time is short and incumbents have less control of their customer base than they believe. Not only will they establish a market position early, but top management will get invaluable “on the job training” in the new technology.

Companies should also focus on the question, “How can we use this technology to improve service for our customers?” Some successful “early adopters” of the Web, such as **Costco**, **The Gap** and **Office Depot**, have viewed it as one more way to reach customers and generate sales—as something that is complementary to their basic business. And, partly by using the Net, **Mattel** is attempting to transform itself from a ‘plain-vanilla’ manufacturer of toys (such as Barbie and Fisher-Price), into a leader in entertainment software and interactive toys. Following its acquisition of *The Learning Company*, Mattel is the number two maker of consumer software after Microsoft.

### 3. Producer versus Distributor

Although each industry and company must be analyzed on a case-by-case basis, it is broadly true that the Web increases the power of producers. Some distributors and middlemen will be “disintermediated” as producers communicate with customers over the Web and, in some industries, deliver product as well. (**Dell’s** direct model has revolutionized the way PCs are sold, at the expense of companies such as Best Buy, Circuit City and CompUSA.) This will shake up a host of industries, creating new risks for many firms but opportunities for others.

Elsewhere we discuss the impact of the Web on retailers, but one thing is clear: Certain manufacturers with strong brand names will use the Web to sell direct to consumers. Recently, PaineWebber analyst Jeffrey Edelman noted:

“Levi Strauss and Whirlpool . . . have chosen to set up their own e-tailing sites as opposed to having their products sold online through a traditional merchant. For retailers such as J.C. Penney and Sears, who are seemingly large buyers of both of these popular brands, this blockage could have a significant impact on their online traffic and revenue.”

The longer-term risk could be that it impacts their *in-store* revenues as well—especially if manufacturers offer a discount to Web shoppers. Shoppers might stop by Sears to compare refrigerators, and then, in the comfort of their den, buy one on the Web. Obviously, this is bad news for Sears but a positive for Whirlpool and Maytag. And for some items, shoppers will likely bypass the retailer entirely and buy directly from the manufacturer, especially when the manufacturer has a stronger brand name than the distributor: e.g., **Estee Lauder** and **Tommy Hilfiger**.

Figure 3  
Producers versus distributors



Source: PaineWebber.

The Net offers all sorts of disintermediation possibilities in many industries. In the financial sector, consumer lenders such as Household International and MBNA are at risk because the Net is increasingly enabling consumers to use a search mechanism to find the lowest price for a given financial product. While, as discussed below, many financial products that are complex (e.g., life insurance), or that require face-to-face interaction (e.g., portfolio planning), are unlikely to migrate to the Net, it is already the case that many mortgages are obtained without any human interface. Similarly, auto insurance is likely to be a big seller on the Net, given the straightforward nature of the product. Efficient auto insurers such as **Allstate**, Geico (owned by **Berkshire Hathaway**) and **Progressive** will likely capture significant sales directly over the Net.

The Net also facilitates less obvious forms of disintermediation. For example, whereas previously a **Disney** cartoon may have prompted a parent to go to a toy store and buy a Disney product, now that parent can shop directly from Disney.com.

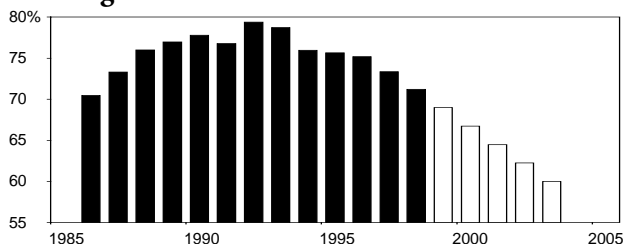
#### *Cheaper airline tickets*

For airlines, the Web is reducing costs and slightly improving margins. Four years ago, travel agents sold 78% of domestic airline revenue; today the figure is 71% and, by our estimates, is headed toward about 60%, much of which will be handled by on-line agents rather than traditional agents (Chart 14). Airlines pay \$35 to sell a ticket through a traditional agent, \$18 to sell through an Internet agent, and only \$5 if they sell it directly over the Internet.

The \$17-\$30 savings from selling a ticket on line is big, when you consider that the average gross profit on an airline ticket is about \$30. This saving will be divided between the companies and their customers—an example of how, as productivity rises, both profits and consumers' real incomes can rise. Note that **AMR Corp.** particularly benefits from the shift to Internet booking through the Travelocity business, which is 100% owned by **Sabre Group**, in which AMR owns an 82% stake. Similarly, **Carnival Corp.** can use its Web site to effectively lower its operating costs by allowing customers to directly book cruises, thereby lowering the company's commission costs to travel agents.

Chart 14

#### **Travel agents' share of domestic airline revenue**



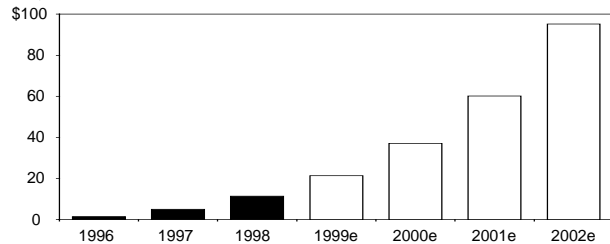
## 4. E-tailing versus Brick and Mortar Retailing

For established retailers, the Web represents both a threat and an opportunity (Chart 15). The theoretical threat is that a new company backed by venture capitalists can create a presence on the Web and steal customers.

Chart 15

#### **E-commerce sales (business to consumer)**

In \$ billions



#### *A new sales channel for an established distribution system*

Does this mean that established retailers are “dead ducks?” Not at all. PaineWebber's specialty retail analyst, Aram Rubinson, recently wrote:

“Most people believe that the barriers to entry on the Web are relatively low and that the biggest barrier is marketing or brand awareness. We couldn't disagree more. There are barriers to entry on the Web, and marketing is one of them, but the biggest one by far is distribution.”

It is because of this distribution issue that Rubinson thinks that **Office Depot**, for example, has a huge advantage over potential Web start-ups:

“In addition to a relatively easy-to-use front end, officedepot.com has 700 stores and 30 distribution centers at its fingertips. Some of those facilities are incredibly complex and took Office Depot 11 years to build. We therefore submit that creating a front end to leverage a sophisticated back end is far easier than creating a back end to support a relatively nascent front end.”

#### *The catalog advantage*

While it only takes \$5-10 million to build a pretty good Web site (and the actual operation of the Web site can be outsourced) what is difficult is actually creating a warehousing and distribution system that will deliver the order, correctly and on time (with **Federal Express** being a popular choice of deliverer). This requires the “pick and pack” technology *used by catalog retailers*, which is fundamentally different from a warehousing operation that is normally sending out a full box or full pallet of an item to a store.

Although the Net facilitates new entrants, the biggest barrier to entry in retailing is distribution.

Three implications:

- It is easier for companies that already have catalog operations, such as **Office Depot**, **Staples**, **Talbot's** and **Victoria's Secret**, to go online.
- Some established retailers with weak logistics and distribution are at a big disadvantage when it comes to e-tailing. Federated Department Stores recently bought direct merchandiser and catalog company Fingerhut in an effort to expand the Internet sales of its flagships, Bloomingdale's and Macy's.
- Other catalog retailers are likely to be acquired by big retailers who need pick-and-pack distribution systems. Potential acquisition candidates include **Lands' End**, **Lillian Vernon** and **Spiegel**.

However, companies dependent on catalogs for sales must make the transition to the Web to survive. Compared to the Web, paper catalogs are more expensive to produce, much harder to use and are usually out of date by the time they are printed. The risk for entrenched firms like Sigma Aldrich, a maker and distributor of chemicals used in labs, is that competition will become keener, and pricing much sharper, when Web-based suppliers such as Chemdex enables researchers to easily compare prices on thousands of products on a real-time basis. Another industrial company heavily dependent on a bulky catalog is W.W. Grainger.

### *Dissed?*

As noted, retailers run the risk of being disintermediated by manufacturers who sell direct over the Web. Because it cuts out a layer of distribution, this should lower costs and reduce prices. However, the degree of risk depends on the retailer; it is quite low where:

- The retailer has its own distinctive product line (**Gap**, **Tiffany**, **Victoria's Secret**).
- The retailer has a *stronger brand image* than the products it sells. Everyone knows **Home Depot**, **Lowe's** and **Staples**, but who knows the names of the companies who make the lightbulbs, paperclips, file-folders, etc.? And, even if they did, who would want to go to all those separate Web sites to buy home and office supplies? **Zale** is another company that has a stronger brand image than the products it sells.
- The retailer adds value to the retail experience via, for example, a respected fashion sense (**Abercrombie & Fitch**, **Ann Taylor**, **Gap**) or by offering customers a very wide range of products and services (**Costco**, **Wal-Mart**).

These are various aspects of the same phenomenon: adding value. Retailers that add value to the shopping experience will have heavily trafficked Web sites and will win repeat customers so long as they deliver the goods (literally). But where the retailer is merely an extra layer in the distribution chain, it is at risk.

- As noted, major retailers of "white goods" risk being disintermediated.
- So do department stores that have a weaker brand name than the product lines they carry—Federated, Saks.
- Hard-to-shop and hard-to-get-to (e.g., mall-based) stores will be less successful in taking orders on the Web for "pick-up at the store"—e.g., K mart.
- Also vulnerable are retailers with a weak brand and that add little to the shopping experience—Charming Shoppes, Gadzooks.
- Off-price retailers—Ross Stores, TJX Companies—face the risk that the manufacturers of the products they sell set up their own Web sites.

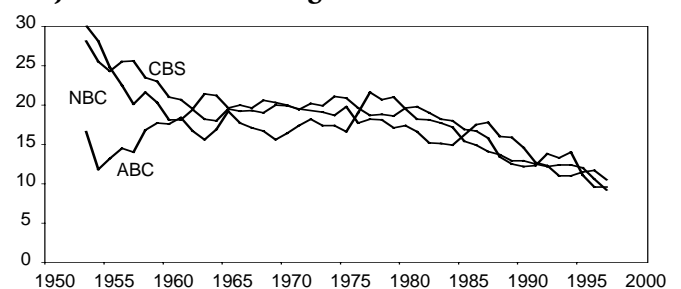
## 5. New versus established brands

In "The New Millennium American" (September 7, 1998) we noted that:

"One source of brand dominance is that the fragmentation of American media makes it increasingly tough to build a new brand. Instead of buying time on popular TV shows such as "Bonanza" or "Dallas" to reach America's great middle class, marketers now have to advertise on the major networks, many cable stations, and the Internet—and they still won't reach the consumer market as effectively as before. As PaineWebber analyst Chris Dixon puts it, 'brand is king in the consumer cacophony.'"

This fragmentation of American media has been one of the factors behind the steady decline in the ratings of the major TV networks (Chart 16).

Chart 16  
Major TV network ratings



Source: Nielsen Media Research.

Although the Web can be an effective medium for reinforcing *existing* brands, the Web creates challenges for firms trying to build *new* brands:

- It further fragments media, making it harder for an advertiser to reach a large audience.
- A key element of brand building is a campaign that creates a “warm and fuzzy” feeling about a product. The Net is not well suited to this, because most consumers mainly use the Net to actively get information rather than to passively receive it.
- A PC’s small screen can quickly become cluttered with too many advertisements.

The Net further fragments media, making it harder for advertisers to reach a large audience.

### *Radio wins from Web brand building . . .*

In “The New Millennium American” we discussed the concept of “time deepening”—instead of doing just one thing at a time, people do two, three, or even four things at once. As we noted in that report, the radio is an excellent time-deepening device:

“Once upon a time, when radios were bulky appliances, the family sat around the radio in the evening and listened to ‘The Shadow’ or a Brooklyn Dodgers game. By the 1950s they listened to radio while driving a car; today they listen to the radio while driving and making phone calls.”

The time-deepening capabilities of radio is why it is an ideal medium for Web companies seeking to build brand awareness. In particular:

- Two thirds of radio listening occurs outside of the home, most often in the car, where listeners are receptive to new information.
- For Web companies, radio is a complementary medium, rather than a competitive one (e.g., you can surf the Web and simultaneously hear on the radio an ad for an interesting Web site, but it’s difficult to surf and watch TV at the same time).
- Radio is a good forum for “warm and fuzzy” advertising campaigns that support brand-building by Web start-ups.

Consequently, over the next few years, radio companies such as **Clear Channel** and **Infinity Broadcasting** should benefit from a new category of Web advertisers seeking to promote their brands via this complementary medium.

### *. . . and from the Web*

In addition to Web brand building, the Net also benefits radio by facilitating the creation of Web radio stations. Such stations have two key advantages over traditional broadcast models: listener personalization (i.e., listeners can customize their own channel by choosing the artists they want to hear) and excellent reception.

While broadcast radio has been slow to embrace the Net, Web radio is growing rapidly—about 1,000 U.S. stations now Webcast, up from about 500 a year ago. (“Webcasting” simply means translating broadcast signals into the digital language of the Web.) Two factors in particular have spurred the growth of Web radio. First, the rollout of high-speed phone and cable lines, as well as improved software, is fostering better sound quality. Second, and perhaps more important, is **Yahoo’s** recent purchase of Broadcast.com—by far the largest Webcasting service with 385 stations.

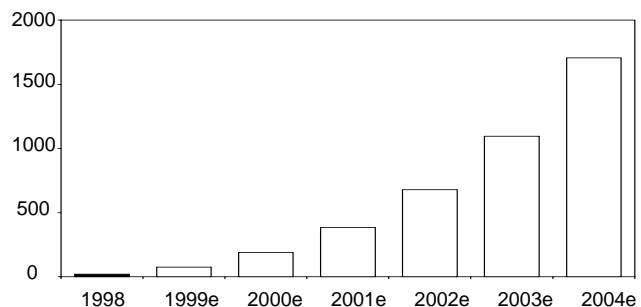
The two main revenue sources that Web radio offers are commerce and advertising. Web radio allows stations to leverage a loyal base of local listeners and advertisers into ways to boost electronic commerce. For example, Web radio enables listeners to respond immediately, and purchase a CD they just heard with the click of a mouse.

But the real payoff from Web radio will likely be advertising. A good example of the potential here is the experience of **Clear Channel’s** six-station group in Orlando. This site draws about 4 million listeners each month, with so many surfers clicking on ads for vacation time shares or concert tickets after hearing the radio spots that the group plans to increase its Web ad rates. For the industry as a whole, Net-related ad and commerce sales are expected to soar from \$76 million this year, to close to \$2 billion in just five years (Chart 17).

Chart 17

### **Web radio’s trajectory**

Revenues; dollars in millions



Source: *USA Today*, Paul Kagan Associates.

*How Net infomediaries could become new brands*






Yet, even though established brands have an *initial* advantage over established brands, longer term, the Net could *threaten some established brands* because, as discussed above, it makes comparison shopping much easier. Today there are two constraints that make many brands valuable, both of which have to do with scarce resources:

- Limited information about vendors,
- Limited “shelf space” for access to products or services.

This control of information and distribution has, up until now, allowed brands to charge more. But, with that information and distribution available cheaply over the Net, market power is reduced and brands that charge too much, or have weak products, will likely have problems. For established brands, it will be a tricky balancing act—maintaining a brand franchise that commands a price premium without that price premium eroding the brand value.

Figure 4

The evolution of infomediaries

Store	Paper	Cyber space
  	  	  

Source: PaineWebber.

There will be lots of “infomediaries” on the Net that systematically assess products and decide, in a totally objective manner, which are best. Institutions that performed the function of infomediaries have been around for a long time, but the Net will allow the development of faster and more sophisticated ways for consumers to compare products, systematically and continuously:

- Department stores can be considered the first infomediaries in that they did the “work” for the consumer in choosing the products that offered the best combination of price and quality. Today, **Costco** and **Wal-Mart** have become premier infomediaries because they have a reputation for offering the best products available for a given price.
- *Consumer Reports*, *JD Power* and *Morningstar* have long acted as paper-based infomediaries. However, there tends to be a “gap” between reading the report

and buying the product; on line, you will be able to read an infomediary’s article on cameras, and then, in just a click, purchase the model they rank highest.

- Lately, Web portals, such as **Yahoo**, whose *Yahoo Store* initiative lets surfers comparison shop and order products, have sought to become Net infomediaries. While, in theory, any Web site could be an infomediary, only those with a solid reputation and an easy-to-use format should do well. As well as **Yahoo**, **America Online**, **Amazon.com** and **Microsoft** are likely to emerge as the leading Net infomediaries.

Because they facilitate comparison shopping, Infomediaries are a particular threat to retailers selling *product-based* brands, which includes most department stores. But companies that offer *lifestyle brands* should be less vulnerable.

“Lifestyle brands” express a certain attitude towards life, which the owners of the brand can export into a variety of different areas. Consumers are buying a philosophy of life, not just a product that can be compared with other products. Examples of “lifestyle brands” are:

- **Gap**, one of the preeminent brands in casual apparel.
- **Gucci**, which designs, produces and distributes high-quality personal luxury accessories and apparel, and **LVMH Moët Hennessy Louis Vuitton**, which is involved in the production and distribution of wines, spirits, luggage, leather goods, perfumes, beauty products and fashion. (Note that LVMH has been trying to acquire Gucci.)
- **Starbucks**, whose products are synonymous with a sophisticated, socially responsible, yet free-spending “Yuppie” lifestyle.
- **Tiffany**, the internationally renowned designer and retailer of fine jewelry and gift items.

**6. Gorillas versus Monkeys**

Of course, the best way to build name recognition and establish a brand is to give your product away for free. This is what cigarette and razor blade companies used to do, and it is what many tech companies are doing today:

- Hardware is free. FreePC.com is giving PCs away.
- Software is free. Microsoft probably instigated all of this, when it started giving its Web browser away.
- Services are free. It seems that everyone—from **Yahoo** to the Republican National Committee—offers free e-mail.

There are essentially five reasons why a Net company will give a product or service away for free:

- To generate ad revenue by attracting a large number of eyeballs. (FreePC.com is subsidizing its PC giveaways through advertising and other revenues.)
- To thwart another powerful player (this was **Microsoft's** strategy versus Netscape).
- To attract consumers who will, hopefully, become profitable customers sometime in the near future. (While it isn't giving products away for free, **Amazon.com** has been willing to incur losses in order to establish itself as the preeminent Net retailer.)
- As a way to collect demographic information. Most everyone who signs up for a freebie is required to provide, at a minimum, their age, sex and zip code.
- As a way to build loyalty. In the case of e-mail, for example, someone who affiliates their name with a company's and comes to the site often to check mail will not only reinforce the connection with that brand, but spread its name to fellow correspondents.

While some "monkeys" will survive and become profitable niche businesses, most will be overpowered by the three Net "Gorillas"—AOL, MSFT and YHOO.

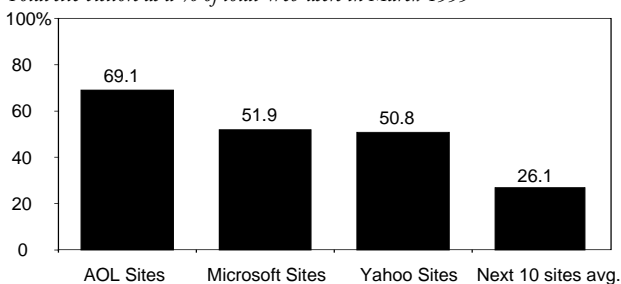
Many small companies are battling for a place on the Web by giving something away for free. But while the "barriers to entry" are remarkably low, the barriers to *profitable prosperity and growth* on the Web are extremely high. As we wrote in "Net for Naught" (May 10, 1998):

"Some companies will enjoy rapid sales growth over the next few years, *but this will not translate into sustainable long-term earnings growth*. And, given the intense competitive pressures, many other companies will *not be able to sustain either sales or earnings growth*. So the key issue for many of these stocks is *not valuation but, rather, survivability*."

Chart 18

### Percent of surfers visiting the three "gorillas"

Total site visitors as a % of total Web users in March 1999



Source: Media Metrix.

While some "monkeys" will survive and become profitable niche businesses, most will be overpowered by the three Net "Gorillas," namely:

- **America Online**, which reaches 70% of all Internet users via its AOL and Netscape sites. AOL has a superior business model because, instead of relying only on advertising and hyper-competitive Internet commerce, it gets \$21.95 per month from 17 million subscribers.
- **Microsoft's** MSN has a solid reach as a portal, and the company has a blue-chip brand name, very deep pockets, superior execution capability, a plethora of Web offerings, and a unique opportunity to link its Internet sites with its application software.
- **Yahoo**, which has solid reach and is rapidly reaching the scale required to execute.

Because they have huge advantages over the hundreds of "monkeys," these companies should create the true destination sites that, by virtue of the wide variety of services and programming they offer, capture the lion's share of the Web surfer's time. Among their advantages:

- Mass-market brands.
- Economies of scale—very important in the low-margin world of cyber-space.
- Economies of scope—these companies offer enough categories of vertical coverage that customers do not have to go elsewhere to get things done.
- The financial clout and market presence to partner with major firms—be they Web companies or traditional media companies—in order to fill out their line-up of product offerings. For example, in addition to its merger with Netscape and acquisition of Moviefone, AOL has struck deals with CBS, eBay, and CNET.
- Wide market reach for advertisers—it is more efficient for a huge firm like Procter & Gamble or General Motors to place its advertising with one or two "gorillas" rather than dozens of "monkeys."

The Web dominance of the three "gorillas" is not far off in the future (Chart 18). And their dominance is only likely to increase as they acquire or co-opt some of their stronger competitors while other competitors drop out of the race.

## 7. Commoditized information *versus* proprietary content *versus* specialized insight

If knowledge is power, consumers have a lot of muscle in the era of DGDP. One of the main reasons to use a travel agent used to be that they had nearly exclusive access to key information. What airline flies to a particular airport? What is that airline's flight schedule? What is the seating configuration of the plane used on a particular flight? Now, all this information is freely available on the Web pages of airlines, airports and travel sites. Similarly, car dealers have seen their franchise weakened by the shift in information. By logging onto the Kelley Blue Book Web site, potential car buyers can find a sticker price in seconds. And many sites list invoice price data—a figure that used to be kept a closely guarded secret.

In addition to disseminating information that heretofore was not freely available, the Web also makes available for free huge quantities of information that consumers once had to pay for. Since 1990 sales of the Encyclopedia Britannica's multi-volume sets (which cost in the range of \$1,500-2,200) have plunged, partly reflecting the abundance of data now freely available on the Web (Chart 19).

Chart 19

### Encyclopedia Britannica sales

Worldwide sales of 32-volume printed version (in '000s)



Source: *The Economist*.

### Commoditized information

Stock quotes and financial information, once available only to the paying clients of financial data providers such as Reuters and Dow Jones, are now freely available on many Web sites (albeit oftentimes with a time delay). So too are the latest financial news stories complete with detailed analysis. A partial list of commoditized information—that is, information that is available for free on the Web—includes:

- News
- Weather around the world
- Financial and commodity prices
- Sports

- Maps
- Phone numbers
- Yellow pages
- Movie listings and reviews
- Travel information

The commoditization of information is clearly bearish for many companies, including many of the traditional providers of news, sports data and financial information. However, as we discuss below, while much information is now available for free, proprietary content and individualized insight will remain valuable commodities.

### Proprietary content: show me the money

*Commoditized information*, which by definition is available for free on the Web, should be distinguished from *proprietary content*, which consumers are actually willing to pay for. The best example is *The Wall Street Journal* on line, which costs \$59 per year and has 250,000 paying subscribers. Another example is Sportsline.com, whose 60,000+ subscribers pay \$6 per month on average.

One reason for the success of these sites is that they help consumers make money, via investing and gambling, respectively. However, so much is available for free on the Web that it is not easy to persuade consumers to “show me the money.” For example, many newspapers can be read on line for free. And *Slate*, the online news magazine that was started with much fanfare by Microsoft, stopped charging because subscriptions were so weak.

But consumers will be willing to pay for the proprietary content of selected newspapers that have a monopoly that extends beyond coverage of the latest city hall scandal or recent crime wave. For example:

- *The Wall Street Journal's* monopoly is Wall Street and the financial markets.
- *The Washington Post's* monopoly is the affairs of the nation's capital.
- *The New York Times's* monopoly is world affairs, given its unparalleled coverage of events outside the U.S.

Similarly, large entertainment companies—such as **Disney** and **Time Warner**—have a valuable franchise in their ability to create original content.

### Individualized insight

Having information is one thing; knowing how to use it is another. While using the Web to convey information to customers, professional firms provide individualized, one-on-one insight to help customers solve problems.

Consumers will be willing to pay for this, because it saves time and maximizes the probability that correct decisions will be made. For example:

- The full set of tax regulations and all the necessary tax forms are readily available on the Net, as are tips and advice on cutting taxes, but a huge number of people still turn to professional preparers to complete their tax returns.
- If you are building a portfolio that is consistent with your particular goals and risk tolerance, you need the advice of someone who understands both the financial markets and your own particular circumstances.
- If you are preparing a substantial and complicated will that involves estate planning considerations, you will need the advice of a professional.

Consumers will be willing to pay for *insight* tailored to their specific needs.

These service providers must creatively combine the capabilities of the Web and of Real People to provide the best service for the lowest cost. The professionals on their staff must actually provide individualized insight—not just perform clerical functions that could be done much more cheaply on the Web.

### ***Online financial services versus Real People***

The Web will significantly alter the financial services landscape but, because financial services range from commodity products to individualized insight, the effect will be highly uneven.

- Many commodity products—such as home mortgages, car insurance or term life insurance—will migrate to the Net, causing pricing to become much sharper, given the ability to compare rates on the Web. (In the U.K., where auto insurance is bought and sold on the phone, consumers regularly switch policies to save as little as five pounds.)

- In the area of online banking, two key factors separating the banking “haves” from the “have nots” will be ease of use and breadth of service (e.g., the ability to both receive and pay bills on line). While e-banks such as Net.bank and TeleBanc Financial have lately enjoyed soaring stock prices and swelling deposits, here too it will likely be the case that it is the Gorillas in the industry that benefit the most from the Net. After all, large, nationwide banks have the infrastructure (e.g., their own ATMs), the personnel (e.g., loan officers) and the reputation, three critical factors for a successful banking operation.

**Citigroup** has long been a technological pioneer in the banking industry (CEO John Reed has a very strong technical background). **Wells Fargo** has a history of using innovative methods to deliver service. And **Bank One's** management appears to be deeply impressed by the Internet's potential, and is believed to be making one of the largest financial and strategic bets on the Net in the industry. (ONE's acquisition of credit card company First USA greatly advanced its cyber-powers.)

The Web will be a modest plus for such firms as **Bank of New York** and **State Street** that are heavily involved in fee-based processing businesses, as the Web reduces costs and increases convenience of trade execution and clearance.

- Important and complex financial products—whether it is home insurance, whole life insurance, or estate planning products—are unlikely to move to the Net. Most consumers need assistance in mastering the complexities of the choices, and they may also need help in overcoming “analysis paralysis” and actually executing a decision. The value of individualized insight in these areas should prevent the Net threat from seriously undermining the franchise of insurance firms such as **Hartford Life** and **Nationwide Financial** and full service brokerage firms such as **Donaldson, Lufkin & Jenrette**, **Merrill Lynch** and **Morgan Stanley Dean Witter**.

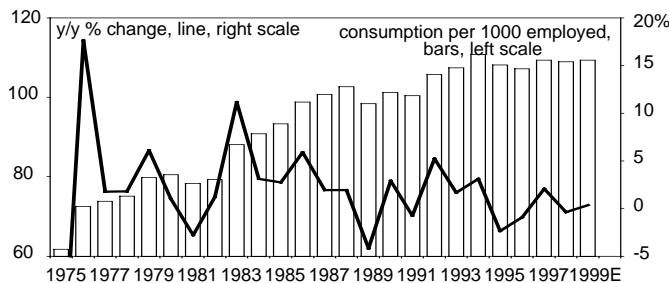
### 8. Paper versus Paperless

The Web is fundamentally but subtly changing the relationship between people, paper and words. Computers clearly are *not* going to replace paper as a medium for actually reading long passages of text. On this score, Princeton historian Robert Darnton cites none other than Bill Gates:

“Reading off the screen is still vastly inferior to reading off of paper. Even I, who have these expensive screens and fancy myself as a pioneer of this Web Lifestyle, when it comes to something over about four or five pages, I print it out and I like to have it to carry around with me and annotate. And it’s quite a hurdle for technology to achieve to match that level of usability.”

Most people would agree with Mr. Gates. Reading more than a few paragraphs of text on a screen is unpleasant, and you can’t scribble in the margin or toss it in your briefcase. One might therefore infer that the rise of the Web would actually *increase* demand for paper, as people download enormous amounts of information and print it out on high-speed printers. But this turns out not to be the case.

Chart 20  
**U.S. consumption of uncoated free sheet paper**



Source: AF&PA, PaineWebber Inc. estimates.

Chart 20 shows annual domestic consumption of uncoated free sheet paper per employed worker. (Uncoated free sheet is a broad paper category that is indicative of paper consumption in the office; other grades include newsprint, which is growing much more slowly, and coated paper, a smaller category that is growing rapidly.) Paper consumption growth has slowed from 6.4%, 1975-88, to 2.0% over the past decade, when the U.S. economy was going on line. It has been nearly flat since 1994 despite robust economic growth.

#### **Selective printing versus mass storage of paper-based content**

One explanation of why paper consumption per employee has slowed is that while people still prefer to *read* lengthy passages of text on paper rather than a screen, they would

just as soon *store* it on-line. The reams of paper that were printed but never read are increasingly being stored in the form of bytes and bits, and printed only as necessary. This trend is bearish for commercial printers such as Bowne & Co. and R.R. Donnelley, but bullish for makers of computer printers such as **Lexmark**.

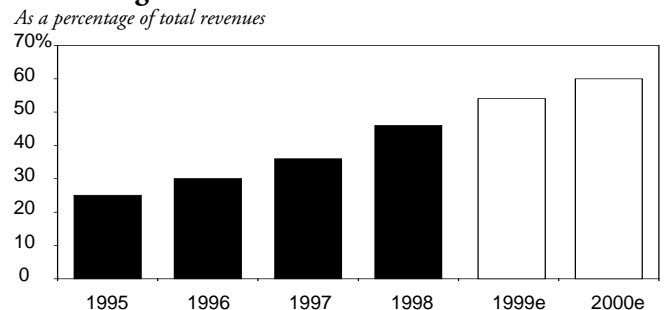
It is also a positive for **Xerox**, which makes digital copiers that can scan or download a document and rapidly collate, staple and even bind multiple copies. Whereas page counts for traditional light-lens (analog) copiers are growing at a low single-digit pace, page counts of copiers connected to networks are growing at a double-digit pace. Reflecting growth in the demand for printed pages, the percentage of revenues that Xerox derives from digital copiers has been accelerating (Chart 21).

Selective printing will replace mass storage of paper-based content.

Before long, these trends will lead to the online book. Currently, the book has one foot planted in cyberspace and the other in the 19th century. Books are researched and written on a computer, edited on a computer, and printed in a computerized printing plant. But then, just as in the days of Charles Dickens, they are converted into paper, stored in a warehouse, and shipped to stores. After a year or two, most books go out of print and can only be purchased in used book stores. This is a pretty ridiculous system.

Soon publishers will store books on line and make them available to consumers who, for a fee, can download them over the Internet and, if desired, print them on a digital bookmaker such as the Xerox Document Binder 120. Even after books disappear from store shelves, they will continue to generate revenues for the author and publisher. This could be a long-term plus for Xerox, as well as for book publishers.

Chart 21  
**Xerox’s digital revenues**



Source: Xerox, PaineWebber estimates.

## 9. Cyber space versus real estate

In the first few weeks of 1999, shares of retail REITs sold off sharply on fears that e-commerce would curb demand for retail space. As we discuss below, while the spread of the Net does have significant implications for some segments of the real estate industry, not all of those implications are completely negative.

### *Warehouse space*

As discussed elsewhere in this report, the Net is leading to two important types of disintermediation:

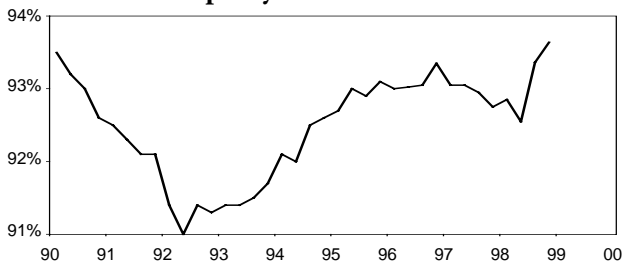
- Consumers are buying directly from the producer.
- Consumers are buying from Web retailers.

Both types of disintermediation are *increasing* demand for warehouse space (Chart 22). Manufacturers who want to make fast, convenient deliveries to Web shoppers will need warehouses scattered around the country. And Web retailers are also building distribution centers to handle the shipment of products to customers. Stronger demand for warehouse space should be positive for **AMB Property** and **EastGroup Properties**.

Disintermediation will likely increase demand for warehouse space, as manufacturers and Web retailers will need distribution centers scattered across the country.

Chart 22

### **Warehouse occupancy rate**



Source: F.W. Dodge, Regional Financial Associates, and PaineWebber.

### *Retail space*

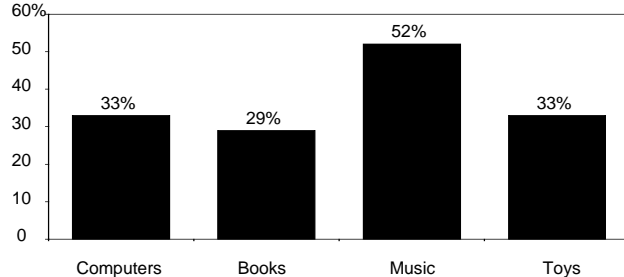
While the advent of Web retailing is positive for warehouse demand, it should hurt demand for certain types of retail space. The need for retail space in such categories as computers, software, books, music, and toys should slow (Chart 23). However, some physical personal service retail categories will avoid the Net threat, including such mundane service as dry-cleaning, hair stylists, shoe repair and locksmiths. Convenience stores selling candy, newspapers, cigarettes and soda should remain in demand. One segment that is particularly vulnerable is factory outlets—why travel to the outer suburbs to see what merchandise a

manufacturer is trying to offload, when you can check their Web sites for the latest bargains?

Chart 23

### **Online sales growth as a % of total growth**

1998-2002e, by category



Source: Estats Retail Shopping Report, U.S. Census Bureau, ICSC.

But shopping is a social as well as an economic activity. Some consumers will still want to travel to sleek, chic “destination malls” where they can shop in a wide array of well-stocked stores, and check out the latest fashions. Some will buy in the store, others will buy later over the Web. They may also take in a movie, eat in a restaurant, or visit a hair stylist. Therefore, Macerich and Simon Property Group, which own upscale malls, should not be hurt by the Web.

However, the “power centers” that typically have an anchor such as K mart, plus many smaller stores selling “commodity” items such as books, music and cheap clothing, are at risk. Their customers will likely migrate to the Web, where prices tend to be lower and comparing prices is easy. Two REITs vulnerable to this trend are Developers Diversified Realty and Glimcher Realty.

### *Office space*

The Net could potentially lower the demand for office space in several ways:

- Banks and other financial services will have fewer and smaller offices as customers go on line.
- Telecommuting may reduce the demand for office space as more people work out of the home.
- The rise of the “paperless office” would mean less demand for filing cabinets and storage facilities.

But these trends do not, in fact, point toward a major diminution of demand. After all, there is always substantial tenant turnover; while the building stands, tenants come and go. For example, shoe stores used to occupy 25% of retail mall space, but today it is just 10%. Gourmet coffee shops are a significant segment that did not exist ten years ago; another fast-growing segment is small-business support firms such as Kinko’s and (increasingly) Staples. Shrinking demand from banks (which has been under way for years as firms merge) will be partly offset by

growth in other segments such as the “new industrials”—computing, communications and content industries.

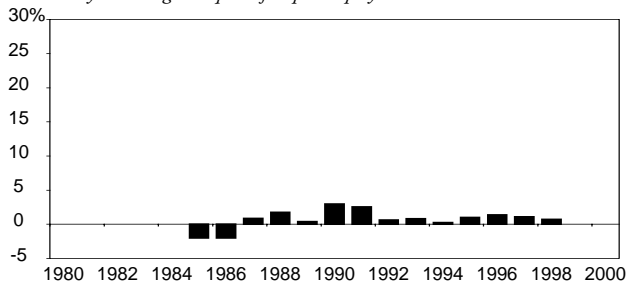
As for the alleged threat from telecommuting, this has existed since the 1970s, yet absorption of office space has not declined recently (Chart 24), although workers' office space has not grown nearly as rapidly as their cyber space (Chart 25). There are a few explanations. Strong economic growth fostered by the shift to a DGDP economy boosts employment. Moreover, most telecommuters, either from home or from the road, *do* have office space at work that they use occasionally. And the popularity of telecommuting will always be limited by the definite if intangible synergies that come from people working together in an office.

The paperless office is also an overblown threat. As we have seen, it does appear that paper consumption per employed worker has indeed leveled off, probably because more information is stored in computers rather than file cabinets. But computers take up space too. In the DGDP age, the productivity of service workers will increase because the capital equipment used by each worker has increased dramatically. Secretaries used to use a typewriter. Now they use a PC and share with other workers PC printers, copying machines and fax machines; on another floor is a computer center full of servers and the office space of computer workers.

Chart 24

**Growth in office space per worker**

Year over year change in square feet per employed worker

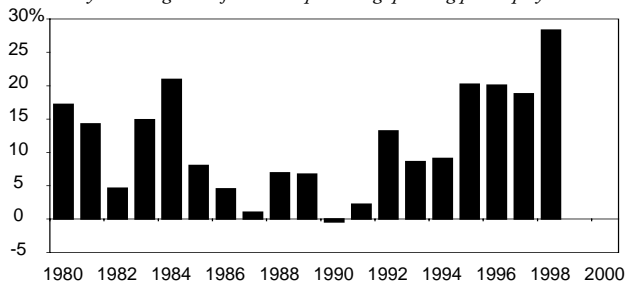


Source: Rosen Consulting Group estimates, PaineWebber.

Chart 25

**Growth in cyber space per worker**

Year over year change in information processing spending per employed worker



Source: PaineWebber.

**Appendix: Two Predecessors of the Information Revolution**

**The First Industrial Revolution**

The First Industrial Revolution occurred at a specific place and a specific time—England between 1760 and 1790. It was then that a series of innovations in spinning and weaving cotton—the spinning jenny, the water frame, Crompton’s mule, and the power loom—rapidly mechanized the production of cotton cloth, which historically had been far less important than woolens. The amount of raw cotton imported into Britain grew from 2.5 million pounds in 1760 to 22 million pounds in 1787 and 366 million pounds in 1837. This was the first true “take-off” of an industry driven by the invention of a new technology, rather than the discovery of mines (e.g., South American gold in the 16<sup>th</sup> century) or a new crop (West Indian sugar in the 17<sup>th</sup> century).

**Why England?**

Which raises the question, why? Why England in the late 18<sup>th</sup> century? The answer is instructive to observers of the Internet, because *it reveals the power of expanding, efficient markets to drive economic innovation*. What happened to the English economy in the eighteenth century could well happen to the global economy in coming decades as the Internet makes markets more efficient and precise.

**England’s domestic market**

In the 18th century, there were plenty of nations that had enough capital, and enough ingenious inventors, to build the new textile machinery. What they lacked was expanding markets that triggered the process of innovation. Historians are in agreement that England was the first to industrialize primarily because its manufacturing districts served the largest, freest, and most prosperous markets of any in the world. The domestic market was prosperous and accessible because:

- England’s population grew about 50%, to nine million people, during the 18th century. Owing to the enclosure of common land and the modernization of agriculture, England—in contrast to France, which experienced sporadic famines in the late eighteenth century—was able to feed this expanding population with little trouble. Consuming greater amounts of meat and white bread, English laborers enjoyed a higher standard of living than their peers across the English channel.
- In the 18th century, it was much cheaper to transport goods by water than by land. Because England was an island, it was comparatively easy for merchants and manufacturers to reach consumers in any part of the nation. Moreover, in the 18th century roads were

improved and canals were dug, which further reduced transportation costs. And there were no internal customs barriers within England.

- A key factor that tied the English market together was the dominant position of London, a huge city of more than one million people, or about 12% of the nation's population. This was a huge and accessible market for English manufacturers. And the commercial character of England was enhanced by the fact that London—in contrast to other capital cities such as Paris, Rome, and Madrid—was not only a center of government, society and culture, but a gigantic port city.

### The colonial market

In addition to a large and accessible domestic market, English manufacturers could sell goods to its burgeoning colonies. The British Empire's engine of wealth was the West Indies; sugar was a pivotal commodity in the global economy of the eighteenth centuries, much as petroleum would be in the 20th.

The sugar islands were supplied with flour, meat, fish, and lumber shipped from the 13 colonies of North America. A land of temperate climate, abundant and fertile land, scarce labor and high wages, the mainland colonies were considered by contemporaries "the best poor man's country." Growing rapidly via natural increase and immigration, the U.S. population was 3.9 million by 1790. Enjoying perhaps the highest living standards of any nation on the globe, these people were voracious consumers of the textiles, pottery, cutlery and hardware manufactured in England.

### Adam Smith on the power of markets

How, then, did these expanding markets affect British industry? In his seminal treatise, *The Wealth of Nations*, published in the fateful year 1776, Adam Smith argued that the chief source of increasing labor productivity in any economy was the *division of labor*, a proposition he illustrated with the homely example of the pin maker. A single untrained individual, Smith argued, could make only a few pins per day, but a well-organized shop employing ten persons could make "upwards of forty-eight thousand pins a day," through a proper organization of labor and use of the appropriate tools:

"One man draws out the wire, another straightens it, a third cuts it, a fourth points it, a fifth grinds it at the top for receiving the heat; to make the head requires two or three distinct operations; to put it on, is a peculiar business, to whiten the pins is another; it is even a trade by itself to put them into the paper; and the important business of making a pin is, in this manner, divided into about eighteen distinct operations, which, in some manufactories, are all performed

by distinct hands, though in others the same man will sometimes perform two or three of them."

Adam Smith argued that "the Division of Labour is Limited by the Extent of the Market." Where the market was large, it was possible to operate a specialized and productive shop making pins, or buttons or cotton thread. What small village could possibly need 48,000 pins per day? But when transportation improvements created large markets, division of labor was no longer limited by the extent of *that* market. And it was in precisely such shops, Smith argued, that the proprietor had the ability and incentive to *make the effort needed to devise specialized machinery* that would increase the productivity of the business. Smith's insight was prophetic. It was the explosive domestic and colonial demand for textiles and other manufactures that stimulated the search for labor-saving technical and organizational innovations that in turn led to the First Industrial Revolution in the late 18th century.

### The Internet will further increase the division of labor

Let us take Adam Smith's insight from the 18<sup>th</sup> century to the 21<sup>st</sup>. If "the Division of Labour is Limited by the Extent of the Market," the division of labor should increase even further once every household is connected to a global market via the Internet. Many people have valuable skills for which, however, there is inadequate demand in their own area to build a business. When these individuals can serve a global market by posting a Web page and selling over the Web, they will indeed be able to sell their service profitably. The Web will also permit the sale of all sorts of resources that are now wasted because it is too difficult to find a buyer. Already eBay is connecting owners of collectibles with buyers. If your husband is a John Travolta fan, and you want to buy him an original poster for the movie "Saturday Night Fever," eBay may connect you with someone who has it. The same is or soon will be done with used books, hotel rooms and airline seats that are about to go unsold, as well as the expertise of lawyers, accountants and other professionals who want to work part time. The Web will also permit international arbitrage of labor markets. For example, software programmers in India may work for Seattle firms who pay better than those in New Delhi.

### The First Industrial Revolution in America

Enterprising and ambitious, the merchants and artisans of the United States lost no time importing the Industrial Revolution from England to America. In the four decades before the Civil War, most of their industrial innovations fell into two categories. The more capital-intensive was the textile mills, typically built on the bank of a fast-flowing river. These were perfected by resourceful businessmen in New England, who combined capital earned in overseas commerce with trade secrets stolen from England.

The most famous textile mills were built in Lowell, Massachusetts, in the 1820s by a group of wealthy Boston merchants. The mills performed all the steps of textile production—cleaning and carding cotton, spinning yarn, weaving cloth, and finally dyeing and finishing the fabric.

Though they were impressive symbols of industrial modernity, textile mills actually employed far fewer people in antebellum America than the low-tech, labor-intensive “putting out system,” which applied Adam Smith’s principal that productivity could be boosted by increasing the division of labor. It divided the process of making a product into narrow operations, and then parceled them out to specialized workers, who toiled in cramped, ill-lit sweatshops. In shoemaking, for example, leather was cut into pieces in a fairly large central shop. Then the “uppers,” or upper part of the shoe, were sent out to workers who stitched them into the proper shape and returned them to the central shop; the uppers were then sent out to other workers who attached them to the soles and finished the shoe. By the 1850s thousands of workers, most of them immigrants, were scratching out a living in New York, Philadelphia, and other cities by participating in the putting out system.

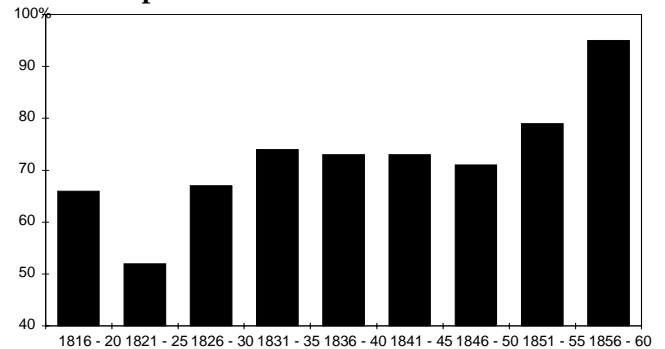
### The Railroad Revolution

Textile mills and the putting out system comprised Phase I of the First Industrial Revolution in America, but they did not create a modern industrial economy. Phase II was the *integration and acceleration of economic activity through the creation of a national railroad system* between 1840 and 1900. To anyone interested in the economic impact of the Internet, the Railroad Revolution deserves close attention, because railroads did to America’s *industrial sector* what the Internet is doing to the *service economy*.

Because the U.S. was a continental economy spanning the Appalachian mountains, slow transportation was a formidable barrier to economic growth. The construction of turnpikes in the early 19<sup>th</sup> century helped, but only a little; wagons could only go 20 miles per day. By connecting the Great Lakes with New York City, the Erie Canal, which was completed in 1825, linked Midwestern farmers with the East Coast. But canal boats moved at the pace of a horse and could not operate when canals were iced up; this was an inadequate interim solution that was quickly superseded by railroads. The first U.S. railroad was built in 1826, but—owing in part to a severe recession that started in 1837—railroads really “took off” in the late 1840s and the 1850s. Railroad trackage rose from 9,000 miles in 1850 to 30,000 miles in 1860, and the Midwest was connected with the East Coast. It was then that railroads started to transform the United States. After a hiatus during the Civil War, there was a railroad building boom from 1865 to 1873 and another during the 1880s. By 1900, the basic railroad system was complete.

Chart A1

### Cincinnati wholesale flour price as percentage of the New York price



Source: Gary M. Walton and Hugh Rockoff, *History of the American Economy*, p. 200.

As Harvard historian Alfred Chandler has demonstrated, it was the railroad that created the modern American economy. As the Internet is likely to do, the railroads destroyed many traditional industries and created new ones. Here are some of their most important effects:

- Most obviously, railroads cut transportation costs, expanded markets and *reduced price differentials between distant markets*. For example, in the late 1840s wholesale flour prices in Cincinnati were only 70% of the New York level, but a decade later they were 95% (Chart A1). This raised living standards on the East Coast, where the price of flour declined, and increased opportunities for Midwestern farmers, who could reach a larger market. Once refrigerated rail cars were introduced in the 1870s, regional disparities in meat prices also dropped.
- Railroads not only affected the price of grain, but *transformed the entire process of marketing it*. Traditionally, farmers harvested their wheat and corn, poured it into sacks, threw the sacks into a wagon, and took it to a mill or market town, where the farmer could proudly show the merchant or miller the excellent quality of his crop. This annual ritual was transformed by the railroad in the 1850s. Because grain elevators could not handle sacks, grain was inspected and assigned a grade, poured onto a conveyor belt which dumped it into a silo, from which it was loaded into rail cars. As historian William Cronon put it, now a “golden stream” of grain flowed through the economy. Once grain became a graded but relatively homogenous commodity, farmers and merchants were able to *trade it for future delivery*. Thus was created Chicago’s commodity futures market.
- Like the Internet, railroads *sped up economic activity* while making it more regular and predictable. Because goods were not in transit for as long, inventory/sales ratios declined, which in turn raised return on investment. And if your shipment was in transit for two

days, not two weeks, there was *a lower risk that the price would move sharply against you* before the goods reached market. Low risk increased willingness to ship goods, which further improved the efficiency of markets.

- The railroads were America's first "big business." Activities in distant points had to be precisely coordinated by a staff of professional managers using modern accounting systems, which generated reams of data that could be systematically analyzed to identify ways to reduce costs. A major tool for managing railroads was the telegraph, which was invented in the 1840s and followed the railroads as they crossed the continent.
- The railroads imposed standardized time on a rural society where each town set its clock slightly differently. In was in the year 1883 that the railroads divided the U.S. into four "time zones" within which all timepieces were to be synchronized. The Internet will likewise transform our sense of time. Cyber executives talk about managing on "Internet time" which means A) operating at the speed of e-mail, not "snail mail" and B) letting consumers do business 24 hours a day.
- The railroads hastened economic development by *consuming huge quantities of modern, high-performance products*. Because wrought iron rails wore out too fast, there was an immense demand for steel—as well as glass, copper and coal. Because railroads were voracious consumers of capital they also needed investment banking services. The modern Wall Street first took shape in the 1850s to finance railroads. In a similar fashion, the Internet is driving demand for ever more powerful high-tech gear ranging from micro-processors to modems to browsers. Intel is, in effect, the Carnegie Steel of the Third Industrial Revolution.
- By cutting transportation costs and knitting together the nation, the railroads *created a mass consumer market* served by modern, high-volume retailers. These appeared after the Civil War in several forms: mail order retailers (Sears, Roebuck), chain stores (A&P) and department stores—magnificent marble temples of consumption that sprang up in New York and other major cities. What made these new business models feasible was much higher sales volumes. Whereas a traditional merchant might move merchandise worth \$250,000 per year, departments stores handled \$30 million or more. Similarly, many prominent Internet enterprises, such as Dell Computer and Amazon.com, are predicated on low costs, low profit margins, high sales volumes, and very high inventory turnover. Dell Computer turns its inventory 61 times per year.

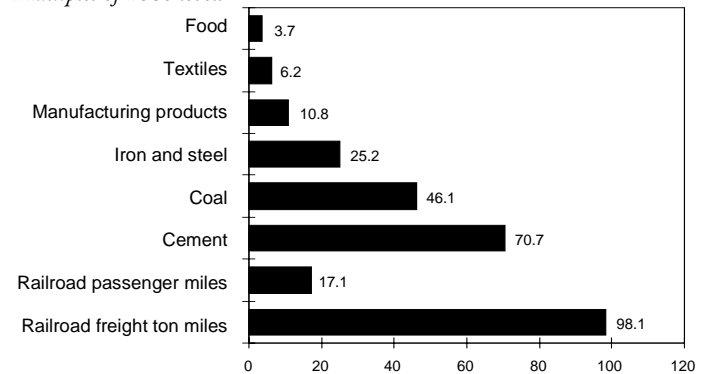
- A mass market required masses of goods, and railroads—fast, regular, dependable—could rapidly push raw material through factories. This permitted mass production, by agile entrepreneurs using new machinery and processes, of everything from cigarettes (James B. Duke) to soap (Procter & Gamble) to photographic film (George Eastman) to steel (Andrew Carnegie). As a result, prices fell, and purchasing power increased. For example, a maker of sulphuric acid marveled in 1882 that the output had "increased nearly 1,000 percent in the past ten years. In 1866, the price was 5 cents per pound, today it is 1 ¼ cents." This was an example of the "benign deflation" fostered by the railroads; by accelerating information flow, the Internet is having a similar effect.

Clearly, the railroad left few industries unaffected as it carried the First Industrial Revolution across the North American continent and created a modern industrial economy. Whether measured in terms of output produced or people employed, railroads grew much faster than most other major industries between 1860 and 1910 (Charts A2, A3).

Chart A2

### Output expansion 1860–1910

Multiples of 1860 levels

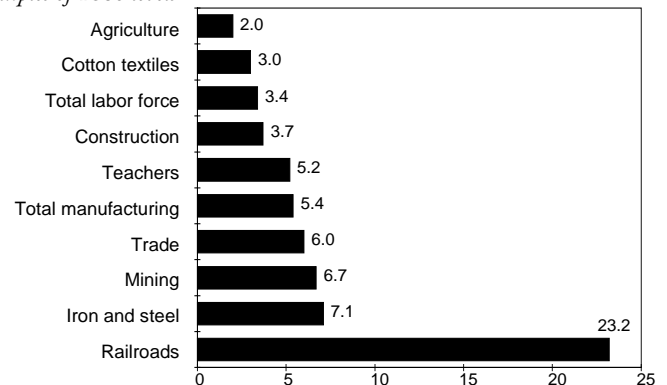


Source: Gary M. Walton and Hugh Rockoff, *History of the American Economy*, p. 373.

Chart A3

### Labor force expansion 1860–1910

Multiples of 1860 levels



Source: Gary M. Walton and Hugh Rockoff, *History of the American Economy*, p. 372.

## Andrew Carnegie and the emergence of a new business culture

The railroads, as we have seen, fostered a new way of doing business in America, one that emphasized speed, precision, and cutting unit costs by increasing volumes. The career of Andrew Carnegie, ably chronicled by Harold Livesay, personifies this new business culture, because he worked in many of the strategic industries of the age, including telegraphs, railroads, Wall Street and steel. Born into a working class family in Scotland, Carnegie migrated to America in 1848. At the age of 13 he went to work in a spinning mill but soon moved on to a telegraph office in Pittsburgh.

This was a fortunate choice of employment. Telegraph offices launched the careers of several titans of business, including Thomas Edison and Richard Warren Sears (founder of Sears, Roebuck), because they were the nerve centers of the 19th-century economy. Prominent executives were constantly rushing in to send important messages, so workers who provided good service could make valuable contacts. Carnegie caught the eye of Thomas Scott, superintendent of the western division of the Pennsylvania Railroad. He was hired as a telegraph operator but rapidly moved up. Smart, aggressive, and cocky, garrulous and ingratiating when he needed to be, Carnegie quickly mastered the intricacies of the railroad's operations. At the age of 24 he was made superintendent of the western division of the Pennsylvania. This was one of the best managed railroads in the country, and Thomas Scott constantly impressed on Carnegie the importance of expanding the volume of business to cut unit cost. Scott's prescription for high profits was "big trains, loaded full, and run fast."

Carnegie's position at the Pennsylvania Railroad led him into the world of high finance. He and his colleagues invested in a series of start-up companies such as Woodruff Sleeping Car Company, Union Iron Works, and Keystone Bridge Company. Leaving nothing to chance, Carnegie and his partners then had the Pennsylvania Railroad place large orders with their firms. Not surprisingly, these were enormously lucrative investments, as was a plunge into the Pennsylvania oil boom of the 1850s. These ventures introduced Andrew Carnegie to the wily ways of Wall Street in the Gilded Age, but the ambitious Scot had a desire to build a great company from the ground up. He knew enough about railroads and iron to realize that the thing to produce was steel. Not iron, but steel, a tougher metal that could be made through the recently perfected Bessemer process.

Carnegie created a partnership consisting of 11 people, most of whom were involved with railroads or iron. After weathering the financial trauma of the depression of 1873, the company in 1875 completed the Edgar Thomson

Works. Named after the President of the Pennsylvania Railroad, this would become the most efficient steel works in the world. To avoid extortionate freight rates, it was built near two railroad lines, and to maximize productivity it was carefully laid out so as "to assure a very large and regular output."

Operating in a deflationary environment, Carnegie knew that *the key to profitability was cutting costs*. He hired the most talented iron and steel makers he could find, developed an intricate accounting system to keep track of costs, and relentlessly pushed his employees to increase the throughput of "E.T." as the Edgar Thomson works were known. Two of Carnegie's business principles were "Cut the prices; scoop the market; run the mills full," and "Watch the costs and the profits will take care of themselves." His aim was to create a virtuous cycle: charge less than competitors, sell more steel, increase E.T.'s output, and drive down unit costs. The strategy worked brilliantly; Carnegie Steel's profits rose from \$2 million in 1888 to \$40 million in 1900. A year later Carnegie sold his company to J.P. Morgan, who made it the centerpiece of U.S. Steel.

Just as executives such as Andrew Carnegie spearheaded the First Industrial Revolution by applying the principles of railroading to related industries, so are such firms as Intel, Cisco, Dell and Microsoft leading the Information Revolution. They are not only *building* the Internet but *using* it in their own business. Dell's Internet sales were at a \$5.0 billion annual rate in their latest quarter; Cisco's were \$7.9 billion. Moreover, such executives as Bill Gates, Paul Allen and Craig McCaw have invested in many key firms in the Information Revolution.

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## The Second Industrial Revolution: birth of the "machine age"

In 1880, most Americans only used machines if they worked in a factory or traveled on a railroad or steamship. Forty-five years later, machines were ubiquitous in daily life, thanks to two innovations: the automobile and electricity. The real payoff from these innovations, in terms of raising living standards for ordinary Americans, came in the 1920s, 40+ years after Thomas Edison invented the incandescent light bulb, and nearly 30 years after autos first hit the roads.

This lengthy time lag is significant and instructive, because—as economist Paul A. David has pointed out—a similar lag has occurred in the Information Revolution. The first commercial computers were sold in the early 1950s, but not until the 1990s did computers greatly affect the typical consumer. Some observers have derided the computer as a high-tech gadget that did not really

improve business productivity. As the economist Robert Solow put it, “We see computers everywhere but in the productivity statistics.” In 1995 MIT Press published a book by Thomas K. Landauer, *The Trouble with Computers*, that explained “why computers rarely improve the efficiency of the information work they are designed for.” That criticism had some credibility when PCs were mainly used for word processing and spreadsheets—but far less now that the Internet is creating fundamentally new and more efficient business models.

### “Everyone wants to go from A to B sitting down.”

America’s automotive revolution, like the French Revolution of 1789, began at the glittering apex of society and worked downward. The leisured nobility of Newport and Oyster Bay were the first to be affected; then the doctors, lawyers and merchants of the suburban bourgeoisie; and finally the hard-pressed peasantry of Iowa, Kansas and Arkansas.

The forerunner of the automobile was the bicycle, a craze that swept America in the 1890s and introduced consumers to the novel idea of traveling the roadways without the aid of a horse. For the first time, consumers read lavish advertisements detailing the specific technical virtues of a particular “make” of vehicle. For a few years the public was impressed, but the trouble with bicycling was that it was more work than riding a horse. The logical solution was to connect an engine, whether powered by electricity, steam, or gasoline, to a bicycle—or to a tricycle or quadricycle.

By 1900 the quadricycle, now called the automobile, was a viable mode of transportation for the wealthy, adventurous sportsman. It was a captivating item of conspicuous consumption that, like yachting today, mixed style and sport. Serious sportsmen could compete in both speed races and grueling long-distance reliability tours that tested the durability of vehicle and driver alike. Auto enthusiasts did not stint on equipment. In 1906 *Harper’s Weekly* observed, “there are more than 200 persons in New York who have from five to ten cars apiece. John Jacob Astor alone is credited with thirty-two.”

Prior to 1906 or so it was still an experimental vehicle that had to be treated with all the care due a temperamental racehorse. One buyer wrote in 1901, “Before purchasing the machine I had obtained the impression that it only required from five to eight minutes to start. I found, however, from experience that blowing up the tires, pumping up the airtank, the supplying of water and getting up stream would occupy on the average twenty-five to thirty minutes.” In short, starting a car in 1901 was about as easy as setting up a PC in 1982.

Unlike many high-tech consumer products, autos did *not* rapidly decline in price. Nevertheless, as they improved in quality and Americans grew wealthier, sales expanded.

Autos appealed to consumers’ innate laziness; as one observer explained, “Everyone wants to go from A to B sitting down.” Doctors who had to make house calls in rural areas were among the first to buy. The auto’s reputation for reliability received a big boost from the San Francisco earthquake of 1906, when Americans “were astonished at the small amount of repairs needed by machines of popular makes after not only days, but weeks of the severest strain.” And in addition to their increasing reliability, cars were prestigious and fun to drive: “The man who owns a motorcar gets for himself, besides the joys of touring, the adulation of the walking crowd.”

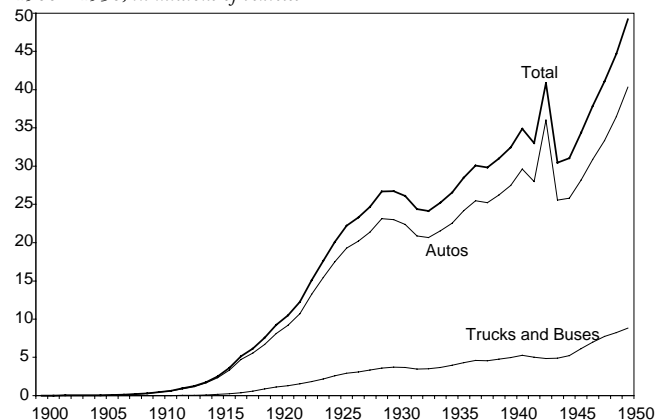
### Exceeding Wall Street’s expectations

Considering automobiles a costly and superfluous luxury, appropriate only for affluent consumers like themselves, Wall Street financiers consistently underestimated their commercial potential. When Billy Durant, founder of General Motors, remarked that the auto industry would be producing 500,000 cars within a few years, George W. Perkins, a senior partner in J.P. Morgan and Co., exclaimed that such an idea was preposterous. Perkins advised Durant to stop mouthing such nonsense if he wanted financial aid. In 1908, the year that Perkins dispensed this piece of wisdom, 65,000 cars and trucks were produced; eight years later the figure was 1,617,708—more than three times Durant’s forecast. In less than a decade a gigantic new industry, the backbone of the American economy in the twentieth century, sprang to life in the upper Midwest. A citizen of Flint, birthplace of General Motors, wrote, “One must himself walk over the literal miles of factories in process of construction before one begins to grasp the immensity of the manufacturing undertaken.” Today, in 1999, investors who are paying lofty multiples for such Internet stocks as Microsoft, AOL and Cisco are betting that the Internet will enjoy the same sort of exponential sales growth.

Chart A4

### U.S. motor vehicle registrations

1900 – 1950, in millions of vehicles



Source: *Historical Statistics of the United States*, p. 716.

### From luxury to necessity

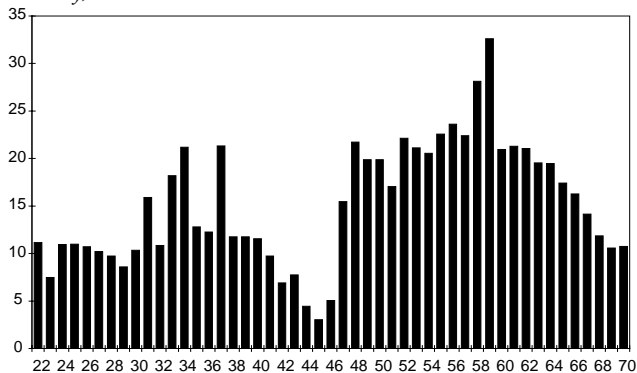
But although autos became well established in the first two decades of the 20th century, it was in the 1920s that they became virtually a middle class necessity. The number of motor vehicles registered in America rose from 7.6 million in 1919 to 26.7 million in 1929 (Chart A4). The introduction by Ford Motor Co. in 1927 of the Model A to replace the Model T (which was losing market share to Chevrolet) was a frenzied national media event, similar to the introduction of Windows 95. The utility of vehicles increased as they became easier to start (no need to crank in order to start), more concrete roads were built and speed limits increased. In most states, the speed limit was 20 in 1919, versus 35 or 40 in 1931. Motor vehicles became a much more credible alternative to railroads, which began their long retreat in the 1920s by closing underutilized branch lines that faced competition from trucks and buses.

The 1920s was also the decade when auto-related businesses such as service stations, roadside restaurants and motels began to proliferate. However, road-building rose to much higher levels in the 1950s, when the interstate highway program was launched (Chart A5). This trend created some tremendous investment opportunities, including Holiday Inns (which was founded shortly after World War II), Hertz and Avis (a play on both the auto and the airline), McDonald's (founded in 1955), and suburban real estate projects (of which the most famous was Long Island's Levittown). Like the Internet, the automobile fundamentally reoriented American life, leaving many winners and losers in its wake.

Chart A5

### Miles of highway completed

Annually, in thousands



Source: *Historical Statistics of the United States*, p. 711.

### Electricity: the gradual revolution

In contrast to the auto or the personal computer, electricity was not a discrete device that an individual hobbyist could acquire to impress his friends. Not unlike the Internet (which was used by scientists and academics for

decades before migrating into the mainstream economy) electricity was a *system* that had to be developed, perfected, and slowly integrated into the fabric of American life. First introduced in the 1880s, electricity's real payoff in terms of boosting labor productivity did not come until the 1920s.

In the early 19<sup>th</sup> century, life was darker than it is today. Interior spaces were illuminated with fireplaces, flickering candles, and lamps fueled by whale oil and kerosene. Gradually, these light sources were replaced by coal gas piped into buildings, but its flickering flame was far from bright and deposited soot on fabric and wallpaper. So consumers were understandably excited by the invention of very bright "arc lights" that could illuminate outdoor areas. Historian Richard Nye describes how "In 1885 *Electrical World* reported a scheme for lighting the entire city of Paris with an artificial sun mounted on one central tower in the Tuileries Garden. The 1,100-foot tower was to have one hundred lamps of 200,000 candle power each, turning night into day." Fortunately for Paris, the plan did not prove practicable.

In 1880 Thomas Edison perfected the incandescent light bulb, the first electric light suitable for interior use, and over the next two decades it was gradually adopted by wealthy homeowners. Electric lights were also heavily used in central business districts; indeed, a well-illuminated downtown was a source of prestige. In 1900 in Chicago's Loop, "The department stores [are] quick to seize upon any new scheme for advertising. . . . [They] have developed the electrically lighted shop window almost to a state of perfection." Electricity also powered elevators, which made the modern skyscraper possible.

Another early application of electricity was the streetcar. In the 1870s American cities were choked by horrific traffic jams of pedestrians, horses, and horse-drawn "omnibuses" which were far from pleasant. One passenger wrote, "Modern martyrdom may be succinctly defined as riding in a New York City omnibus. . . . People are packed into them like sardines in a box with perspiration for oil. Passengers hang from the straps like smoked hams in a corner grocery." Electric streetcars, which were perfected in the late 1880s, were a huge improvement over horse-drawn conveyances, and hundreds of lines were set up by entrepreneurs during the 1890s. With many residents eager to move out of the crowded, dirty, disease-ridden central city (which was growing too large to be easily "walkable"), electric streetcars created America's first suburbs. In order to stimulate travel and put their electric generating capacity to good use, many firms built brightly illuminated amusement parks, such as New York's Coney Island, at the end of the lines.

### Electrifying the factory

In addition to improving lighting and transportation, electricity eventually supplanted coal-powered steam engines as a source of power, but this process was gradual for several reasons. There was a constant war between two “standards”—direct current versus alternating current. Entrepreneurs also had to determine the best “business model”—should there be many isolated electric generators situated in individual buildings and factories, or huge “central stations” that produced electricity for thousands of customers? After many thorny technical problems were resolved, the “central station”—what we now call an “electric utility plant”—was victorious. By 1901 engineers had developed generators that had real economies of scale and could produce cheaper and cheaper power as plants got bigger.

But even after cheap electricity was available, industrialists were slow to use it to raise productivity dramatically. In 1900 most factories were powered by costly coal-burning steam engines. As historian Harold L. Platt has pointed out in an excellent book on the electrification of Chicago, this power system had a number of flaws:

- It required a “complicated transmission system of shafts, belts, and pulleys that reduced its efficiency to a mere 30 percent or less.”
- It “precluded orderly work flows, because a mechanical transmission system dictated that the biggest machines be placed closest to the steam engine.”
- The ceilings of factory buildings had to be “reinforced at great expense to support the heavy load of the power system’s shafts, belts, and pulleys.”
- These transmission systems were dangerous for workers—an arm could easily get caught in a whirling fan belt—and they were also a fire hazard.

Against these many drawbacks, traditional factories had one outstanding virtue: They were already built! Power was a relatively small cost of production, in comparison to labor, raw materials, and depreciation, so industrialists were not about to build new plants just to save energy. Consequently, America’s industrial plant converted to electricity gradually. According to Harold Platt, “By 1914 Commonwealth Edison Company supplied only 17 percent of the primary power used by Chicago Industries.” The first step of many factory owners was to attach an electric generator to the existing steam plant in order to produce electricity to power electric lights, which were brighter than gaslight. The next step was to use electricity to power machinery that was already in place; this liberated the factory from the traditional transmission mechanism of belts and pulleys.

The real payoff from electrifying factories occurred when new factories were built that used electricity supplied by an electric utility. The advantages were many:

- No need to invest in a power plant for the individual factory, unless it was very large.
- Without the need for an overhead transmission mechanism, the building could be of a lighter, cheaper construction, with skylights and better ventilation.
- If necessary, overhead cranes for moving materials could be installed.
- Freed of the constraint of positioning machines on the factory floor so as to optimize the transmission of power, machines could be placed in *the order that made the most sense from the point of view of improving work flow and saving labor.*

These various advantages permitted the creation of the modern assembly line, developed by Henry Ford for his Highland Park plant, which was opened in 1910. (They were further refined in Ford’s River Rouge plant, built after World War I.) David E. Nye points out that the assembly line took to its logical conclusion Adam Smith’s principle of the division of labor:

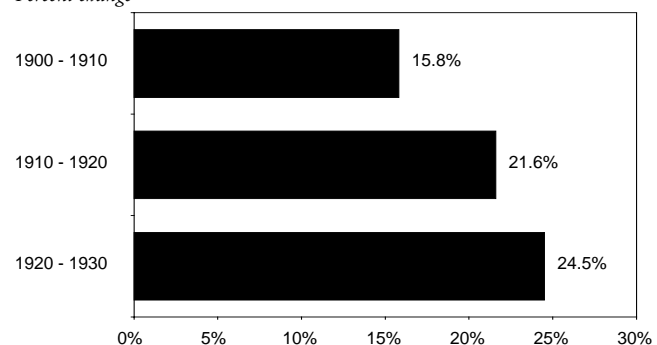
Managers carefully timed each job, so that it could be subdivided into many small operations of nearly equal duration. A worker’s job was reduced to repetition of a precise task that usually lasted considerably less than a minute.

Thanks to the flexibility afforded by electricity, tasks could be placed in the optimal order; no longer did all of the lathes, for example, or all of the stamping machines need to be placed together. Partly because of the enhanced productivity afforded by electricity, there was a marked deepening of the American capital stock. “Between 1914 and 1929,” Harold L. Platt writes, “manufacturers added machine power at a rate three and a half times as great as for manpower. In just fifteen years, the average worker was using almost 60 percent more horsepower on the job.”

Chart A6

### Real gross private domestic product per hour worked

Percent change



Source: *Historical Statistics of the United States*, p. 948.

## The New Economy of the 1920s

The proliferation of automobiles and electrical power in the 1920s created a faster, more flexible, more productivity economy. As Chart A6 shows, there was a clear acceleration of productivity growth during the 1920s, which, for most Americans, was a decade of great prosperity. Real GDP grew at a 4.2% annual rate, the number of cars tripled, aviation was commercialized, the percentage of dwellings with electric service rose from 35% to 68% and Americans first became hooked on home entertainment received over an electronic device, the radio.

Reflecting the impact of the Second Industrial Revolution, a new set of glamour stocks captured the attention of investors. The change is reflected in the membership of the Dow Jones Industrials (Table A1). Although mining, railroad, and railroad machinery stocks were still important, the “glamour industries” now included:

- electric utilities (notably Commonwealth Edison, Middle West Utilities, and other firms in the Chicago-based empire of Samuel Insull),
- electrical machinery (General Electric and Westinghouse),
- radio and motion pictures (Radio Corporation of America, Victor Talking Machine, Paramount Publix),
- autos (General Motors, Chrysler, Nash Motors, but not Ford, which was still private),
- petroleum (Atlantic Refining, Standard Oil, Texas Corp.).

These companies represented the “new economy” of their day—they were the Microsoft, Cisco, AOL and Dell of the 1920s.

Table A1

## The changing composition of the Dow Jones Industrial Averages

1896	1916	1928
American Cotton Oil	American Beet Sugar	Allied Chemical
American Sugar	American Can	American Can
American Tobacco	American Car & Foundry	American Smelting
Chicago Gas	American Locomotive	American Sugar
Dist. & Cattle Feeding	American Smelting	American Tobacco
General Electric	American Sugar	Atlantic Refining
Laclede Gas	American Tel & Tel	Bethlehem Steel
National Lead	Anaconda Copper	Chrysler
North American	Baldwin Locomotive	General Electric
Tenn. Coal & Iron	Central Leather	General Motors
U.S. Leather pfd.	General Electric	General Railway Signal
U.S. Rubber	Goodrich	Goodrich
	Republic Iron & Steel	International Harvester
	Studebaker	International Nickel
	Texas Co.	Mack Trucks
	U.S. Rubber	Nash Motors
	U.S. Steel	North American
	Utah Copper	Paramount Publix
	Westinghouse	Postum, Inc.
	Western Union	Radio Corp.
		Sears, Roebuck
		Standard Oil (N.J.)
		Texas Corp.
		Texas Gulf Sulphur
		Union Carbide
		U.S. Steel
		Victor Talking Machine
		Westinghouse Electric
		Woolworth
		Wright Aeronautical

Source: Jeremy J. Siegel, *Stocks for the Long Run*, p. 44.

Additional information is available upon request.

**Prices of other companies mentioned as of 5/5/99:**

Abercrombie & Fitch ANF \$89 11/16  
 Allstate ALL \$37 1/2  
 Amazon.com AMZN \$146 1/2  
 AMB Property<sup>1</sup> AMB \$22  
 AMR Corp AMR \$72 3/8  
 Ann Taylor ANN \$49 3/4  
 Amer Online AOL \$129 3/4  
 AT&T<sup>1</sup> T \$56 15/16  
 Avis Rent A Car AVI \$34 3/4  
 Bank of New York BK \$38 1/2  
 Bank One ONE \$59 1/4  
 Barnes & Noble<sup>1</sup> BKS \$34 3/8  
 Berkshire Hathaway BRKA \$77,000  
 Best Buy BBY \$47 3/16  
 Borders Grp BGP \$14 5/16  
 Bowne & Co BNE \$17 3/16  
 Carnival Corp CCL \$42 3/8  
 CBS Corp CBS \$44 3/8  
 Central Newspapers<sup>1</sup> ECP \$34 3/16  
 Charming Shoppes<sup>2</sup> CHRS \$3 19/32  
 Circuit City CC \$64 1/2  
 Cisco Systems<sup>2</sup> CSCO \$110 31/32  
 Citigroup<sup>1</sup> C \$72 3/4  
 Clear Channel<sup>1</sup> CCU \$70 3/8  
 CNET Inc CNET \$119  
 CompUSA CPU \$7 1/8  
 Costco<sup>2</sup> COST \$81 7/8  
 Dell Comp Corp<sup>2</sup> DELL \$41 5/16  
 Developers Diversified Rlty DDR \$15 13/16  
 Disney DIS \$30 1/16  
 Donaldson, Lufkin & Jenrette DLJ \$61 13/16  
 Donnelley (RR) & Sons DNY \$35 3/4  
 Dow Jones & Co DJ \$55 3/4  
 EastGroup Properties<sup>1</sup> EGP \$18 5/8  
 eBay Inc EBAY \$186 13/16  
 Estee Lauder EL \$96 15/16  
 FDX Corp FDX \$111 13/16  
 Federated Dept Stores FD \$48 1/2  
 Ford Motor Co<sup>1</sup> F \$64 3/8  
 Gadzooks Inc<sup>2</sup> GADZ \$11 3/16  
 Gap Inc GPS \$69 3/8  
 General Electric<sup>1,3</sup> GE \$109 1/16  
 General Motors GM \$86 15/16

Glimcher Realty Trust<sup>1</sup> GRT \$16 11/16  
 Grainger (W.W.) GWW \$50  
 Gucci Grp GUC \$75 5/16  
 Hartford Life<sup>1</sup> HLI \$52 3/8  
 Hertz Corp HRZ \$61 3/8  
 Home Depot HD \$58 13/16  
 Household Intl<sup>1</sup> HI \$48 1/16  
 Intl Bus Mach IBM \$212 1/8  
 Infinity Broadcasting<sup>1</sup> INF \$26 7/16  
 Intel Corp<sup>2</sup> INTC \$64  
 Intimate Brands IBI \$53 3/4  
 K mart KM \$16 1/16  
 Knight-Ridder KRI \$53 13/16  
 Lands' End LE \$38 13/16  
 Level 3 LVL \$86 5/16  
 Lexmark Intl Grp LXX \$117 1/8  
 Lillian Vernon<sup>4</sup> LVC \$14 3/8  
 Lowe's Cos<sup>1</sup> LOW \$53 1/16  
 Lucent Tech<sup>1</sup> LU \$57 15/16  
 LVMH Moet<sup>2</sup> LVMHY \$55 3/8  
 Macerich Co MAC \$25 13/16  
 Mattel Inc MAT \$25 9/16  
 Maytag Corp MYG \$72 13/16  
 MBNA Corp KRB \$27 1/8  
 McDonald's<sup>1</sup> MCD \$40 5/8  
 MCI WorldCom<sup>2</sup> WCOM \$89 5/8  
 Media One Grp<sup>1</sup> UMG \$76 7/8  
 Merrill Lynch<sup>1</sup> MER \$81 3/16  
 Microsoft<sup>2</sup> MSFT \$79 1/8  
 Morgan (J.P.) JPM \$138 13/16  
 Morgan Stan Dean Witter<sup>1</sup> MWD \$99 3/16  
 Musicland Stores MLG \$11 7/16  
 Nationwide Finl Svcs<sup>1</sup> NFS \$45 1/2  
 Netbank NTBK \$177  
 New York Times NYT \$34 13/16  
 NEXTEL Comm<sup>2</sup> NXTL \$35 7/8  
 Office Depot ODP \$21 1/4  
 Penney (J.C.)<sup>1</sup> JCP \$47 1/4  
 Priceline.com Inc PCLN \$151 3/16  
 Procter & Gamble PG \$91 3/16  
 Progressive Corp PGR \$143 1/4  
 Qwest Comm QWST \$83 3/4  
 Reuters Grp<sup>2</sup> RTRSY \$81

Ross Stores<sup>2</sup> ROST \$47 1/8  
 SABRE Group TSG \$53 7/8  
 Saks Inc SKS \$29 1/16  
 Sears, Roebuck S \$48 9/16  
 Sigma-Aldrich<sup>2</sup> SIAL \$34 13/16  
 Simon Property Group<sup>1</sup> SPG \$28 9/16  
 Spiegel SPGLA \$7 1/8  
 Sportsline USA<sup>1</sup> SPLN \$35 1/2  
 Sotheby's Hldgs BID \$42 3/8  
 Staples<sup>2</sup> SPLS \$29 5/8  
 Starbucks Corp<sup>2</sup> SBUX \$37 1/2  
 State Street Corp STT \$83 1/2  
 Sun Microsystems<sup>2</sup> SUNW \$57 13/16  
 Talbots TLB \$32 3/16  
 Telebanc Fincancial TBFC \$105 1/16  
 Tiffany & Co TIF \$85 1/4  
 Time Warner Inc<sup>1</sup> TWX \$71 1/4  
 TJX Companies TJX \$32 9/16  
 Tommy Hilfiger TOM \$70 5/8  
 Toys R Us TOY \$23 1/16  
 Wal-Mart WMT \$45 1/16  
 Washington Port WPO \$571 7/16  
 Wells Fargo<sup>1</sup> WFC \$43 7/8  
 Whirlpool Corp WHR \$68 1/4  
 Xerox Corp<sup>1</sup> XRX \$60 3/16  
 Yahoo Inc YHOO \$161 5/16  
 Zale Corp<sup>1</sup> ZLC \$37 7/8

<sup>1</sup>PaineWebber Inc. has acted in an investment banking capacity for this company.

<sup>2</sup>PaineWebber Inc. makes a market in this security.

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<sup>4</sup>An officer of PaineWebber Incorporated or Mitchell Hutchins Asset Management Inc. is a director of the company being reported upon.

May 9, 1999

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