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# Looking Back to the Next Century

To follow Messrs. Jim Clark and Desh Deshpande is an honor as well as a risk. I will not make a difficult situation worse by attempting to match their practical insights. My talk will be like a scholarly article -- long on references to others' work and short on practical content. This is as it should be: scholars should develop the knowledge that transcends the passions of the day and without great regard to its immediate utility.

Casey Stengel once said: "I never make predictions - at least not about the future." Instead of trying looking ahead through a telescope, I will hold a mirror to the past and let you think about the degree to which historical patterns will repeat themselves. Hence the title of my talk, looking ahead to the Next Century. Next week I will post the text this talk on my web site www.bhide.net in the hope that some of you might be lured into following the links to buy my book, The Origin and Evolution of New Businesses. Even academics can learn an Internet trick or two to sell their wares.

I will first discuss what past patterns of entrepreneurial activity might tell us about the so-called New Economy -- I'd rather not deal with a short term blip in the longer term pattern, but it hardly seems avoidable. Then we can move on to a centennial perspective.

## I. The New Economy:

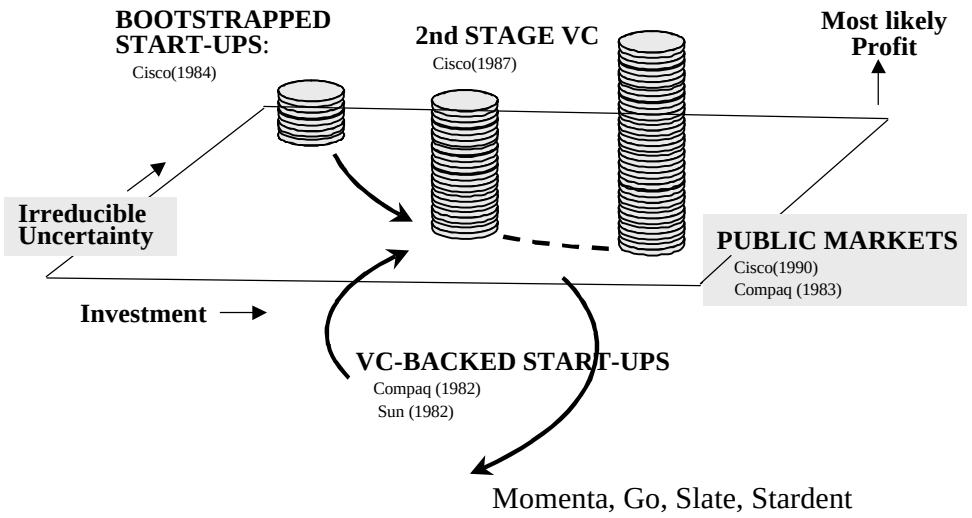
Plainly put, I see significant evidence of a mania whose consequences extend well beyond the valuation of some high technology stocks.* There have been noteworthy manias in our time before -- in the nifty fifty stocks of the early 1970s, in gold and silver in the in 1980 and the Nikkei in the early 1990s. The distinctive feature of this mania isn't that valuations are more extreme -- who is to say whether Cisco's and Intel's stocks are more or less richly priced than was Polaroid's stock in 1972 or Sony's stock in 1992? In previous manias, markets extrapolated from the current trajectory, irrationally trusting that a company whose profits had grown at 30% p.a. in the past would maintain this rate of growth forever. Now, investors are betting on a fundamental change in trajectory, believing that companies making significant losses now will, one day, make

* I characterized technology valuations as a bubble in an interview published in the March 6, 2000 issue of The Industry Standard, a couple of weeks before the NASDAQ made a new high. The timing was entirely fortuitous-- but it does provide an alibi against accusations of following stock charts.

substantial profits. These beliefs affect the basic processes of new business formation and growth.

It is sometimes argued that the pattern of Internet startups is just like the pattern found in the early stages of any new industry. In 1899 there were 30 companies and numerous individuals making automobiles. When the Altair was introduced in 1975, Gates and Allen were among a score of programmers who tried to write a BASIC for the Altair. In the early 1980s Sun was one of 30 companies trying to build UNIX workstations based on the Motorola 68000 chip. What's different now?

In .the normal pattern of entrepreneurial activity, we find an inverse relationship between the uncertainty -- which I refer to in the sense on unmeasurable and unquantifiable risk -- and the investment requirements of new initiatives. The larger the capital requirements, the greater the number of investors who need to be persuaded about the merits. When uncertainty is very high for instance because the technology and market are immature, it is difficult for entrepreneurs who passionately believe in the opportunity and in their own capacities to persuade many investors to back their schemes. So you see lots of entry into automobiles in the late 1890s and software in the mid-1970s, but on a small scale, by self-financed entrepreneurs. As market and technological declines and competition weeds out the weaker entrants, the survivors can scale up their businesses by raising funds initially from a few private intermediaries like VCs and still later from many purchasers of public securities.




Source: Bhide (2000) The Origin and Evolution of New Businesses

The evolution of Cisco from a small, struggling enterprise into the world's leading supplier of the "routers" that link computer networks in different locations conforms to this classical pattern.

Sandy Lerner and Len Bosak started Cisco in 1984. They persuaded friends and relatives to work for deferred pay and financed the venture by running up bills on their credit cards. In 1987, the founders secured funding from Sequoia Capital. At the time the company was profitable and was booking between $250,000 and $350,000 in monthly sales, but it needed cash to finance growth. With Sequoia's capital and recruitment of a seasoned CEO, the company further expanded its revenues and profits, paving the way for an IPO in February 1990.

Some businesses like Compaq and Sun whose strong technologies or teams reduced their perceived uncertainty could secure funding required to start out on a larger scale and accelerate the process. Historically such businesses that received early stage financing numbered only a few hundred a year, and even these elite start ups had to produce actual profits to go public. Startups with star-studded teams like Stardent, Momenta, and Slate, which failed this test and couldn't go public quickly, fell off the map.

Today relatively unformed businesses can raise capital from public markets to scale up businesses that may have great potential but have not demonstrated their capacity to turn a profit. Contrast Sun Microsystems incorporated in February 1982 with Chemdex incorporated in September 1997. Both started with concepts that could lead to substantial long-run profits, had exceptionally capable founders and secured financing from Kleiner-Perkins. The difference? It took four years for Sun to go public and only two for Chemdex. In its pre-IPO fiscal year, sun booked revenues of $115 million on which it earned $8.5 million in net income. Chemdex booked $29,000 in revenues and lost $8.5 million.

By design, Sun turned profitable in its first quarter and has remained so ever since. The first entrepreneurial case I wrote (in 1989) was *Vinod Khosla and Sun Microsystems*. This is what Vinod said in the case:

> We didn't have a big overhead structure because we didn’t have any money to spend. We matched our expenses to our revenue real tight. You might ascribe this to my Indian heritage -- $100k was a huge sum on money. On the first anniversary they presented me with a sharp pencil, because one, I needed it, and two, that was all they could afford they said. But that was pretty much the culture of the company.
>
> We were unlike most startups. Most startups have everything -- marketing, sales, support, advertising, and PR -- in place before they have a product to sell. They get up to $600,000 to $800,000 a month of expenses before they've really started selling anything.
>
> Since we finished the first year and were profitable, people started to look at us seriously. They started to consider us viable. People feel a lot more comfortable with something there and running and profitable, even if it is small, relative to

> nothing there. *There's a radical, nonlinear function between those two.* (Italics added).

Most long lived high technology companies including H-P, Oracle, Microsoft, Cisco, Dell -- have been profitable more or less from the start. Some of them took longer to go public than Sun -- five years for Cisco and ten years for Microsoft -- but when they did, they had built a track record of profitable operation.

I'm not suggesting that the entrepreneurs and VCs of the New Era are more reckless -- they are simply responding to conditions in the capital markets. In the 1980s, profitability was considered an important indicator of a firm's long-run prospects. In 1999, investors were unfazed by Chemdex's warning in its prospectus that:

> We have a history of losses and anticipate continued losses for the foreseeable future.
>
> We have had substantial losses since our inception. We currently expect our losses to increase in the future and we cannot assure you that we will ever achieve or sustain profitability.

The 'radical-non linear difference in perceptions of profitable and unprofitable businesses that Vinod Khosla referred to has disappeared. David Packard's belief that more businesses die of indigestion than of starvation has gone. Faith in first mover advantages and land grabs has become so pervasive that entrepreneurs who might want to grow their businesses at a more sensible pace cannot afford to. If your competition issues public stock before it become profitable, or gives away its product to gain market share, you have to as well. As Machiavelli said "Success or failure depends on conformity to the times."

Perhaps I'm comparing apples and oranges. H-P, Sun, Compaq, Cisco, Dell, Microsoft et al. Started out making discrete units of hardware and software; Chemdex and the other New Economy companies have to build an infrastructure or network and must secure a critical mass of customers before the profits roll in. Very well, lets look at Federal Express, the mother of infrastructure plays from the 1970s. FedEx had to establish a national network of planes, trucks and warehouses before it could even try to generate revenues. Fred Smith had to risk about $8 million in his family fortune and raise $50 million in venture capital and bank debt. The company was incorporated in June 1971 and had its first profitable month in July 1975. It missed many projections and it took small miracles to survive several near death experiences. Its cumulative losses over 26 months of operation before it turned a profit were only $29.3 million or about $93 million in 1999 dollars. And because of skepticism about its long run profitability, Federal Express, which entered the black in July 1975, had wait almost three years, until April 1978, for

its IPO. By contrast, as of 12/31/99 Chemdex had accumulated deficits of $57 million. IVillage, a women oriented network had accumulated deficits, as of 12/31/99 of $193 million dollars. Perhaps the Chemdex businesses will one day rival Federal Express, but iVillage?

The consequences of indiscrimination

What's wrong with this picture? Obviously the lack of profit pressure reduces incentives to scrutinize the costs and benefits of expenditures. More subtly, the easy availability of public equity impairs the trial and error required for the long run growth of new businesses. Some new businesses start out with just the right business model and the right team. But many startups in new and rapidly changing industries, don't always get it right. Success requires what a process of opportunistic adaptation that cannot be easily executed as a public company.

Chemdex for instance is trying to morph into Ventro, a company that builds B2B marketplaces in many industries. This evolution was not anticipated in its business plan or IPO -- according to a knowledgeable source, the company discovered that transactions in specialty chemicals alone could not support the costs of a high quality infrastructure. The new name and strategy initially found favor with the fast money crowd and the stock shot up to $243 on February 25th. When I last looked, it had lost 86% of its value and was trading at $33 a share.

Ventro has a great team and may well deliver on its new vision. In retrospect, $33 a share may turn out to have been a great opportunity. Even so, trusting the kindness of strangers, especially if they happen to be day traders may not be a good policy. Public ownership is good for scaling up a profitable business model, not for trying to develop one. FedEx had to make important changes to its marketing strategy to attain profitability. I wonder if Fred Smith would have pulled off these changes if FedEx had already been public. Disclosure rules that require you to advertise "going concern" opinions from your accountants, stock prices that fluctuate like yo-yos and the threat of class action suits do not facilitate the process of learning or trial and error.

Corrective Mechanisms

What might end this mania? New Era IPO valuations involve inherent contradictions. They anticipate significant long-lived profits, which require the effort of talented personnel for many years after an IPO. But because valuations anticipate so much, the greatest rewards lie taking companies public, which in turn creates a strong incentive for the brightest and the best to not hang around afterwards. If the purchasers of stock came to understand this dynamic, the IPO market might become more discriminating.

Even if the day traders don't come to their senses, new supply will eventually overwhelm the market. Hot IPOs have done wonders for VC returns. Returns from investments in venture

capital funds between 1981 and 1996 were indistinguishable from the returns from investing in publicly traded stocks, because the write-offs from investments in Momenta and Stardent partially offset the fabulous returns from investments in Cisco and Sun. After 1996 as the IPO market has become less discriminating, VC portfolios involve fewer write-offs, holding periods have shrunk and exit values have multiplied. Name brand VCs have earned annualized returns in excess of 100% a year.

These returns have attracted many new entrants and substitutes. The investment banks who underwrite IPOs have moved up the value chain and put billions of dollars into their venture capital activities. All of the top consulting and accounting firms have set up incubators, which are also sprouting like dandelions in spring on university campuses.

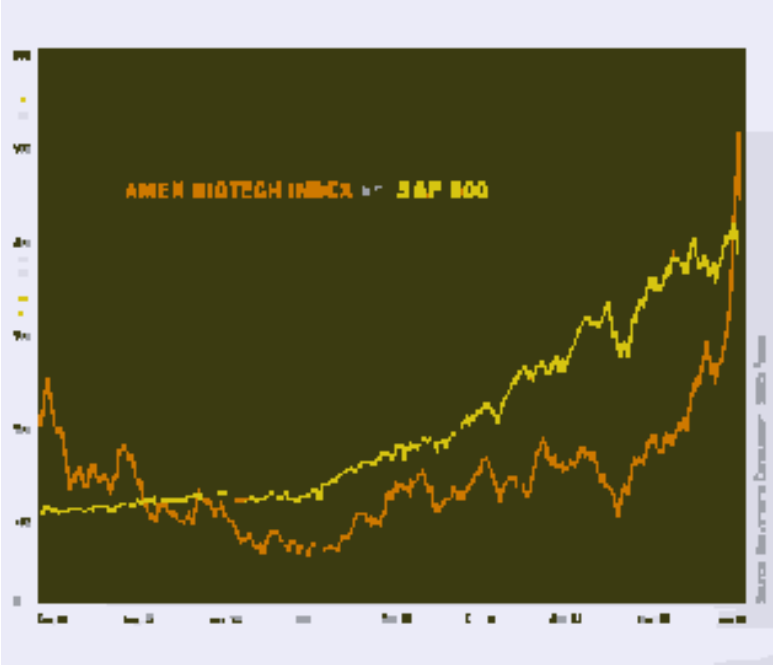
Cynics suggest that the nuveau VCs and near VCs, resemble the English railroad promoters of the 19th century whose business was the manufacture of stocks, not the provision of transportation. Whatever their motivation, by joining the gold rush, they will help bring it to an end. The profit motive will eventually provide its attendant social benefit.

In debunking extravagant claims about a new era, I do not want to overstate the downside either. I don't want to become the Ravi Batra of 2000, though I wouldn't mind his book sales. Batra's book, *The Great Depression of 1990* spent several weeks on the New York Times best seller lists. Not all New Era companies are profitless wonders --eBay was profitable from the start and Yahoo turned profitable fairly quickly. Provided the mania does not continue to spread for a long time, the restoration of sanity, whether sudden or gradual, will not bring this economy to its knees. With some exceptions -- day traders-- for instance, we will on balance come out ahead. The great technology companies like Microsoft, Sun and Cisco will not suffer great injury because of declines in the price to earnings ratios of their stocks -- they will be able to retain employees more easily and make acquisitions more cheaply. A more discriminating venture capital and IPO market will discourage MBAs who (like myself!) are best suited for careers in professional firms or academia from starting dot.coms; this will clear the field for individuals who have the innate desire and capacity to build lasting businesses. Fairly or not, the founders of economically unviable companies will come out ahead if they sell out or take some money off the table in time. The best location in an insane world may be inside the asylum. And as consumers we will enjoy the benefits of technologies whose development the irrationally exuberant have subsidized.

The boom and bust in biotechnology provides a good preview. In the early 1990s financial markets seemed to take the view that genetic engineering would help cure every disease that afflicts mankind. Companies whose name included some part of the words *biology*, *technology,*

*or genetics* could issue stock without any obvious route to profitability. To replenish the IPO pipeline, VCs courted PhDs and MDs with implausible business plans. Then the bottom fell out. According to Josh Lerner's data, the total external financing raised by U.S. bio technology firms fell by more than half in just two years – from over $5 billion in 1992 to under $2 billion in 1994. Biotechnology stocks had a wilder ride. The Amex biotechnology index peaked at 250 and in the next two and a half years, proceeded to lose 80% of its value. It would take almost another decade to regain that peak.



Source: Bioventure consultants stock report

But, its worth remembering, research into new drugs and therapies, and the formation of new companies didn't come to an end. It merely reverted to more sensible patterns. And although biotechnology did not meet the extravagant initial expectations, it has and will continue to make significant contributions to medicine. So it will be with the so-called New Economy. Valuations and expectations will fall, but not forever. A valley lies before us; we aren't standing on the edge of a precipice.

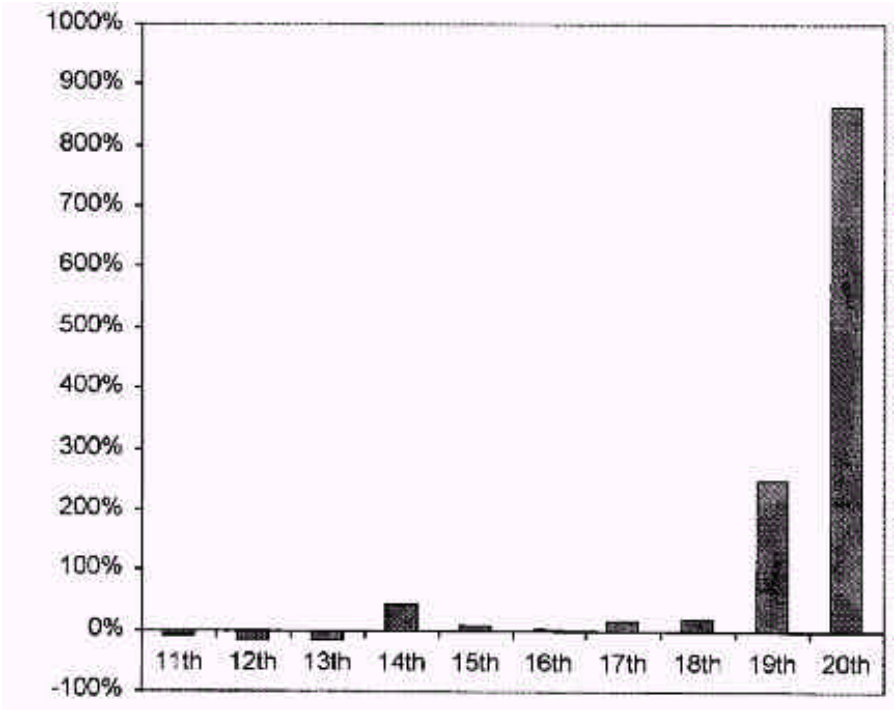
Enough about the short term; on to the 20 century retrospective.

## II A Century of Innovation

We are approaching (it doesn't actually end till December 31st 2000) the end of a most remarkable century. According to the economist Delong, the 20th century saw "the material wealth of humankind explode beyond all previous imagining."[1] DeLong estimates that per capita growth in the 20th century was more than three times the rate seen in the 18th century, which in turn had been several times the rate in any previous century.*

Growth in Real World GDP per capita



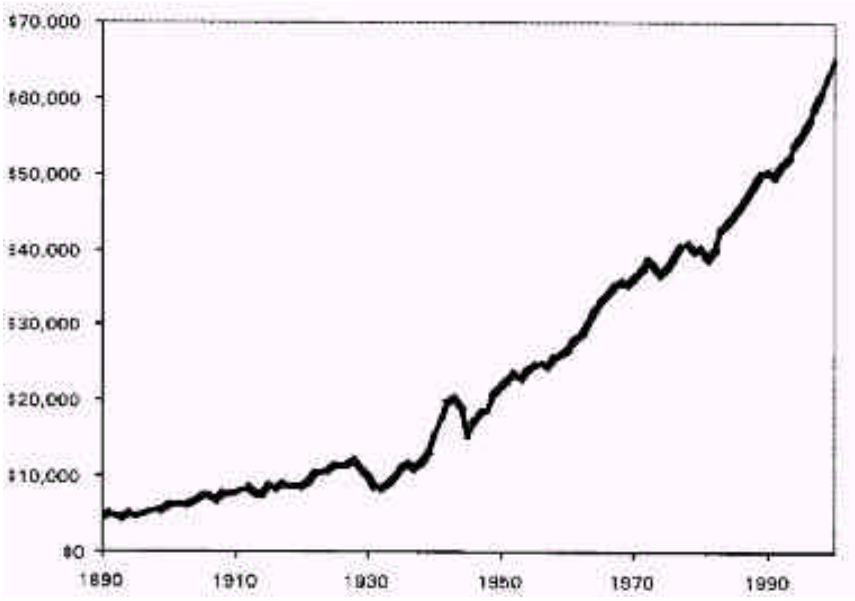

Source: © 2000 by J. Bradford DeLong , NBER working paper 7602

Although according to DeLong virtually all of humankind saw improvements in material well being, growth rates were strongest in the industrial nations of the West. For the U.S., DeLong estimates a ten and a half-fold increase in (quality adjusted) real per capita GDP in the 20th century.

* DeLong's estimates attempt to make conservative adjustments for increases in the range and quality of goods and services that affect our standard of living, but which the usual measures of GDP growth do not reflect. Comparisons of GDP between the 19th and 20th century for instance do not take into account, for instance our enjoyment of airplane travel, CDs or the medicines that enable us to lead longer, healthier lives.

U.S. Estimated GDP per capita




Source: © 2000 by J. Bradford DeLong (2000), NBER Working Paper 7602

The patterns of growth depicted in the charts raise two sets of questions. First, why was growth in the 20th century more or less continuous? In the 19th century, several depressions interrupted economic growth; the 20th century saw but one depression. As with any economic series, per capita GDP does not fit a totally smooth curve. But viewed from an appropriate distance the zigs and zags in the U.S. per capita GDP chart disappear. As DeLong puts it, after the set back of the Great Depression, a broad upward sweep is the central feature. The 1970 and 1991 recessions, the 1974 oil shock and the 1982 inflation reduction depressions are but small ripples or notches. Why didn't growth follow a more stop and go pattern?

Second, why did the rate of economic growth increase after the second industrial revolution? The great growth spurt of the 19th century took place during the second industrial revolution, which is regarded to have started in 1850. Not only was growth in the 20th century much faster than growth in the 19th century, it seems to have gradually but perceptibly picked up speed as the second industrial revolution drew to a close in the early 20th century.

Determinants of Growth

In the models of classical economists, long run growth resulted from increases in labor and capital -- the so-called factors of production. The more fecund and thrifty a population the faster

the economy should grow. The growth of per capital GDP (which controls for population) was thus largely a function of the savings rate.

Joseph Schumpeter, one of the few, and certainly the best known, economists of the 20th century to recognize the importance of entrepreneurship, questioned the classical growth model. Schumpeter argued that that new technologies and "combinations" that disrupted the prevailing equilibrium, rather than say, the steady accumulation of capital stock, led to the long term growth and development of capitalist economies. Economist Robert Solow's 1956 and 1957 papers seemed to bear out Schumpeter's claim. They reported, according to the economist Stiglitz, the "shocking" empirical finding that "most of the growth of the economy over the past century had been due to technological progress."[2] According to Solow, an increase in the use of capital accounted for only 12.5 percent of the doubling of gross output per man hour from 1909 to 1949; the remaining 87.5% was due to "technical change."[3] These results point to the critical role of entrepreneurship in economic growth, because as the economist Baumol puts it, any technical change or innovation "will require entrepreneurial initiative in its introduction."[4]

Another intriguing result discovered in follow-up studies to Solow's work relates to changes in the relative contribution of innovation and entrepreneurial activity. Rough estimates compiled by the London School of Economic's Nicholas Crafts suggest that capital accumulation made a larger contribution to growth than did technical change in the 19th century; innovation really came into its own in the 20th century.[5]

Broad-based innovation

Innovation did not become a more potent economic factor in the 20th century because of an upsurge in raw invention however. New products were 'invented' at a remarkable pace in the previous century. The inventions credited to the period 1850 to 1900 include the monorail, the telephone, the microphone, the cash register, the phonograph, the incandescent lamp, dynamite, the electric train, linotype printing, the steam turbine, the gasoline engine, the street car, movies, motorcycles, automobiles, refrigerators, concrete and steel construction, pneumatic tires, aspirin, and x-rays. These inventions arguably play at least as significant a role in our lives as the inventions credited to the entire 20th century. Rather the distinctive feature of the 20th century economy lies in the conversion of rudimentary inventions into products that many can use. This conversion involves a complex sequence of activities undertaken by many individuals and businesses. Modern innovation has been broad-based, affecting virtually all members of society as consumers and as producers.

19th century inventions were made by a few individuals. Edison brought forth a remarkable cornucopia including incandescent bulbs, motion pictures, and gramophones, from a small facility in Menlo Park (New Jersey, not California) with fewer employees than the typical Silicon Valley startup. Alexander Graham Bell had one assistant. Automobile pioneers were one or two man shows -- Karl Benz and Gottlieb Daimler in Germany, Armand Peugeot in Franc and the Duryea brothers of Springfield, Massachusetts.

But one or two person outfits couldn't develop products for mass consumption. The early automobiles were expensive and not very useful contraptions, owned according to Stanford economist, Nathan Rosenberg by a few buffs who rode around the countryside terrifying horses. Turning a raw invention ("initial basic conceptualization of a product or process") into an economically significant innovation requires according to Rosenberg, "an extensive process of redesign, modification, and a thousand small improvements which suit it for a mass market, for production by drastically new mass production techniques, and by the eventual availability of a whole range of complementary activities, ranging, in the case of the automobile, from a network of service stations to an extensive system of paved roads.[6]" All this takes more than a few brilliant inventors.

In the 20th century the tasks of converting inventions into mass-market products pervaded Western society. As often as not, the pioneers paved the way for followers who build on and refined the first offerings. Planned and unwitting collaborations, taking place simultaneously and in sequence led to substantial improvements in our standard of living. And although the rewards were not uniformly distributed, many individuals involved in the process shared in some of the immense value they created for consumers. Innovation by the people and for the people engendered broad-spread prosperity.

Consider the evolution of microcomputers. My current laptop (a sadly out-of-date 1996 model) which provides more processing power and functionality than did the computer center of my undergraduate engineering college seems to have little in common with its 1975 ancestor, the Altair. Altair aficionados derived less practical use from their machines than did the turn-of-the century automobile buffs. Lacking basic input or output devices (such as keyboards and printers) Altairs could not even scare horses. Numerous innovations -- such as electronic spreadsheets, the mouse and graphical user interfaces turned this oddity into a ubiquitous artifact.

Continuous improvements and refinements in performance and features have been a hallmark of the industry -- Excel 7.0 has come a long way from the first spreadsheet, VisiCalc. Complementary innovations have played a crucial role in such improvements: Excel 7.0 could not

have been implemented on earlier generations of hardware. The introduction of new microprocessors, storage devices, application and operating system software, communications technologies (such as local area networks and the internet), innovations in manufacturing and distribution (such as the "build to order" process) and the opening of new market segments (such as home computing) have reinforced each other and sustained a virtuous cycle of ever improving price-performance.

This multi-faceted development process has provided a valuable product for hundreds of millions of consumers; and, unlike the solo inventors of the 19th century there is a long list of entrepreneurs, investors, and employees of high tech firms who played a role in the process and to varying degrees harvested a reward. They include Ed Roberts, Gates and Allen, Jobs and Wozniak, Dan Bricklin, Mitch Kapor, Metcalf, Michael Dell… if I had all names of all the Dellionaires in Austin and the Microsoft millionaires, I'd probably spend the rest of the afternoon reciting the list. And to the degree that industrialized economies of the 20th century had more of their populace contribute to and benefit from innovative activity in the PC and other industries, we should expect them to have experienced more rapid per capita growth, than in the 19th century, even with fewer dramatic 'inventions.'

The protracted, multi-stage process may also help explain the steadier nature of 20th century growth. Schumpeter's model, which may have sought consistency with the major booms and busts of the 19th century and the Great Depression, involve periodic major innovations followed by routine diffusions of the innovation. A more incremental, on-going process of innovation we should expect should not be as affected by or have as great impact on fluctuations in economic growth. And indeed we observe that the 1982 recession, the deepest in the U.S. after the Second World War, did not seem to retard the brisk pace of innovation in the PC industry. It is impossible to estimate the degree to which those innovations helped moderate the recession, but it could not have hurt.

We could point to several complementary developments that helped make the 20th century a period of broad-based innovation. Today I will focus on two: the emergence new organizations that increased the diversity of the economic system; and second, of a societal consensus that embraced change.

Diversity and Specialization

The growth of new forms of organization, most prominently, the large professionally managed corporation, facilitated the efficient coordination of the initiatives required to commercialize new

products and technologies. These organizations did not however make individual entrepreneurs and owner managed firms -- the dominant economic actors of the 19th century obsolete. Rather the new and old forms complemented as well as competed with each other. The 20th century economy comprised a diverse economic system with different forms specializing in different types of innovative activity.

According to the historian Alfred Chandler, a "new form of capitalism", the "large managerial business enterprise", appeared in the last half of the nineteenth century.[7] This new form, which was controlled by a hierarchy of salaried executives rather than the owners, "dominated the core industries in the United States"[8.] by the end of World War I and by the 1960s, it became ubiquitous. In 1967 Galbraith observed that the five hundred largest corporations produced nearly half the goods and services annually available in the United States. Galbraith wrote: "Seventy years ago the corporation was still confined to those industries—railroading, steamboating, steel-making, petroleum recovery and refining, some mining—where, it seemed, production had to be on a large scale. Now it also sells groceries, mills grain, publishes newspapers, and provides public entertainment, all activities that were once the province of the individual proprietor or the insignificant firm."[9]

Large corporations represented as dynamic an economic force as the individual entrepreneurs who had initially founded them did. Schumpeter placed the individual entrepreneur at the center of the innovative process in his early work, but later claimed that the large corporation would inevitably usurp the entrepreneur's role. His 1911 book, The *Theory of Capitalist Development* credited capitalist innovation to entrepreneurs with the 'dream and will to found a private kingdom' and the 'will to conquer.' The 1934 work, *Capitalism, Socialism and Democracy* placed kingdoms ahead of conquerors. In creating the giant enterprise, Schumpeter now declared, entrepreneurs had eliminated their own function. The "perfectly bureaucratized giant industrial unit" could automatically discover and undertake the 'objective possibilities' for innovation. It had "come to be the most powerful engine of progress."

Large corporations did in fact undertake entrepreneurial functions remarkably well. They brought us jet engines, television sets, plastics, pharmaceuticals, mainframe computers, and a host of new products to market. Domestic companies ventured overseas and became multinational. They also experimented with and adopted new forms of decentralized organizations to accommodate their increasing size and scope. Schumpeter's "perfectly bureaucratized giant industrial units," to use Chandler's words, "provided a fundamental dynamic or force for change in the capitalist economies".[10]

Managerial capitalism, to use the historian Alfred Chandler's terms, did not eliminate entrepreneurial capitalism. Owner managed companies, which receded to the background after the Second World War, still did account for nearly half of economic activity. The new products and markets developed by Ken Olsen's Digital and Edwin Land's Polaroid were on par with those developed by the professionally managed IBM and Kodak. Startups created new industries, such as xerography and cable television.

Events in the 1970s shook common beliefs about the omnipotence of large corporations. "The big corporations," Galbraith once wrote, "do not lose money." In the recession of 1957 he noted, "not one of the largest U.S. Corporations failed to turn a profit. Only one of the largest 200 finished the year in the red." Subsequently, however, large firms were no longer immune to losses. Penn Central filed for bankruptcy; Lockheed and Chrysler were spared this fate by federal bailouts. In the recession of 1982, eight of the top 100 industrial companies and 21 of the largest 200 ended the year with a deficit. Employment in large companies topped out as well. In 1979, David Birch published a study that claimed that small firms generated 66% of all new jobs created in the U.S whereas "middle sized and large firms, on balance, provided relatively few new jobs."[11]

Our views about large companies seem to have been completely reversed -- many now believe that the model is obsolete, and that giant corporations should emulate startups -- 'bring the Silicon Valley inside' according to an award winning article in the Harvard Business Review. This New Era thinking reminds me of an article I co-authored for the Wall Street Journal, in June 1981. The consensual Japanese model was in the vogue -- Ezra Vogel's 'Japan as Number One' would soon become a hit. In "The Crucial Weaknesses of Japan Inc." I wrote:

> Japanese aircraft and aircraft engines do not traverse the skies as Japanese ships sail the seas. Japanese pharmaceuticals do not minister to the illnesses of the world… the adventurous oil driller speaks English, even in the South China Sea.
>
> This tapestry of success and failure is understandable if it is acknowledged that like other forms of human organization, Japanese society has both strengths and weaknesses…
>
> Consensus smothers mavericks. Homogeneity breeds ethnocentricity… Capital is cheap for the project that is acceptable to a like-minded group of managers and bankers but can be altogether denied to a visionary entrepreneur….
>
> consultation among salesmen, engineers and production workers may lead to a fine long-term plan to offer a cheaper, better quality TV set every six months. But it takes a highly individualistic Hong Kong entrepreneur to succeed in the rapidly changing, boom or bust market for high fashion garments or electronic toys.

It took more than ten years after I wrote this article for the weaknesses of the Japanese system to be recognized. Now when there is an obsessive interest with what's wrong with Japan, the time has come perhaps, to write about the Crucial Limitations of Silicon Valley.' In fact a single economic form cannot sustain broad-based innovation: vibrant economies require diversity. With the benefit of hindsight at least, we should recognize that the growth of large corporations in the 20th century represented an increase in this diversity rather than a displacement of the entrepreneurial firm. Very roughly the large corporation went from a negligible share of GDP in 1890 to about half in 1950. But over that period, quality adjusted GDP, more than quadrupled. So the total output of the smaller firms must also increased substantially.

The debate about whether Schumpeter was right in his claim that large firms are better equipped to innovate than startups and small firms seems to miss the larger point about why both forms have prospered side-by-side. Companies on the Fortune 500 list and startups that go on to make the *Inc.* 500 list play complementary rather than overlapping roles. The David versus Goliath image misrepresents reality -- startups like Compaq and Netscape that take on IBM and Microsoft are exceptions, because the typical entrepreneur does not have the resources to take on the giants. Rather, startups typically pursue small and highly uncertain opportunities, in the northwestern region of the investment-uncertainty map that I showed you earlier, whereas the comparative advantage of the Fortune 500 lies in undertaking much larger and less uncertain projects which occupy the Southeastern region of the map. These different kinds of initiatives reinforce each other in the multi-faced and protracted process of innovation.

Companies like IBM enjoy several advantages in undertaking large initiatives. The most obvious one derives from their capacity to mobilize significant capital from investors. Besides capital, large initiatives usually also require significant irreversible commitments by many customers, employees and other resource providers. An established corporation’s base of tangible and intangible assets provides advantages in securing such commitments. Cash flows from existing businesses and access to capital markets allow the established corporation to offer credible contractual safeguards to the resource providers. Prior reputations help engender the confidence that the corporation will not behave opportunistically in matters that cannot be contracted for and honor promises that are necessarily vague – for example, to not “punish” employees for failed initiatives or provide the “good” after-sales service.

Established corporations also have an advantage in solving the coordination problems involved in launching large initiatives. Major projects, which seek to exploit economies of scale and scope, involve securing the joint effort of many personnel and solving conflicts among the providers of

specialized resources. Established companies with well-developed coordination mechanisms have obvious advantages in doing so.

The microcomputer revolution illustrates the important contribution of established corporations. According to Steffens, the 'entry of large established companies from the computer, office products and consumer electronics industries (like, IBM, Xerox, DEC, NEC and Sanyo) between late 1981 to the end of 1982 'legitimized' personal computers. IBM utilized its "enormous market power and committed significant resources."[12] The company established "a highly automated, high volume assembly plant which provided significant economies of scale." It encouraged third party software houses to develop higher performance applications. It "made use of bulk discounting to switch the purchasing channel from individual users to corporate buyers." IBM, which then accounted for sixty-one percent of worldwide general-purpose mainframe computer market, "effectively legitimized the personal computer in the minds of data processing managers in large organizations." It broke down a "major psychological marketing barrier, namely the attitude that had existed within many DP [data processing] departments that personal computers were an unfortunate nuisance and certainly not part of the corporate management information system." IBM's penetration of the corporate market was so successful that the company could not satisfy demand for approximately eighteen months. This created an opportunity for many startups to develop IBM compatible machines or "clones."[13] IBM's entry also led to "increasing professionalism in the industry" and forced competitors to invest in marketing activities, especially in advertising, distribution and service support."[14]

Substantial investments by Intel, and after the late 1980s, by Microsoft, have sustained on-going improvements in performance and reductions in costs. Intel spent more than $4 billion to develop the Pentium family of microprocessors. Development costs for the Merced (P7) chip are expected to exceed $8 billion.[15] Intel has also invested heavily in making and marketing its microprocessors. One new semiconductor fabrication facility costs well in excess of $1 billion to build, and in 1997, the company spent $3.5 billion in the Sales, General and Administration (SG&A) category. Microsoft has spent similar amounts in developing and marketing software. In 1997 for instance the company spent $2.5 billion on R&D, slightly under 20% of the $13 billion it booked in revenues.[16]

Individual entrepreneurs complement the role of large corporations by undertaking initiatives that the governance structures and long-term orientation of large companies preclude them from undertaking**.** The checks and balances required to meet the directors' "duty of care" and to secure the trust of diffused stockholders gives the executives of companies like IBM access to large amounts of capital. The checks and balances also limit however a firm's capacity to pursue

small, uncertain initiatives. By filling this opportunity space, bootstrapped entrepreneurs help incubate technologies whose promise is initially unknown. Many new “disruptive” technologies, according to Christensen, cannot initially compete in mainstream markets and can only be sustained in out-of-the way niches. In 1975, for instance, the personal computer was a poor substitute for mini- and main frame computers and was of interest mainly to hobbyists. Corporate decision-makers (or any other objective analysts for that matter) cannot predict which offbeat products and technologies will enter the mainstream; individual entrepreneurs who have the capacity and incentive to pursue uncertain, niche projects help select and develop the ‘fittest’ ones. Between 1975 and 1980, for instance, tinkerers and enthusiasts conducting low-cost, and not particularly scientific, experiments with personal computers, refined the technology and developed commercial applications that broadened its appeal. The cumulative efforts of a diffused band of individual entrepreneurs reduced the uncertainty about the size of the potential market and paved the way for IBM to enter the business. A similar pattern, we may note, later emerged with Internet technologies.

The willingness to pursue niche opportunities helps propagate innovations after they have become recognized. New businesses provide complementary goods and services whose revenue potential is too small to interest established companies. In the 1980s for instance, startups provided services such as installation and maintenance and products such “add-on” hardware and software and educational books and videos that both took advantage of and helped advance IBM’s efforts to make the PC a mainstream product.

Opportunistic entrepreneurs relieve the inflexibility that arises because of the adherence of established companies tend to adhere to long-term strategies. Large companies build valuable know-how and reputations by steadfast adherence to rules about the markets they will serve and the services that they will provide. These rules can sometimes lead to sub-optimal practices. When IBM introduced its PC, for instance, it offered standard levels of service and support. For some sophisticated customers the standard was too much and for some technical novices it was too little. Similarly, when PCs were in short supply IBM’s policy of treating dealers ‘equitably’ led to a geographic distribution of machines that did not reflect differences in demand. IBM would not ship more product to regions where customers placed a high value on PCs and were prepared to pay a premium to obtain them. New businesses that took advantage of such misallocations helped mitigate their consequences. Some sold PCs at a low cost to customers who did not need much hand holding and service; others (the so called “Value-added-resellers”) charged premium prices to customers who did. Upstart businesses also operated ‘gray’ markets, buying surplus machines from authorized IBM dealers and selling them in territories where PCs were in short

supply. Thus IBM could maintain its reputation for treating authorized dealers equitably while entrepreneurs helped place its computers in their highest valued use.

Entrepreneurs similarly help mitigate the costs of standardized employment policies that large corporations adopt. Corporations try to recruit individuals who will fit their culture and norms in order to promote cooperation and teamwork. Such policies however, limit their ability to employ the best individual for a given task, especially in the early stages of a technology, when many of capable individuals lack the backgrounds and temperaments that suit the organizational climate of a large corporation. Corporations can reduce this problem by contracting out tasks to startups that can 'make do' with difficult staff and where there isn't much teamwork or organizational climate for quirky individualists to disrupt. IBM can secure the use non-conformist programmers without compromising its culture by turning to startups who can best utilize their talents. Startups can also help established corporations, whose employment policies are optimized for long-term relationships, fill their transient needs for labor.[17] Companies like IBM have historically adopted policies such as a commitment to promote from within and to provide job and income security in order to encourage employees to internalize organizational objectives and acquire 'firm specific' skills that have limited value to other employers. The effectiveness of such policies depends on the constancy of their application. Unlike the firm promises in written contracts, these policies often have an ambiguous 'best efforts' quality: for instance, corporations 'favor' internal promotions but do not rule out hiring outsiders; unless the circumstances are clear cut deviations impair credibility. Moreover, in order to promote solidarity and teamwork, the policies have to be uniformly applied: corporations cannot easily offer job security just to employees from whom they wish to elicit high 'specific' investment in human capital.

The difficulty of discriminating between employees poses an acute problem in the development of new technologies and markets. In the early stages of a product or industry, firms have needs for labor that disappears later. For instance, marketing personal computers initially required considerable hand holding and missionary selling; as consumers gained experience and comfort with the product, their need for such service declined. Established companies that employ staff for these transient services who they later dismiss, risk tarnishing their reputations as good employers. They can instead rely on startups, whose staff do not expect much job security and often lack many employment alternatives, to satisfy these needs.

## Embracing Change

Social beliefs about change encouraged individuals and organizations to undertake entrepreneurial activity. In 1910 the great sociologist Max Weber argued that the 'Spirit of

Capitalism' derived from religious conviction. Merchants and industrialists believed they had a duty to strive for wealth as well as a duty to lead austere lives; hence they accumulated capital. But 20th century advances turned on more than the availability of capital. Thrift, the respect for law and for economic liberty and other such attitudes necessary for growth in the 19th century continued to be important but broad-based innovation required a wider set of beliefs.

A free society cannot conscript its members to work on new technologies and innovations. Companies can assign employees to R&D projects, but such personnel are free to leave. More over a single organization or individual cannot develop a significant innovation. Many have to tacitly or explicitly believe that it is worth making the effort, that the benefits will exceed the costs. In this century, the belief that change is desirable and inevitable grew beyond a few visionaries and affected the cost and benefit calculations of large portions of the population. You grew rich by pursuing the New, New Thing. If you didn't, you got left behind. Machiavelli's oft repeated claim, that "there is nothing more difficult to take in hand, more perilous to conduct, or more uncertain in its success, than to take the lead in the introduction of a new order of things" seemed obsolete. Individuals and organizations came to see stagnation as the risky choice.

Their growing acceptance turned such beliefs into self-fulfilling prophecies. Gordon Moore's famous "law"—which he proposed in an *Electronics* magazine article in 1965, provides a classic and important illustration of the relationship between the expectations of advances in technology and the realization of such advances. We cannot properly call Moore's 1965 observation, that the number of transistors that built on a chip doubles every eighteen months, a natural or economic law. Transistors are not rabbits, with a genetic impulse to shrink and multiply; putting more transistors on a chip requires the purposive investment of time and money. Nonetheless, Moore's observation has become an influential self-fulfilling prophecy. Semi-conductor companies, who believe in Moore's law, invest the resources needed to make it come true. Downstream customers, (such as PC manufacturers) and providers of complementary goods to their customers (such as applications software companies) design products in anticipation of the eighteen months cycle. So when the new chips arrive they find a ready market, which in turn validates beliefs in Moore's Law and encourages even more investment in building and using new chips. Indeed survival in the IT industry requires competitors to build constant improvements in the performance of transistors into their development plans.

To be sure society did not unquestioningly embrace innovation. Reaction to labor reducing innovations which dates back to the Luddites who smashed textile machinery and continues to find expression in the protests of small retailers against the expansion of Wal-Mart. Delong argues that 20th century tyrannies which more brutal than in any previous century had their roots

in the "feelings of social dislocation and disquiet" generated by advances in technology and organization. Why didn't such reaction slow down economic progress or exhaust the innovators.

Faith in progress outweighed the skepticism in part because the actual disruptions created by innovation are considerably lower than the inchoate disquiet that change often engenders. Champions of innovative activity, like the Luddites, exaggerate the pace and incidence of the destruction it generates. “A perennial gale of creative destruction” wrote Schumpeter "is an “essential fact about capitalism. It is what capitalism consists in and what every capitalist concern has got to live with.”[18] The Schumpeterian imagery shows up in recent books like "Blown to Bits". Destruction apparently is the price of innovation: the automobile must displace the buggy makers and mass merchandisers must put the country store out of business. The innovator combines the roles of Shiva the Destroyer and Brahma the creator, of the mobs of the French revolution who overthrew the *ancient regime* and Napoleon who founded an empire on its remains. Although we can find striking cases that support the gale of destruction metaphor, we should not confuse what's vivid with what's representative. Extensive coverage of the Columbine shootings ought not to lead us to require bulletproof school uniforms. "New combinations" usually displace existing structures gradually rather than through a sudden cataclysmic gale.

The considerable refinements and development of complementary goods needed to make new technologies commercially viable limits the rate at which they can displace existing products and processes. It took five years after the introduction of the Altair for Dan Bricklin and Bob Frankston to develop VisiCalc, the 'killer app'. It took decades after the appearance of the Internet on university campuses for Tim Berners-Lee to begin weaving the World Wide Web.

Moreover, unlike urban redevelopment projects that must first level decrepit structures, innovations usually start out on virgin ground. Cost and unreliability often preclude new technologies from serving existing mainstream needs. The early automobiles were too unreliable a substitute for stagecoaches to deliver mail and too expensive to satisfy mainstream transportation needs; like the early PCs, they appealed instead to the enthusiasms of a few individuals for trendy products.* Customers’ switching costs and prior investments make them unwilling to adopt new technologies for current needs. For instance, after the 1980s personal computers became cheap and reliable enough to migrate from the fringe hobbyists market into commercial use. But even as PCs sprouted in offices everywhere, they did not displace many traditional main-frame applications, because of the great cost that turning over the installed base entailed, not to mention the reluctance of many MIS personnel to obsolete their personal human

* Schumpeter himself noted that innovations create the needs they satisfy rather than fill preexisting needs. In *Business Cycles* ((1939) he cited the example of automobiles.

capital. Spreadsheets, the “killer application” that created a commercial market for personal computers allowed users, many of who had not previously used computers extensively, to perform analyses and simulations that they would not have otherwise performed.

Serving new markets is less risky and expensive for innovators than attacking existing ones. Machiavelli deemed attempts to establish a new order perilous because "the innovator has for enemies all those who have done well under the old conditions, and lukewarm defenders in those who may do well under the new." Serving new needs limits the resistance offered by the old order and the capital requirements of a new venture. Moreover, decision-makers in large, well-established companies have the capital to attack the existing order have a strong bias against cannibalizing their existing businesses. Robert Cringely, who has written a popular history of the industry, suggests that IBM executives backed its PC initiative in 1980 because they thought personal computers would not reduce the demand for IBM’s other products.[19]

The role of PCs in expanding the pie rather than destroying existing technologies represents a common pattern. Airplanes did not reduce the demand for automobiles; they increased the total volume of travel. Microwave ovens secured their place in the modern kitchen alongside the traditional stoves and ovens. Mobile phones have not reduced the number of landline connections.

To be sure, some new technologies have attacked existing products from the outset. Sun and other microcomputer based engineering workstation manufacturers targeted their products against mini-computers. The new on-line services such as Travelocity, Amazon, and E-trade compete against traditional travel agencies, bookstores and stockbrokers. It seems implausible to me, however, that the growing importance of information technology in the economy derives, to any significant degree, from displacement effects. According to a 1998 U.S Department of Commerce report, the share of the information technology (IT) sector (computing and communications) grew from 4.2% of the gross domestic product of the United States in 1977 to 6.1% in 1990 to 8.2% in 1998.[20] This is probably not because computers have displaced traditional goods and services. Rather, IT has accounted for a disproportionate share of growth: according to the Department of Commerce IT industries have been responsible for more than one quarter of real economic growth[21] that is, about three times their share of the economy.

Of course, new combinations can undermine older businesses without competing for their customers, by drawing away capital, labor and other inputs. Fast growing companies offer investors and talented individuals opportunities for capital gains and excitement that firms in slower growing fields cannot. The stock market provides a striking indicator of the appeal of IT

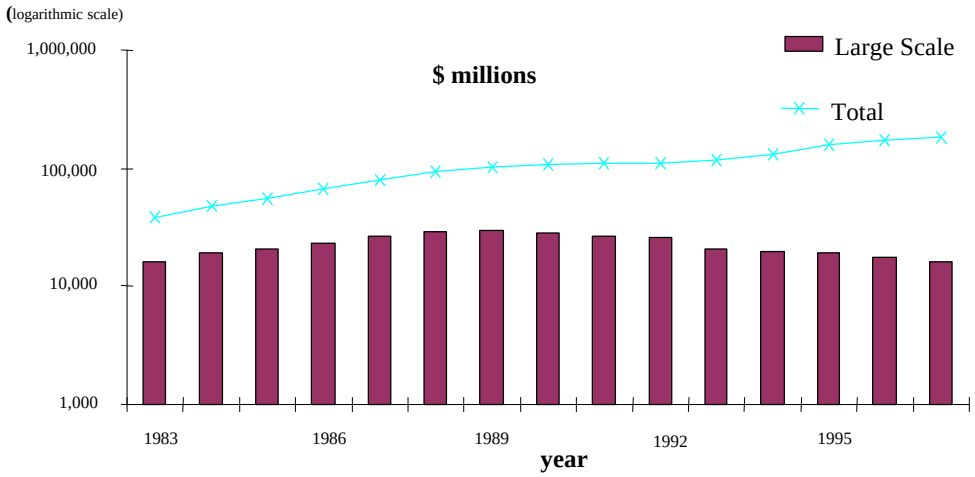
companies. The Department of Commerce report on IT notes that the collective market capitalization of five large companies – Microsoft, Intel, Compaq, Dell and Cisco, grew to over $588 billion in 1997 from under $12 billion in 1987. IT industries also offered workers higher compensation. The Department of Commerce estimates that the 7.4 million people employed in the sector earned about $46,000 a year compared to an average of $28,000 in the private sector.[22] Such differentials do sap the vitality of slow growing companies and industries, but the process is insidious and gradual.

Similarly, in the long run, technologies that initially serve 'new' needs and can take over traditional markets. Automobiles and trucks did replace buggies and stagecoaches and packet-switched Internet telephony may someday make the existing circuit based telecommunications obsolete. But the displacement often takes place at a much slower rate than the hype about the obsolescence suggests. In 1938, the New York Times observed that the typewriter was "driving out writing with one's own hand," yet Petroski reports the sale of 14 billion pencils in 1990.[23]

Newer computer architectures have taken away share from mainframes, but over 30 years after the introduction of minicomputers and more than 20 years after the introduction of microcomputers, the mainframe remains an important category. Total worldwide revenues of large-scale computer processors (or mainframes) amounted to $16 billion in 1997 compared to $16.2 billion in 1982 Their share of the total computer market dropped considerably in that period, from about 42% in 1982 to about 9% in 1997 as total demand grew from $38 billion to $183 billion. Although its share of total revenues has declined considerably, IBM's mainframe business continues to be large and profitable. In 1997, mainframes and their associated storage devices generated $5.7 billion for the company. Networks of smaller processors may eventually make mainframes extinct but their destruction will not be the consequence of a cataclysmic "gale of creative destruction."

**COMPUTER PROCESSOR REVENUES**




Note: Includes embedded peripherals only; excludes all external peripherals and software
Total processors include large, mid-range, workstations, servers and PCs.
Source: McKinsey database; McKinsey analysis

The political and social resistance to encroachments by new technologies often is muted because the victims tend to be relatively small and fragmented; automobiles displaced buggy makers; Wal-Mart, Staples, and Home Depot took away share from small time retailers. Some high-profile companies, particularly in high technology industries, have been leapfrogged by competition from the next generation of innovation. Henderson has studied this phenomena in the photolithography equipment business and Christensen in disk drives. The high flying manufacturers of dedicated word processors of the 1970s such as Wang, CPT and NBI, lost out in the 1980s to PC-based software that could provide the same functionality at a much lower cost.

But superseding innovations usually kill off the young companies, with a narrow technology or product focus rather than mature corporations like IBM, H-P and Microsoft whose resources allow them to 'catch up' with the pioneers. Innovations usually cause mortal harm to the giants only in conjunction with protracted obstinacy and denial. I can think of few examples from the last two decades where a large corporation has failed to survive because of an innovation from which it could not defend itself.

Moreover, the destructive force of new combinations represents but one, arguably minor, cause of businesses failures. The great majority of U.S. establishments that fold every year are sole proprietorships in low-tech businesses such as restaurants, beauty salons and house painting. Many large companies fail because of ‘internal’ management lapses. My former employer, E.F. Hutton, was forced to merge into its competitor Shearson Lehman, because poor internal controls led first to a check kiting scandal and then, in the stock market crash of 1987, de facto insolvency. International Harvester is no longer with us because in 1980, management took a six-month

strike to get out of a contract with the United Automobile workers that wrecked the company.[24] Or companies can fail because of the financial policies they adopt.

The fear of new technologies may well be pervasive in society. And paranoia about being leapfrogged may provide a useful antidote to hubris in successful businesses and spur to innovation. But the less threatening reality has helped keep the Luddites in check.

To conclude: my look into the rear view mirror suggests the following:

- New Era valuations have distorted the normal processes of entrepreneurship, but hopefully self-correcting mechanisms, ironically driven by participants in the gold rush, will return us to a healthier historical pattern.
- 20th century growth is going to be a tough act to follow, at least as far as the U.S economy is concerned.
- The exceptional growth in the 20th century was the result of on-going processes of innovation that many contributed to and benefited from.

- Broadbased innovation was sustained by diversity in organizational forms and a convergence of beliefs about the value of change.

## Endnotes

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[6] Rosenberg (1976) p.75-76
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11 Birch, D.L. (1979).
[12] Steffens (1993) p. 197
[13] Steffens (1993) p. 179-181
[14] Steffens (1993) p. 197
[15] Estimates supplied by Joanne Guiniven, Electronics Consultant, McKinsey & Co.
[16] Correspondence with Joanne Guiniven, Electronics Consultant, McKinsey & Co..
[17] The discussion on sub-contracting draws on and extends an unpublished working paper by Bhide and Stevenson (1986)
[18] Schumpeter (1961) PP. 81,83-84
[19] Cringely (1996) p. 125-126
[20] U.S. Department of Commerce (1998) p. 4
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[22] U.S. Department of Commerce (1998) p. 6
[23] Petroski (1990)
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