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Entrepreneurial Dynamism and the Success of U.S.High-Tech

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Joint Economic Committee Staff Report
Office of the Chairman, U.S. Senator Connie Mack

EXECUTIVE SUMMARY

- ***U.S. Expansion Led by the High-Tech Sector.*** America's robust economic expansion is being led by the high-tech sector, which is currently generating over one-third of real economic growth. U.S. high-tech industries are leaders in world markets and highlight the gap between America's dynamic economy and the slow-growth economies of Europe and Japan.

- ***U.S. High-Tech Success.*** No top-down or strategic plan was responsible for the success of U.S. high-tech industries such as semiconductors, software, and biotechnology. Rather, open markets and decentralized sources of financing have allowed entrepreneurs to pursue diverse innovative approaches.

- ***Entrepreneurs and Growth***. The explosion of high-tech business start-ups and their rapid expansion in recent years emphasizes the importance of entrepreneurship to economic growth. Recent studies have found that the United States has the highest level of entrepreneurship among major nations, and that high levels of entrepreneurship are correlated with higher economic growth rates across countries.

- ***Entrepreneurs Create Tomorrow's Jobs***. Remarkably, about 10 percent of U.S. jobs disappear each year due to layoffs and business failures. This high rate of job loss emphasizes the crucial role played by entrepreneurs who generate a constant stream of new businesses and jobs, provided that they have the incentives and opportunities to expand and innovate.

- ***Efficient Use of Innovation Inputs.*** High levels of entrepreneurship and competition ensure that R&D,

education, and investment capital are used to maximum advantage in the economy. Inventions don't generate economic growth until entrepreneurs gather financing, create businesses, and successfully compete in markets that are open to new ideas.

- ***Financial Market Innovation.*** U.S. financial market innovations have supported the growth of young high-tech companies, which depend heavily on external funds to fuel expansion. U.S. capital markets have spawned efficient new public share issues, and a venture capital market about four times larger than Europe's. Additionally, a large supply of wealthy investors in the United States provides early funding to high-tech entrepreneurs in a decentralized "angel" market, which is thought to be about twice the size of the venture capital market.

- ***High-Tech's Virtuous Circle.*** The U.S. high-tech sector has grown rapidly in a virtuous circle of wealth creation as successful entrepreneurs recycle their income and expertise back into new business start-ups. Policymakers can promote this virtuous circle by pursuing open trade and investment policies, deregulating product and financial markets, removing barriers to entrepreneurship, and lowering taxes on the returns to risky start-up financing.

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The rapid growth of U.S. high-technology industries is giving added respect to the role played by entrepreneurs in our economy. Many high-tech entrepreneurs have created vast new businesses and thousands of new jobs in just a few years after starting out with nothing more than a good idea. In part, America's robust economic expansion is being led by entrepreneurial companies in software, semiconductors, biotechnology, and Internet-related industries. American companies are world leaders in these industries, and dominate global markets for many high-tech products and services.

This report—the third of the JEC series on economic growth—helps to explain the remarkable success of U.S. high-tech companies. It focuses on the role of open markets, innovative ideas, and entrepreneurship in the success of the U.S. high-tech sector. If economic policy continues to provide the proper environment, America's lead as the wealthiest and most technologically advanced nation will be maintained well into the next century.

Senator Connie Mack, Chairman
Joint Economic Committee

INTRODUCTION

America's robust economic expansion is being led by the high-technology sector, which is currently generating over one-third of real economic growth. High-tech industries now account for about 8.2 percent of U.S. gross domestic product, up from just 4.5 percent in 1980.[1]

U.S. software, semiconductor, biotechnology, pharmaceutical, and Internet-related industries lead world markets. U.S. firms produce half of the world's semiconductors.[2] The U.S. biotechnology industry is about five times larger than Europe's.[3] U.S. companies are expected to account for 80 percent of the world's top-selling pharmaceutical products by 2002.[4] And the United States leads the world in Internet-related industries with 60 percent of all Internet host computers, and half of the world's Internet users.[5]

U.S. leadership in the high-tech sector highlights the gap between America's fast-growing and dynamic economy and the slow-growth economies of Europe and Japan during the 1990s. This economic gap can be measured by comparison of per-capita GDP figures. In 1998, the per-capita GDPs of the European Union and Japan were just 70 and 79 percent, respectively, of the U.S. figure.[6] These income gaps show no signs of narrowing any time soon. As a result, some foreign governments are making reforms in an effort to "ape American business dynamism."[7]

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[1] *The Emerging Digital Economy II*, U.S. Department of Commerce, 1999.
[2] Semiconductor Industry Association Web page <www.semichips.org>.
[3] "Biotechnology Spotlight," *OECD Observer*, March 1999.
[4] "Pharmaceutical Groups Search for Quick Fix," *Financial Times*, September 13, 1999.
[5] Internet host figures from Network Wizards/MIDs <www.ngi.org/trends>; Internet use figures from Computer Industry Almanac, Inc.
[6] *OECD in Figures 1999 Edition*. Organization for Economic Cooperation and Development, 1999. Figures are based on purchasing power parities.
[7] *Economist*, February 13, 1999.

What has the United States done right? Economists often explain economic expansions by pointing to factors such as consumer spending, exports, or other aggregate indicators. But to sustain economic growth over the long-term, more fundamental institutional factors must be considered.

These factors include entrepreneurship, open markets, and the diverse generation of ideas and innovations – all factors that have been conspicuous in the growth of U.S. high-tech. This report describes how these mutually reinforcing strengths have fueled high-tech growth, and have contributed to America's lead as the wealthiest and most technologically advanced nation. These strengths can be summarized as follows:

- **Entrepreneurship**. Entrepreneurs reorganize the economy by creating new companies and better products with lower costs. Their risk-taking actions shift people and resources from old uses to new and higher-valued uses. By doing so, entrepreneurs increase productivity and generate economic growth.
- **Open-Market Dynamism**. The benefits of entrepreneurship are maximized when markets are open to new business start-ups, new products, and new ways of working. The U.S. high-tech sector shows how rapid economic expansion can occur in a market which is relatively unregulated, is open to foreign trade and investment, has a flexible and mobile labor force, and is financed by efficient capital markets. These conditions have attracted many entrepreneurs to high-tech, and led to the creation of new opportunities for American workers.
- **Diversity**. Uncertainty about the future course of technology and the economy is pervasive. As a consequence, the best way to build tomorrow's successful industries is to allow entrepreneurs to pursue diverse business ideas. Diversity is an American strength. New ideas flow from its open culture, superior university system, immigration, and elsewhere. Ideas are turned into innovations in large corporations, swarms of start-up companies, and thousands of public and private research labs. Funding for innovation is also

diverse with investment from thousands of venture capitalists, angel investors, and other sources of capital.

Entrepreneurship, open markets, and diversity have no doubt always played a central role in America's economic growth. But rapid shifts in technology and fast-changing markets in the new "knowledge economy" suggest that these institutional strengths are more important than ever.

Consider the enormous "churning" that occurs in jobs and businesses. About 10 percent of U.S. jobs disappear annually due to business closures and contractions.[8] As a result, about 13 million new jobs must be created every year in order to maintain a healthy job market. These jobs are created in high-tech and other growth industries if entrepreneurs are given the open markets and incentives needed to expand and innovate.

The need to stimulate continual job creation in new industries suggests that federal policy focus on creating the best possible business environment for entrepreneurial high-tech companies. Not only do high-tech entrepreneurs create new jobs to replace those lost in shrinking industries, they serve to rapidly implement new scientific advances that flow from the nation's research labs. This latter role is crucial because innovation experts find that rapid and efficient exploitation of inventions may be just as important as their initial generation.[9]

High-tech policy should recognize that the benefits of education, research and development (R&D), and other high-tech investments are maximized when entrepreneurs have incentives to execute new business ideas efficiently in open markets. Regulation, taxation, trade, investment, and immigration policies can all affect the entrepreneurial dynamism that has kept America's high-tech industries in the lead.

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[8] "Gross Job Flows," Steven Davis and John Haltiwanger, in *Handbook of Labor Economics*, 1998.

[9] "The Global Environment of U.S. Science and Technology Policies," David C. Mowery *in Harnessing Science and Technology for America's Future*, National Research Council, 1999. p.84.

In this report, Section 1 looks at the role of entrepreneurs and the incentives they face; Section 2 discusses why open markets are central to a growing, dynamic economy; Section 3 examines how a diversity of people and institutions contributes to America's high-tech success; and Section 4 presents the report's conclusions.

1. THE ENTREPRENEURIAL ECONOMY

I. The Times Are a Changin'

The rapid growth of many U.S. high-tech industries is giving new respect to the role played by entrepreneurs in the economy. Many high-tech entrepreneurs have created vast businesses and thousands of new jobs in just a few years after starting out with nothing more than a good idea. The Internet equipment company Cisco Systems is a good example. It was founded in the mid-1980s by a few university computer scientists with the idea of building devices to connect computers into large networks. Cisco, with sales of just $69 million in 1990, has exploded into a worldwide business with sales of over $8 billion and 19,000 employees by 1998.

Cisco exemplifies leading-edge innovation and growth in today's economy. By contrast, stable industrial giants were seen as the backbone of the economy during much of this century. Not only did automobile, steel, and other big corporations create large economies of scale, they were considered to be the dominant source of innovation. Economists such as John Kenneth Galbraith thought that large bureaucratic corporations carefully controlled both the nation's technological progress and consumer tastes. Meanwhile, governments believed that their task was to "manage" the economy by regulating the giant industrial corporations, and keeping full employment by skillfully guiding fiscal policy.

The "managed economy" consensus broke down during the stagflation of the 1970s. It turned out that the government's ability to fine-tune the macroeconomy was a mirage. At the same time, big business stability was upset in industry after industry as scores of interlopers challenged seemingly unassailable firms such as AT&T and IBM. Upstart entrepreneurs have shaken up many once-stable industries such as steel, retailing, and financial services. Evidence indicates that economic activity since the 1970s has moved away from large corporations towards small and medium-size firms. The share of

total U.S. employment represented by Fortune 500 firms has fallen from 20 percent in 1970 to just 8.5 percent by 1996.[10]

Many economists believe that industrial countries are undergoing a fundamental shift away from a "managed economy" towards an "entrepreneurial economy."[11] The cornerstones of the managed economy – stability, homogeneity, and economies of scale - are being replaced by greater turbulence, heterogeneity, and flexibility. These qualities of the new entrepreneurial economy can be seen in high-tech fields such as electronics, biotechnology, and the Internet.

Numerous forces are moving us towards a more entrepreneurial economy. First, the poor employment and growth performance of the overly "managed" economies in the world has caused policymakers to seek new approaches. Second, rising globalization is forcing companies everywhere to improve their competitiveness, and forcing governments to improve their business climates to attract the new growth industries. Third, established companies in every industry are being pressed by entrepreneurs embracing new technologies, such as flexible automation and the Internet, to challenge old ways of doing business.

Even the British Labor party has embraced the new entrepreneurial view. In a recent report, the Labor government noted the following:

> It is important to create the right environment for innovation and the exploitation of new ideas, with a supportive institutional and cultural framework. Macroeconomic stability is crucial. Property rights must be established and enforced, the banking and financial system should be capable of bearing risk, and society should respect, foster, and encourage

[10] "Linking Entrepreneurship to Economic Growth," Sander Wennekers and Roy Thurik *in Small Business Economics 13*, 1999.

[11] *Sources of Growth: The Entrepreneurial Versus the Managed Economy*, David Audretsch and Roy Thurik, with the Tinbergen Institute at Erasmus University Rotterdam, September 1997.

> enterprise. The capacity for growth is reduced in societies that are unwilling or unable to innovate and change.[12]

Pundits are changing their messages as well. In 1989, celebrated MIT economist Lester Thurow opined: "can economic command significantly ... accelerate the growth process? The remarkable performance of the Soviet Union suggests it can ... Today it is a country whose economic achievements bear comparison with those of the United States.[13]" In his new 1999 book, Thurow has changed his tune to reflect the new realities. He now thinks that "there are no institutional substitutes for individual entrepreneurial change agents."

II. Entrepreneurs and Economic Growth

1. The Outsider Entrepreneur. Many business stories illustrate the power that entrepreneurs exert in the new economy. In 1979, Steve Jobs toured a Xerox research facility and saw a computer with an experimental graphical user interface (GUI) - forerunner to today's Windows computer screen. Xerox had no big plans for the GUI, thus leaving the path open for Jobs to implement his vision with the revolutionary Apple Macintosh in the 1980s.[14] Today, most of world's 360 million or so PC users turn on their computers to find a user-friendly interface descended from Apple's original innovation.

Often in U.S. high-tech history, outsider entrepreneurs have played such a "just do it" role, while large research labs have not capitalized on significant inventions. The distinction highlighted by economist Joseph Schumpeter between "invention" and "innovation" is important to keep in mind. Inventions create advances in knowledge, but they don't change the economy until they are implemented as an innovation. Innovations occur when an

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[12] *Our Competitive Future: Building the Knowledge Driven Economy*, U.K. Secretary of State for Trade and Industry, December, 1998.
[13] See Kevin Hassett, *American Enterprise*, Sept./Oct. 1999.
[14] "Poor Little Lisa," *Invention and Technology*, Summer 1999.

entrepreneur gathers the financing, creates the business structure, and injects an invention into the economy. To Schumpeter, economic progress is dependent on innovating entrepreneurs exploiting new ideas and changing the way the economy operates.

Entrepreneurs are needed because new ideas often need new outsider firms to implement them. The minicomputer market in the 1960s was spurred by outsider entrepreneurs at Digital Equipment Corporation and elsewhere. Similarly, the computer workstation market in the 1980s was created by Sun Microsystems, an outsider start-up firm. Some high-tech observers think that IBM had the patents, the scientists, and the R&D to create and hold onto these markets if they had had the foresight. But IBM was unable to adopt the new business perspectives needed for the changing times.[15] It seems that in many cases it is entrepreneurs, not new technologies themselves, that create new high-tech markets and economic growth.

Existing businesses often fear "cannibalizing" their own sales, and so are reluctant to experiment with new products. IBM, for example, was slow to enter the mini and microcomputer markets partly because of fear of cannibalizing its mainframe computers.[16] Because of this reluctance, the economy needs independent entrepreneurs in order to inject new ideas into the marketplace and to let consumers be the judge of new technologies.

Electronic commerce on the Internet provides many examples of independent entrepreneurs challenging established firms. In retail, established leaders, such as Toys R Us, face stiff competition from Web upstarts because they haven't been willing to discount prices to undercut their "bricks and mortar" stores.[17] One measure of the importance of independent entrepreneurs in the exploding Internet industry is that over half of the top 100 Web sites are run by Internet-only companies such as Amazon and Yahoo, and not by traditional

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[15] "The IBM Failure," *Upside Today*, February 28, 1993.

[16] "Antitrust and Technological Innovation," *Issues in Science and Technology*, Winter 1998.

[17] "On the Internet, Toys R Us Plays Catch-Up," *Wall Street Journal*, August 19, 1999.

bricks and mortar companies.[18] *Washington Post* columnist Leslie Walker noted the following:

> The only way to really know what consumers will do is to make them an offer and see how they will respond. And guess who is making these risky first offers? In category after category, whether it's books, toys, music or shoes, Web natives are striking first, while traditional merchants worry about cannibalizing store sales or alienating sales and distribution partners.[19]

Financial industry giants are also feeling the impact of upstart entrepreneurs. Traditional stock markets are being challenged by on-line electronic communications networks (ECNs), which the *Economist* says are "threatening to make old-type exchanges extinct."[20] The magazine notes that, " ... the exchanges' trouble is that their decision-making is often painfully slow and conservative, because so many members have an interest in preserving the status quo." A similar story is being played out in on-line stock trading and on-line securities underwriting.

Large, established companies are responding and attempting to become more entrepreneurial. In recent decades, corporate hierarchies have become flatter, and firms are pushing decision-making down to line managers. Big companies are trying their best to mimic the entrepreneurialism of small companies, and many will succeed. But the economic importance of outsider entrepreneurs implies that public policy should not favor established firms, and should remove barriers to start-ups for competitive challengers in every industry.

2. Entrepreneurs as Generators of Growth and Jobs. Rising levels of global competition are providing challenges for U.S.

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[18] *Forbes*, August 23, 1999.
[19] *Washington Post*, August 5, 1999.
[20] *Economist*, August 7, 1999.

businesses in many industries. Seeking higher levels of productivity to respond to competitors worldwide, U.S. corporations in automobiles, semiconductors, and other industries have invested heavily in technology, refocused their operations, and restructured their labor forces.

Recently, American-style corporate restructuring has become just as much a European and Japanese phenomena. Many European and Japanese corporations are "downsizing" and laying off thousands of workers. The Organization for Economic Cooperation and Development (OECD) notes that Japanese corporate profitability has fallen in the 1990s, with the result that workforce rationalization is now a top priority.[21] In one of many examples, losses at Japanese electronics giant NEC are causing the firm to shed 15,000 workers.

In such a competitive climate, the important question for all countries is: where will the new jobs come from? In a flexible and dynamic economy, entrepreneurs can create new jobs by assembling financing, devising marketing plans, and rapidly growing a new business. By contrast, in an economy that dissuades entrepreneurship by excessive regulations or other disincentives, growth will slow and unemployment will rise. Consider Japan's dilemma, as noted by the *Economist*:

> Japan's shortage of entrepreneurs is a real worry. Big employers are horribly overstaffed. They are now shedding jobs almost as fast as American firms did a decade ago. More young companies are needed to hire these people instead. Yet for over a decade, Japan has been losing more companies than it has created.[22]

Some recent studies have sought to measure statistically the relationship between entrepreneurship and economic growth. A 1997 study by economists at Erasmus University in the Netherlands

[21] *OECD Economic Outlook*, Chapter IV, OECD, June 1999.
[22] *Economist*, February 13, 1999.

examined differences in entrepreneurship and growth across twelve European countries.[23] Their analysis found that those economies which have fostered greater entrepreneurship, including the United Kingdom and the Netherlands, have been rewarded with greater economic growth and lower unemployment. By contrast, France and Germany are still wedded to the "managed economy," and have suffered with slower growth and higher unemployment.

The link between economic growth and entrepreneurship is confirmed by a major new study, the *Global Entrepreneurship Monitor*, conducted by Babson College and London Business School researchers.[24] The study used surveys, interviews, and official statistics to determine differences in entrepreneurship between ten industrial countries. The researchers found large variations in entrepreneurship between the countries, as shown in Table 1. Entrepreneurship was measured by the percentage of the adults that have started a business. At 8.4 percent, the U.S. rate of entrepreneurship was by far the highest, and more than twice as high as the ten-country average of 3.6 percent. Other studies have also found that start-up rates are the highest in the United States, mixed in Europe, and low in Japan.[25]

The researchers then statistically compared differences in entrepreneurship to GDP growth rates. They concluded that variations in entrepreneurship account for about one-third of the variation in economic growth rates between countries.

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[23] *Sources of Growth: The Entrepreneurial Versus the Managed Economy*, David Audretsch and Roy Thurik, 1997.

[24] *Global Entrepreneurship Monitor*, Paul Reynolds, Michael Hay, and Michael Camp, Babson College - London Business School - Kauffman Center for Entrepreneurial Leadership, 1999.

[25] *Technology, Productivity and Job Creation*, OECD, 1998. p.223.

Table 1: Levels of Entrepreneurship

Adults starting businesses as a percentage of adult population

High		Medium		Low	
United States	8.4%	Italy	3.4%	Germany	2.2%
Canada	6.8%	United Kingdom	3.3%	Denmark	2.0%
Israel	5.4%			France	1.8%
				Japan	1.6%
				Finland	1.4%

Source: Babson College GEM study, 1999.

III. American Risk-Takers

Substantial variations exist in levels of entrepreneurship across countries, as confirmed by the Babson College study. Variations seem to stem both from differences in cultural factors (discussed here) and differences in incentives facing potential entrepreneurs (discussed in the next section).

A major OECD study on entrepreneurship in 1998, *Fostering Entrepreneurship*, notes that there is a "near unanimous" view among experts that culture plays an important role in determining variations of entrepreneurship across countries.[26] Anecdotal evidence supports this conclusion. A Blair government poll in England found that "entrepreneur" conjured up images of a "sharpie, exploiter, or freebooter."[27] The Babson College entrepreneurship study found that just 9 percent of Japanese and 38 percent of British thought that "starting a new business is a respected occupation." This compares to over 91 percent of Americans asked the same question.[28]

Japan seems to have lost some of the entrepreneurial zeal which helped build its post-war industrial success. In a recent profile of an elderly Japanese entrepreneur, the *Economist* noted that now such "self-made men ... attract ridicule and condescension in snooty

[26] *Fostering Entrepreneurship*, OECD, 1998. p.50.
[27] "Matters of Spirit," *Forbes*, August 9, 1999.
[28] *Global Entrepreneurship Monitor*, Babson College, 1999.

Japan." [29] According to one U.S. high-tech leader, "the risk-taking culture, which is almost a badge of honor in Silicon Valley, is not present in Japan."[30]

In the United States, entrepreneurship is widely admired for building meccas of innovation such as Silicon Valley. Entrepreneurs put aside stable careers for the uncertainty of an untried scheme. They want to succeed, but in an industry as dynamic as high-tech they often fail due to misjudgment or bad luck. Observers think that there is no shame in failure in Silicon Valley, and most entrepreneurs get up and try again. A new report by the National Research Council describes Silicon Valley as "a business culture that encourages people to strike out on their own. Failure is not welcome, but is tolerated. In fact, venture capitalists seem more willing to invest in someone who already has failed than in a first-time entrepreneur."[31]

American investors also seem to be more willing to take risks than foreign investors. The high-risk U.S. venture capital market is about four times the size of Europe's, as discussed in Section 2.V. The character of the U.S market is also tilted more towards risky endeavors. A much greater share of U.S. venture capital goes towards high-tech firms, and a greater share goes towards early-stage financing than in Europe.

The American entrepreneurial culture has not only generated a high level of business start-ups, entrepreneurs have also created important high-tech institutions such as the venture capital market and NASDAQ. In addition, entrepreneurs are catalysts in breaking down regulatory barriers and jump-starting competition in new growth industries. In telecommunications, MCI challenged the long-distance telephone status quo that had lasted for decades, and helped initiate

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[29] *Economist*, February 13, 1999.

[30] "The U.S. Environment for Venture Capital and Technology-Based Start-Ups," Charles Geschke, President Adobe Systems, *Harnessing Science and Technology for America's Future*, National Research Council, 1999. p.116.

[31] *Harnessing Science and Technology for America's Future*, National Research Council, 1999. p.23.

the 1984 break-up of AT&T. Therefore, entrepreneurship can be a powerful agent of growth and change in many forms.

IV. Entrepreneurial Incentives and Disincentives

1. The American Marketplace. The United States presents the entrepreneur with 270 million consumers and millions of business customers within a wealthy and unified national market. Historically, the strong federal Constitution reduced states' ability to erect interstate trade barriers. As a result, U.S. firms can build great economies of scale and share ideas and technology continent-wide. Historians think that the large size of America's domestic market was a key factor in our more rapid technological advancement and growth than other major countries.[32]

To an entrepreneur, the potential payoff from a risky innovation is greater the larger the market it can be exploited in. As economist Paul Romer notes, "if barriers to trade meant that a computer operating system written in Washington state could only be used in Washington state, it would worth far less than if it could be used all over the world."[33] Empirical studies have shown that one reason for the high U.S. industrial R&D effort compared to other countries is our large domestic market size.

The large U.S. market may give a particularly powerful advantage to the high-tech sector because of the strong geographic "clustering" tendency of high-tech firms. Silicon Valley and other technology clusters seem to develop because of knowledge "spillovers," close proximity to "angel" and venture capital financing, and the availability of skilled workers. A large market means strong technology clusters, as noted by the OECD:

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[32] "Why, Indeed, in America? Theory, History, and the Origins of Modern Economic Growth," *NBER Working Paper 5443*, Paul Romer, 1996.

[33] "Why, Indeed, in America? Theory, History, and the Origins of Modern Economic Growth," *NBER Working Paper 5443*, Paul Romer, 1996.

> The size of clusters is limited by the size of the market... thus there is some evidence suggesting that the United States is more cluster-intensive than Europe because the U.S. market is larger than national European markets, which are still segmented as a result of different national tax regimes, regulations, and policies which favor national products (i.e. national champions).[34]

U.S. policymakers should aim to ensure that the U.S. market remains open with a minimum of state-level limits on commerce. For example, one impediment to a unified national market under telecommunications deregulation is the crazy quilt of different state telecom laws, subsidies, and local rate structures.[35] Similarly, there is concern that the huge potential and rapid growth of e-commerce may be slowed by state and local tax policies. There are about 7,600 local sales taxes in the United States creating a complicated maze for Internet merchants. A new report on e-commerce by the National Tax Association noted that "this myriad of tax rates imposes significant administrative burdens on multistate sellers, particularly smaller sellers whose ability to sell nationally and internationally is enhanced by the advent of electronic commerce."[36]

2. Disincentives to Entrepreneurship. While American high-tech entrepreneurs begin with the advantage of a large and wealthy domestic market, government policy can create disincentives to entrepreneurs in any country. From a broad perspective, countries with larger government sectors tend to have lower economic growth rates, as confirmed by numerous empirical studies. A 1997 OECD cross-country regression analysis found that a 10-percentage point increase in a nation's overall tax rate reduces annual growth by about

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[34] *OECD Economic Surveys, United States,* OECD, 1997.

[35] "Telecom's Tragic Reform Tale," David Dorman, CEO of PointCast Inc., *Upside Today*, March 15, 1998.

[36] *Communications and Electronic Commerce Tax Project Final Report*, National Tax Association, Sept., 1999.

0.5 percentage points.[37] Other studies have found larger effects. A 1998 study by Randall Holcolme, Robert Lawson, and James Gwartney found that a 10-percentage point increase in a country's government spending-to-GDP ratio reduces annual growth by 1.0 percentage points.[38]

An important reason why larger governments tend to reduce economic growth is because they create disincentives for entrepreneurship. Labor market policies are one source of disincentives. For example, wage-earners may be less inclined to strike out on their own in a business start-up if labor market regulations prescribe too generous a set benefits for wage-paying jobs. Alternately, if unemployment benefits are too generous, jobless workers will be less interested in trying their hand at a business start-up. Similarly, high unionization rates can reduce workers' incentives to join a start-up because if the venture fails and they went back to wage work, they may lose union seniority.

Such labor market disincentives appear to be part of the explanation for why U.S. entrepreneurship rates are higher than Europe's. Also, high unemployment in many European countries may, in itself, dampen entrepreneurial activity. Workers may not want to leave a wage job to create a risky start-up because if it fails, they may have a tough time finding a job again. About half of all start-ups fail within the first five years, a fact that must give pause to any potential entrepreneur in a high unemployment country.[39] The next two sections look at the disincentives to entrepreneurship created by taxation and regulation.

3. Taxation. Entrepreneurial businesses take risks with new technologies and new markets if they foresee a chance to earn substantial rewards. Riskier projects must hold the potential of earning higher than normal after-tax returns in order to attract investment. Taxes place a wedge between the gross return from an

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[37] *OECD Economic Outlook*, OECD, June 1998. p.159.

[38] "The Scope of Government and the Welfare State," *Cato Journal*, Fall 1998.

[39] *Fostering Entrepreneurship*, OECD, 1998. p.24.

investment, and the after-tax return to the entrepreneur and investor, and thus create an important disincentive to risk-taking entrepreneurial activity.

Progressive tax systems, which have marginal tax rates that rise with income, are a particular bane for entrepreneurial activity. Under progressive taxation, a potential entrepreneur with a salary job may be reluctant to trade a stable income to start a risky venture if a large and rising share of the returns to entrepreneurial investment are redirected to the tax collector.

A 1997 study by tax economists Robert Carroll, Douglas Holtz-Eakin, Mark Rider, and Harvey Rosen examined the effect of changes to the top marginal income tax rate on entrepreneurial investment.[40] Using sole proprietor tax return data, the study examined small business investment spending before and after the 1986 Tax Reform Act which substantially changed individual income tax rates. The study found that a 5 percentage point increase in marginal tax rates would have a "substantial impact on entrepreneurs' investment spending," with an average capital investment reduction of 10 percent.

The study noted that high tax rates can reduce investment in two ways. First, taxation raises the "user cost of capital" to an entrepreneur considering an investment. This is the hurdle rate of return that a potential investment must earn before it is considered to be a worthwhile project. Higher taxes increase the cost of capital, thus making fewer investments worth undertaking. Second, taxation directly reduces the cash-flow available to an entrepreneur. The more an entrepreneur's revenue stream is channeled towards tax payments, the less will be available for investment spending or other business purposes.

The negative effects of high marginal tax rates on business formation and investment have led most industrial countries to make substantial reductions in statutory tax rates since the 1980s. OECD figures show that the top personal income tax rate across 25 OECD

[40] *Entrepreneurs, Income Taxes, and Investment*, Robert Carroll, Douglas Holtz-Eakin, Mark Rider, and Harvey Rosen, University of Michigan Business School, Working Paper Series No. 98-16, 1997.

Table 2: Change in Top Tax Rates, 1986-1997

Selected Countries	Top Individual Rate	Top Corporate Rate
United States	-10.4	-11.0
Japan	-20.0	-5.5
Germany	0.0	-11.0
France	-11.0	-11.7
Italy	-11.0	0.0
United Kingdom	-20.0	-2.0
Canada	-2.7	-7.0
Average - 25 OECD countries	-12.4	-10.3

Note: percentage point change for the central government top statutory rate.

countries fell 12.4 percent between 1986 to 1997, as shown in Table 2.[41] Similarly, top corporate income tax rates fell 10.3 percent during this same period. The United States lowered income tax rates substantially in the 1980s, but raised them again in the 1990s. The top personal income tax rate was increased from 28 percent in late 1980s to 39.6 percent in 1993, and the corporate income tax rate was increased from 34 percent to 35 percent in 1993.

For entrepreneurial business formation in high-tech, low tax rates on capital gains are particularly important. Start-up and young high-tech firms are likely to retain all of their earnings during their early high-growth phase. Therefore, investors in these firms receive returns in the form of capital gains, in contrast to the dividend yields received by investors in older, slow-growth firms. As a result, the capital gains tax rate directly impacts the willingness of investors to place their funds into start-up and growth-oriented firms.

For the potential investor, technology start-up companies offer particularly high risks because of the fast-changing nature of the high-tech marketplace. Many high-tech firms "are characterized by significant intangible assets, expect years of negative earnings, and have uncertain prospects, and are unlikely to receive bank loans or other debt financing."[42] U.S. capital markets have responded to these special needs with specialized flows of equity including venture capital and angel financing, as discussed in Section 2.V. As such, taxes on equity, particularly capital gains, are especially important to high-tech start-ups.

The finances of the U.S. biotechnology industry make this investment picture clear. There are about 1,300 biotechnology firms, two-thirds of which have fewer than 135 employees. The industry spent $9.9 billion on R&D in 1998, representing 53 percent of industry revenues. A small minority of firms have approved products or revenues, and the industry as a whole reports a net loss. Investors

[41] *OECD Economic Outlook*, OECD, June 1998.

[42] *What Drives Venture Capital Fundraising*, Paul Gompers and Josh Lerner, NBER Working Paper 6906, January 1999.

will not receive returns in the form of dividends for a long time since it takes years and $200-$350 million to bring a new biotech drug to market.[43] Investors receive a return in the form of capital gains if and when a company's drug candidates or other products show promise. Biotech firms survive on a thin "umbilical cord" to the capital markets which are sensitive to government policies which threaten the long-term payoff.[44]

So that investors receive sufficient rewards for supporting risky high-tech entrepreneurship, it makes sense for policy to encourage such investments. As it turns out, most major industrial nations do provide favorable tax treatment for long-term capital gains. A number of countries including Germany, the Netherlands, and Belgium exclude long-term capital gains from tax altogether. A 1998 survey found the average long-term individual capital gains rate across 24 industrial countries was 15.9 percent (see Table 3).[45]

[43] "Some Facts About Biotechnology," Web page of BIO at <www.bio.org>
[44] "Frontier Ethics," *National Journal*, June 5, 1999.
[45] *An International Comparison of Capital Gains Tax Rates*, Arthur Andersen LLP study completed for the American Council for Capital Formation, August 1998.

Table 3: Maximum Individual Capital Gains Tax Rate

Selected Countries	Long-Term Capital Gains Rate
Australia	48.5%; asset cost is indexed
Belgium	Exempt
Brazil	15%
Canada	23.5%
Denmark	40%; shares under $16,000 exempt if held 3+ years
France	26%; annual exclusion of $8,315
Germany	Exempt
Hong Kong	Exempt
Italy	12.5%
Japan	20% of net gain or 1.25% of sales price
Korea	20%; shares traded on major exchange exempt
Netherlands	Exempt
Sweden	30%
Taiwan	Exempt (local company shares)
United Kingdom	40%; shares valued at less than $11,225 exempt
United States	**20%**
Average 24 countries	**15.9%**

Source: Arthur Anderson LLP for American Council for Capital Formation, 1998.

Historically, the U.S. tax code has provided preferential treatment of capital gains, either by a preferential rate or an income exclusion. In 1997, Congress lowered the maximum rate on individual long-term capital gains to 20 percent, although the effective rate is higher in some cases due to income phase-outs on various tax code provisions. Additionally, because capital gains realizations are not indexed for inflation in the tax code, higher inflation rates substantially increase the effective tax rate on gains.

4. Regulation. The paperwork and regulatory burden for an entrepreneur begins the day a business is registered. It continues throughout the life of a firm including when it hires workers, expands across state lines, imports supplies, battles litigation, expands a factory, discards waste, designs employee work areas, creates a pension plan, introduces a new product which requires regulatory approval, or pays income, payroll, sales, or property taxes. All these activities consume resources and shift an entrepreneur's focus away from growing his or her business.

Some estimates have been made of the overall average costs to U.S. businesses of government regulations and red tape. Studies find that small businesses tend to have higher average regulation costs per

employee than larger businesses. The Small Business Administration found that the average annual cost of regulation and tax compliance amounted to about $5,000 per employee in small firms, and about $3,400 in large firms (1992 figures).[46]

The good news for the U.S. economy is that some types of regulatory burden appear to be less than in other industrial countries. For example, the OECD finds that business registration generally involves less red tape in the United States than in Europe.[47] In some countries, such as Italy, it takes up to half a year to jump through the administrative hoops to register a business start-up. A number of European countries even require minimum levels of capital and a business plan certified by an "expert" in order to register a business.

Bankruptcy laws in the United States make it relatively easy for entrepreneurs to go from a failed business to attempting a new start-up. By contrast, in some European countries failed entrepreneurs can be liable for debts the rest of their life, thus dissuading them from starting a business to begin with.[48] However, bankruptcy law must be a balance because if it is tilted too strongly against creditors, they may hesitate to lend to risky start-ups.

Labor market regulation has a widely-cited dampening effect on business expansion and hiring. For example, "employee protection" legislation in Europe, which makes it difficult to lay off workers, makes entrepreneurs less likely to hire workers. Mandates that require employers to provide various employee benefits raise costs and reduce incentives to hire. Such policies in Europe have resulted in higher unemployment rates and reduced willingness on the part of potential entrepreneurs to leave a comfortable salaried job to start a new business. Much labor market regulation is a remnant from the "managed economy" of yesteryear, and needs to be retooled for the new entrepreneurial economy.

In some types of regulatory and administrative burdens, American entrepreneurs are, however, probably no better off than entrepreneurs

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[46] *Fostering Entrepreneurship*, OECD, 1998. p.64.
[47] *Fostering Entrepreneurship*, OECD, 1998. p.54.
[48] *Fostering Entrepreneurship*, OECD, 1998. p.184.

abroad. There is a large room for improvement in the complex U.S. income tax code, for example. Americans now spend over five billion hours per year filling out tax forms, resulting in total collection costs of about 10 cents for every dollar raised.[49] Studies have shown that the relative burden on small businesses of tax compliance is higher than for large companies.[50]

The costs of litigation also impose substantial burdens on technology-intensive U.S. industries, and create a dampening effect on innovation. A company with a tried and true product design may hesitate to experiment with newer technologies because any unforeseen flaws may attract lawsuits. Class action lawsuits related to fluctuating share prices have also been a problem for the high-tech sector. Because of the large uncertainties in technology markets, tech company share prices tend to have large price swings. This has prompted class action lawyers to bring hundreds of suits against tech firms, forcing them to spend millions of dollars on legal defense costs.[51] Congress responded with federal litigation reform measures in 1995, but litigation against high-tech firms has now moved to the state court arena.

Price regulation is a problem for a number of high-tech industries. It adds uncertainty for entrepreneurs about the likely returns to new investment. In telecommunications, despite a general trend towards deregulation, price controls and subsidies on local residential phone service discourages investment in this market. By contrast, the freer long-distance and business phone markets have attracted investments by dozens of competing providers. As the head of one telecom company noted, "the innovation, competition, and investment in the business telephone market are not coming to the home because they

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[49] "Making Tax Choices: A Guide to the Issues and Alternatives," David Bradford and Joel Slemrod, *Tax Notes*, September 1, 1996.

[50] *The High Cost of Tax Compliance for U.S. Business*, Tax Foundation, May 1994.

[51] Stanford University Securities Class Action Clearinghouse Web page at <securities.stanford.edu>.

are stifled by the economically irrational, regulated pricing structure."[52]

Price regulation has also been a concern of the pharmaceutical and biotechnology industries whenever the federal government considers expanding its presence in the health care industry. The investment disincentive of price controls was described in recent Joint Economic Committee hearings by Gordon Binder, CEO of biotech firm Amgen:

> Innovation is expensive, risky and therefore fragile. Price controls - even the threat of price controls - discourages it, badly. I have here a chart of total pharmaceutical company R&D spending in the U.S. during each year of the last decade. You can see that, in that time, the climb was steady - with one exception. In 1994 it almost stopped. What happened in 1994? The President put forward his health care program and it included price controls. This is a simple fact: all policies to advance the biotechnology and the development of pharmaceuticals and encourage industry growth into the next century will be far less successful if Congress imposes any form of price controls on pharmaceuticals.[53]

As the *Financial Times* reported, the current lack of price regulations has given U.S. pharmaceutical firms a big advantage over European firms where drug prices are more tightly controlled. The lack of regulation "has given U.S. drug companies ... a huge advantage. Over the past decade of high domestic growth, it has provided them with a torrential income stream to reinvest in the ever-

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[52] "Telecom's Tragic Reform Tale," David Dorman, CEO of PointCast Inc., *Upside Today*, March 15, 1998.

[53] Testimony of Gordon Binder, CEO of Amgen, before the Joint Economic Committee, June 16, 1999.

more costly business of finding new drugs."[54] As a result, U.S. firms are pulling far ahead of European firms: by 2002, 20 of the world's 25 top-selling drugs are projected to be American, compared to just three that will be European.[55]

[54] "Pharmaceutical Groups Search for Quick Fix," *Financial Times*, September 13, 1999.
[55] "Pharmaceutical Groups Search for Quick Fix," *Financial Times*, September 13, 1999.

2. OPEN MARKET DYNAMISM

I. Entrepreneurs and Open Markets

A 19th century French economist, Jean-Baptiste Say, described the entrepreneur's role in the economy as follows:

> The entrepreneur shifts economic resources out of an area of lower and into an area of higher productivity and greater yield.[56]

Entrepreneurs perform the same vital function today. By shifting workers and investment from old industries to newer, higher-valued industries, entrepreneurs generate economic growth and rising living standards. Entrepreneurs and their investors bear substantial risk because no one knows in advance whether these new uses of resources will, in fact, turn out to be higher-valued than the old uses.

In a new book, Michael Cox and Richard Alm describe how the resource-shifting role of entrepreneurs continuously reinvents the nation's workforce.[57] From the mid-1980s to the mid-1990s, General Electric lost 65,000 workers, but Motorola gained 49,000; AT&T lost 207,000, but Lucent, MCI, Sprint and Bell South gained 202,000; Sears and K-mart lost 196,000, but Wal-Mart gained 624,000; and so on.

Federal Reserve Chairman, Alan Greenspan, recently noted that "the American economy .. is in the grips of what the eminent Harvard professor Joseph Schumpeter many years ago called 'creative destruction,' the continuous process by which emerging technologies push out the old."[58] The ability of entrepreneurs to push out the old, and shift resources to new higher-valued uses can be maximized only

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[56] *Economist*, February 20, 1999.
[57] *Myths of Rich and Poor*, Michael Cox and Richard Alm, 1999.
[58] Quoted in "Study Predicts Sustainable Growth," *Washington Post*, September 9, 1999.

when markets are open to competition, and when entrepreneurs have sufficient incentives to take the risks needed to challenge the existing order.

Unfortunately, governments often erect barriers to entrepreneurs in product markets, financial markets, and labor markets. These include:

- **Market Entry**: restrictions that make it difficult or illegal for entrepreneurs to break into an industry;
- **Market Structure and Evolution**: prescription of standards or industry structures which preclude the market from evolving to meet new demands;
- **Labor Markets**: labor laws which raise costs, and cause rigidities and reduced incentives to hire;
- **Financial Markets**: an inefficient financial system which makes it difficult to raise money for new ventures.

Barriers in any of these areas may impede the economy's dynamism, and reduce the nation's growth potential, as discussed in turn below.

II. Market Entry

The rise of entrepreneurialism in the telecommunications industry after the 1984 break-up of AT&T provides a dramatic illustration of a growth boom spurred by dismantling market entry barriers. The court-ordered break-up, and the opening of the long-distance and telecom equipment markets, loosened the floodgates to a rush of investment led by upstarts such as MCI. The break-up led to falling long distance rates, surging investment in fiber optic cables, the rise of wireless telecom, and other advancements.

But the AT&T break-up was just the beginning of the long process of U.S. telecommunications deregulation. Many restrictions remained after 1984 including market-entry prohibitions placed on the regional Bell operating companies. Congress pushed telecom deregulation further with the passage of the Telecommunications Act of 1996 which attempted to remove these and other entry barriers.

However, the 1996 Act has been only partly successful. Competition has been slow to come to the local residential market, and regional Bell operators have not been able to enter long distance markets yet. Some analysts blame excessive regulatory burdens for the slow progress after the 1996 Act, and suggest that Federal Communications Commission (FCC) regulatory power over the industry has actually increased.

Nonetheless, telecom deregulation has unleashed entrepreneurial forces that will likely push technology ahead despite any regulatory shortcomings. Wireless systems, for example, are increasingly sophisticated and may ultimately provide competition for phone and cable wire systems throughout the telecom arena.

While U.S. telecommunications services have grown quickly under deregulation, the Internet has exploded due to "unregulation," according to a new study by a staff counsel at the FCC. [59] The study describes how the lack of regulation of the Internet and Internet applications has generated an explosion of entrepreneurial activity. The report finds that, "market forces have driven the Internet's growth, and the FCC has had an important role to play in creating a deregulatory environment in which the Internet could flourish."

While U.S. telecom deregulation has been slow and complex, it has been sufficient to put the U.S. in the lead against countries that have been even slower to deregulate. In Japan, the near-monopoly telecom provider NTT has stifled Internet usage with connections that can cost hundreds of dollars per month for even moderate usage. As a result, only 13 percent of Japanese homes have Internet accounts, compared to 32 percent of Americans. And e-commerce has been stifled because "the Ministry of International Trade and Industry (MITI) has mostly been a hindrance rushing out regulations for firms doing business on-line in Japan," according to the *Economist*.[60] Japan's regulated and high-cost telecom is "clearly hobbling the

[59] *The FCC and the Unregulation of the Internet*, Jason Oxman, Counsel for Advanced Communications, Federal Communications Commission, July 1999.

[60] *Economist*, August 7, 1999.

world's second-largest economy as it struggles to keep pace with America in the fast-changing digital age. And it is only one of many impediments to development of Internet businesses here," according to the *Washington Post*. [61]

While the Internet itself has so far blossomed in a generally deregulated mode, some backlashes are beginning to occur from entrenched interests as e-commerce continues to expand. In a new report, the Progressive Policy Institute (PPI) described some of the backlashes that threaten to block e-commerce growth: [62]

- A legal group in Texas won a ruling that could lead to a ban on sales of legal software that helps families create simple documents like wills and contracts without the help of a lawyer.
- The American Federation of Teachers and university teachers in Washington are protesting against distance learning on-line.
- State professional licensing requirements that do not recognize licenses from other states limit the practice of tele-medicine and other on-line professional services.

Such threats can stifle the dynamism that is at the heart of the expanding American high-tech sector. Economic growth comes from allowing entrepreneurs to experiment in new markets, and to provide better services at lower costs to consumers. The PPI report concludes that "...businesses and interest groups ... must not be allowed to use the power of government to protect themselves against economic change that benefits all consumers."

III. Market Structure and Evolution

Early this century, Soviet planners visited Henry Ford's massive Rouge automobile complex in Detroit and were inspired to build equally massive car, steel, and electricity plants. Ford the innovator later switched to smaller, dispersed plants to take advantage of the

[61] *Washington Post*, August 16, 1999.
[62] *The New State Economy Index*, Progressive Policy Institute, 1999. p.40.

growth in electricity power, while the Soviets stuck to their Big is Better approach. The Soviet planners who tried to mimic American economic strength from the top-down didn't realize that what was important was the free market process behind the American factories, not the factories themselves. The open markets that created the factories should have been copied, not the particular structure that American industry took.

A similar mistake is often made by pundits and planners in advanced economies. For a long time, big businesses were thought to be the sole driver of innovation, while "small firms were viewed negatively in the managed economy because their sub-optimal size imposed a less efficient use of resources."[63] Large "national champions" were favored to take on foreign competition. Some still hold these views today, while others now make the opposite error and trumpet the benefits of small businesses without appreciating the huge contributions of large corporations.

The reality is that small businesses and large corporations play complementary roles in today's complex economy. In the high-tech sector, a common pattern is for intense start-up activity to occur in a diverse array of small firms, thus creating many incubators of new ideas. Large companies with greater resources then give a boost to the most promising innovations by investment or acquisition. For example, the Internet company Hotmail was started by an independent entrepreneur, funded by venture capitalists, and then acquired by Microsoft for $400 million.[64] Another recent example is Merrill Lynch's investment in Archipelago, an on-line stock trading network that has applied to become an electronic stock exchange.[65]

Like earlier pilgrims to Ford's factories, foreign officials today trying to discover the secret to America's success flock to Silicon Valley. There they will see a huge diversity of business structures that

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[63] *Sources of Growth: The Entrepreneurial Versus the Managed Economy*, 1997. p.6.

[64] *Washington Post*, August 15, 1999.

[65] "Merrill Announces It Will Purchase Stake in Electronic Trader Archipelago," *Wall Street Journal*, September 10, 1999.

provide great flexibility to the U.S. high-tech industry. In some high-tech industries, such as pharmaceuticals, a large size is important in order to generate economies of scale. But other industries, such as biotechnology, thrive with hundreds of small and medium-size companies. Still other industries, such as software, exhibit a diverse collection of very small and very large companies.

While large corporations have certain innovation advantages, such as being able to fund large R&D budgets, small firms may have a greater tolerance for risky projects, be more open to new ideas, and be more willing to serve small niche markets.[66] As *Red Herring* magazine points out, even Lucent technologies, which has 30,000 scientists in its Bell labs, has a $100 million venture capital fund to search out good ideas in small companies.[67] Netscape co-founder Marc Andreessen summarizes the various strengths of big and small: "big companies are systematically ineffective at incubating new ideas, and small companies lack the sales and marketing forces to bring new ideas to market."[68]

In an open and dynamic economy, market structures and firm sizes are always changing. Most obviously, small firms often grow into big firms. The original Silicon Valley high-tech start-up, Hewlett-Packard, began in 1938 in Dave Packard's garage. Packard and Bill Hewlett started with $500 and an idea which grew into a company with $43 billion in sales and 125,000 employees.

The diversity and dynamism in high-tech businesses would seem to make it a losing strategy for governments to prescribe "top-down" solutions for industry structures. In telecommunications, deregulation has led to a frenzy of business restructuring. Some companies are merging to build a global scale or gain access to technologies they don't have. AT&T, for example, acquired the nation's second largest cable provider, TCI, to launch much-needed local service competition to the regional Bells. Some firms are divesting to focus on core

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[66] *SMEs: Employment, Innovation and Growth*, OECD, 1996. p.43.
[67] "The New Start-Up," *Red Herring*, October 1998.
[68] "The New Start-Up," *Red Herring*, October 1998.

businesses - AT&T, for example, spun off its multibillion dollar manufacturing arm, Lucent.

The huge amount of uncertainty in telecommunications, like other high-tech industries, is helping fuel the frenzy of restructuring. In telecom, for example, there are now at least four strategies to deliver new broadband services to the home including cable, digital subscriber line (DSL), satellite, and wireless.

Unfortunately, federal telecom regulators seem to be rooted somewhat in the past, with the hopes of judging the industry's best structure. The FCC laboriously reviews each merger to see if it's "in the public interest," sometimes taking over six months to do so. This procedure presumes knowledge of the uncertain future on the part of federal regulators that even businesses don't possess. Since mergers have to be reviewed by Justice Department antitrust lawyers anyway, this added layer of regulation seems unnecessary.

As it turns out, governments and pundits are often wrong with their technology industry prescriptions. In a recent paper, Professor David Mowery of the University of California at Berkeley describes how past expert prescriptions for high-tech turned out to be off the mark.[69] He notes that in the 1980s pundits said that new entry to the semiconductor field would be detrimental to U.S. competitiveness, and that capital markets put too much pressure on firms for short-term financial performance. Some U.S. high-tech firms were criticized for abandoning unprofitable lines and for restructuring, which many called "hollowing out." He notes that in these instances and others, the companies turned out to be right and the pundits wrong, as the U.S. high-tech sector bounced back after strong foreign competitive threats.

America's industrial strength is its dynamism, not a scheme to organize or manage industry, which many governments have favored in the technology field. This point is made by the *Economist* in a recent article on the chemical industry:

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[69] "America's Industrial Resurgence," David Mowery in *Issues in Science and Technology*, Spring 1999.

> America's strength has been sustained over decades because it has successfully transitioned from one source of advantage to the next – rather than resting on, or trying too hard to entrench, the advantages that it started with. The contrast with Germany (in some respects) and Britain (in many) is sharp. [70]

This ability to quickly adapt to changing circumstances is based on America's high levels of entrepreneurship, openness, and competition. Professor Mowery finds that open U.S. trade policies "propelled adoption of technology at a faster pace than in most Western European economies or in Japan, where trade restrictions and other policies kept prices higher."[71] Therefore, open markets have allowed the U.S. economy to find quickly new sources of growth, rather than trying to hold on to its past successes.

A final note on the nature of open and flexible industry structures: open markets do not just mean more competition, they allow for more cooperation among firms as well. More competition and cooperation may seem like a paradox. But deregulation in recent decades has generally allowed more of both as cooperation and competition work side-by-side in the market economy. In fact, greater competition in many markets has given an impetus for companies to cooperate on high fixed-cost activities such as R&D.

Federal antitrust rules had thwarted R&D cooperation during the 1960s and 1970s, but Congress relaxed antitrust rules in the 1980s to allow cooperative R&D ventures between otherwise competitive firms. This has led to the creation of hundreds of cooperative research alliances.[72] The *Economist* recently noted that sweeping away the

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[70] *Economist*, March 6, 1999.
[71] "America's Industrial Resurgence," David Mowery in *Issues in Science and Technology*, Spring 1999.
[72] "Antitrust and Technological Innovation," David Hart in *Issues in Science and Technology*, Winter 1998.

rules for companies to share know-how and cooperate on R&D has had an "invigorating effect" on the U.S. economy.[73]

There has been a growing realization that innovation and R&D approaches vary widely between industries. Research cooperation between businesses, and between businesses and universities, has both costs and benefits and may work well in some technology areas and not others. The complexity of the issues and the diversity of research methods means that "top-down" rules are inappropriate - the market appears to be the only mechanism capable of sorting out the most efficient approaches to innovation.

IV. Flexible Labor Markets

In the new entrepreneurial economy, the U.S. labor market is shifting away from a focus on worker "control" towards worker "motivation," with the high-tech sector leading the way.[74] In the past, large corporate hierarchies made decisions at the top, and then monitored work effort below. But today, businesses recognize the importance of motivating workers at all levels to be creative and to generate knowledge for faster responses to changing marketplace conditions. Companies have found that flexible work environments contribute to worker motivation and idea generation.

The best workforces in the new economy incorporate flexible hours, flexible performance-based salaries, independent contracting, and innovative compensation packages. The U.S. high-tech industry has been a leader in innovative work arrangements, ranging from casual dress to stock options.

To the high-tech entrepreneur, hiring workers is risky because high-tech markets change rapidly thus making future labor demands difficult to project. Governments can make hiring decisions even riskier by policies that make it difficult to lay off workers. In many European countries "employment protection" policies are thought to

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[73] *Economist*, February 20, 1999. p.27.

[74] *Sources of Growth: The Entrepreneurial Versus the Managed Economy*, 1997. p.16

share the blame for sluggish job growth in recent years, as such laws make it difficult and costly to shed staff.[75] Employer surveys in countries with rigid employee protection laws confirm employers' reluctance to hire new staff.[76]

Unions can often reduce flexibility in work arrangements as well. Collective bargaining agreements can reduce the scope of performance-based pay, interfering with the ability of entrepreneurs to attract and reward top talent – a key requirement in high-tech industries. Here the United States and Europe sharply diverge as Europe has much higher unionization rates.[77] Union rules can also stand in the way of adopting new technology in the workplace. New machines on the shop floor often require new ways of working, which isn't always possible with rigid union rules.

Deregulated labor markets are often portrayed as a win for business and a loss for workers. But persistently high unemployment in heavily-regulated European labor markets make clear that regulated markets don't make winners out of workers. France's unemployment rate, for example, has averaged above nine percent every year since 1983. France's current solution for unemployment is to mandate a nationwide work week cut from 39 to 35 hours.[78] The strategy will likely cause the opposite - as unions prevent earnings from falling, employers will be stuck with a ten-percent cost increase. As the *Economist* notes, this "policy designed to create jobs would end up destroying them."[79] Less mandated "job security" in the U.S. has actually left America workers more secure because of the ease of finding a new job should they be displaced.

In the U.S. high-tech sector, the flexibility of the labor market coincides with the high mobility enjoyed by workers. Experts believe that American workers are much more mobile and willing to move

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[75] *Fostering Entrepreneurship*, OECD, 1998. p.19.
[76] *Fostering Entrepreneurship*, OECD, 1998, p.86.
[77] "Collective Responsibility," Financial Times, September 13, 1999. See also *Employment Outlook*, OECD, July 1997.
[78] "Turning Back the Clock," *Financial Times*, July 29, 1999.
[79] *Economist*, April 15, 1999.

substantial distances for work than are Europeans.[80] For technology industries, such mobility allows regional "clusters" of specialization to develop – such as software in Seattle – that draw experts from across the country.

High U.S. worker mobility translates into shorter average job tenures than other industrial countries, according to OECD figures.[81] This may be of particular benefit to the high-tech sector because frequent job changing creates a rapid diffusion of new ideas. As skilled workers move to and from firms and university research labs, their knowledge moves with them. Such "knowledge spillovers" are a great source of strength for U.S. high-tech clusters.

The dynamic U.S. labor market is sometimes criticized when a high-profile workforce restructuring or downsizing occurs. But the new economic reality is that European and Japanese corporations are also restructuring under growing global competitive pressures. In Japan, the system of "lifetime employment" may be a thing of the past as poor profitability at many large corporations is leading to big job cuts.[82] With Europe and Japan now experiencing their share of corporate restructuring, but with less business start-ups, they are left with higher unemployment.

V. Dynamic Capital Markets

1. Funding for High-Tech Growth Companies. Free-wheeling and efficient financial markets have been central to the success of the U.S. high-tech sector. Any growing economy must have a mechanism to shift capital away from old industries towards new and higher-valued ones. U.S. capital markets have played this role and efficiently funneled billions of dollars to entrepreneurs in high-growth industries.

Many high-tech entrepreneurs initially depend on their own savings, personal debt, and loans from friends. If a business grows, it may look for external financing. External financing is a crucial lifeline

[80] *Wall Street Journal*, June 24, 1999.
[81] *OECD Economic Surveys: United States*, OECD, 1997. p.156.
[82] *OECD Economic Outlook*, Chapter IV, OECD, June 1999.

for many high-tech start-ups because internal financing (i.e. profits) may not be generated for months or years in some start-ups. In recent years, U.S. high-tech entrepreneurs have reported good access to external financing for business start-ups and growth.[83] Some analysts even think that there is more money than good ideas in some areas, such as the Internet.[84]

Entrepreneurs in Europe and Japan have not been so lucky because of their more heavily-regulated financial markets. In Japan, for example, "fledgling entrepreneurs in this nation of prodigious savers complain that Japan's financial system, with its heavy reliance on big banks, entrenched manufacturers and long-term relationships, is ill-suited to the free-wheeling nature of Internet businesses."[85] Culture also seems to play a role in high-tech funding shortfalls. Commentators think that the risk-aversion of Japanese investors causes them to avoid putting their savings into venture capital funds or start-up companies.

U.S. high-tech entrepreneurs have relied on a uniquely strong and diverse mix of private and public equity to fuel their growth. While initial public offerings (IPOs) have been a high-profile part of the high-tech boom, private equity provided by "angel" investors and venture capitalists has been important in fueling the initial growth of many well-known high-tech successes including Cisco Systems, Intel, Apple, Microsoft, and Genentech.

Private equity investors, whose investments are not traded on public exchanges, typically become involved before a high-tech start-up goes public. Despite complaints that U.S. financial markets are too short-term oriented, private equity investors represent "patient capital," and may not see an investment payback for years.

2. Private Equity – Angel Investors. Typically, angels are mature investors, who are experienced in a specific high-tech industry and understand the challenges of a start-up. In addition to providing

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[83] *Washington Post*, August 15, 1999. The *Economis*t February 20, p.22 makes a similar point.

[84] "The New Start-Up," *Red Herring*, October 1998.

[85] *Washington Post*, August 16, 1999.

capital, angels typically sit on a young firm's board of directors and provide valuable insight and advice. Angels often invest in high-tech firms that are close to home, and are thus one cause of the geographical "clusters" that shape the high-tech industry.

Angel investment is diverse in origin and doesn't flow through organized channels. As such, it is difficult to accurately measure angel investment activity, but angels are thought to invest at least twice as much as the total for the venture capital industry.[86] Some experts believe that the importance of angels is even greater than that. There may be about 250,000 angel investors in the United States investing in about 30,000 firms annually.[87]

Angels are usually wealthy individuals who are high-tech entrepreneurs themselves, and thus represent a "virtuous circle" of high-tech wealth creation. Successful high-tech entrepreneurs, such as the founders of Microsoft, Dell, and Oracle, channel their wealth and knowledge back into high-tech start-ups to create opportunities for new entrepreneurs. Microsoft billionaire Paul Allen has stakes in nearly 100 companies in telecommunications, biotechnology, and other areas. Michael Dell, founder of Dell Computer, has invested about $1 billion into a range of e-commerce companies.[88]

Because wealthy individuals are the force behind angel investment, it is no surprise that the United States has far more angel activity than other industrial countries which generally have higher taxes and fewer wealthy investors. The Babson College entrepreneurship study (see Section 1.II.) examined the participation level in informal or angel business funding across countries. They found that in the United States 5.5 percent of adults have provided informal start-up funds, compared to an average of just 3.3 percent in the other countries surveyed.

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[86] *OECD Economic Surveys: United States*, 1997. p.164.

[87] *New Entrepreneurial High-Growth Companies: Is There a Capital gap Warranting Federal Action?*, Congressional Research Service, February 26, 1999.

[88] "Dell's CEO Bets His Own Cash on the Web," *Wall Street Journal*, August 26, 1999.

Consider the virtuous circle of U.S. high-tech wealth creation when compared to high-tax Sweden. In Sweden, 62 percent of GDP is claimed by the government sector, and the top marginal tax rate is 60 percent.[89] In this situation, few private individuals control sufficient financial assets to be able to invest in new business start-ups. As a result, Sweden has a low rate of entrepreneurship, as noted by the OECD:

> ... in some countries such as Sweden the limited capacity of households to accumulate capital due to solidarity-based wage policies and high social contributions and income taxes has been an obstacle for entrepreneurship development. [90]

High net-worth individuals save a far higher average percent of their earnings than do others, so they are an important source of any nation's investment funds. More particularly, examining the number of millionaires across countries is one way to judge which economies have a sufficient supply of potential angel investors. The U.S. had at least 3.5 million households with net worth of more than $1 million in 1996.[91] By comparison, a 1997 study found just 965,000 millionaires (in ECUs) in seven large European economies (Germany, Britain, France, Italy, Spain, Switzerland, and Holland). In 1997, the ECU was worth 15 percent more than the dollar, while the seven European countries had a combined population 20 percent greater than the U.S.[92] Therefore, it appears that the United States has at least three times the density of millionaires as Europe.

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[89] *OECD in Figures*, OECD, 1999.
[90] *Fostering Entrepreneurship*, OECD, 1998, p.81.
[91] *The Millionaire Next Door*, Thomas Stanley and William Danko, 1996. Other estimates are much higher. For example, *Wired* magazine placed the figure at 8 million (September 1999, p.152)
[92] "Switzerland, Britain have most millionaires per capita in Europe," *Agence France Presse*, September 14, 1998.

Greater numbers of wealthy individuals give the U.S. an advantage not just in angel investment, but in pre-angel investment as well. The OECD notes that, "since most capital in the earlier stages of an investment is provided either by the entrepreneur himself or persons close to him, low household wealth may reduce the capital available for start-ups."[93] The OECD estimates that net household financial wealth equals 275 percent of GDP in the U.S., 200 percent in the United Kingdom, 140 percent in Germany, and just 80 percent in Sweden.[94]

3. Private Equity – Venture Capital. One of the most entrepreneurial areas of the U.S. high-tech sector is the venture capital industry. As a firm grows beyond an entrepreneur's or angel's personal resources, venture capital firms are often approached for additional funding. Venture capital firms are typically organized as limited partnerships – an institutional form which aided the industry's rapid growth.[95] The main sources of funds for venture capital firms are pension funds, endowments and foundations, corporations, and wealthy individuals.

Venture capital firms provide equity funding, assist in strategy, and may recruit experienced managers for young firms. Venture firms spread out the risks of technology investment by developing a portfolio of firms after screening of many business proposals. Venture capital firms are a diverse group: some are generalists, while others are specialist investors; some focus on early-stage investing, while others focus on later-stage firms. They often plan a firm's growth strategy for a number of years before a public share offering, or a merger or acquisition.[96]

Like angel investment, the "virtuous circle" of wealth creation in U.S. high-tech is evident in the venture capital market. Successful

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[93] *Fostering Entrepreneurship*, OECD, 1998, p.228.
[94] *Fostering Entrepreneurship*, OECD, 1998.
[95] *The Economics of the Private Equity Market*, Federal Reserve Board Staff Report, December 1995.
[96] "What is Venture Capital," National Venture Capital Association Web page at <www.nvca.org>.

high-tech firms often invest in smaller start-ups through venture vehicles. Industry giants such as Intel, Microsoft, and AT&T pursue investments in start-ups which have complementary technology. For example, Intel holds an investment portfolio of more than 250 companies with a value of over $3 billion.[97]

U.S. venture capital investment has surged in the past three years from $7.4 billion in 1995 to $25.3 billion in 1998, according to National Venture Capital Association (NVCA) data.[98] Figures for the first half of 1999 show that venture capital investment has soared 72 percent over the first half of 1998. In 1998, 61 percent of venture capital investment went to information technology firms, 19 percent to medical and biotech firms, and the remaining 20 percent to non-technology firms.

Growth in U.S. venture capital investment that began in the late 1970s was mainly triggered by two policy changes.[99] First, deregulation of pension plan rules under ERISA (the Employee Retirement Income Security Act) in 1978 allowed pension funds to invest in higher-risk investments including venture capital. (Such restrictions still remain in other countries). Second, venture capital markets were stimulated by the individual capital gains rate cut from 49 percent to 28 percent in 1979, and to 20 percent in 1981.[100]

As a result of the capital gains tax cut and more liberal pension rules, venture capital investments soared from under $1 billion per year in the late 1970s, to over $4 billion by 1983 as venture capitalists invested in early high-tech dynamos like Apple Computer, Intel, and Genentech.[101] The increase in the capital gains rate in 1986, and the recession during the early 1990s, knocked the wind out of the venture capital market for a while. In recent years, the buoyant

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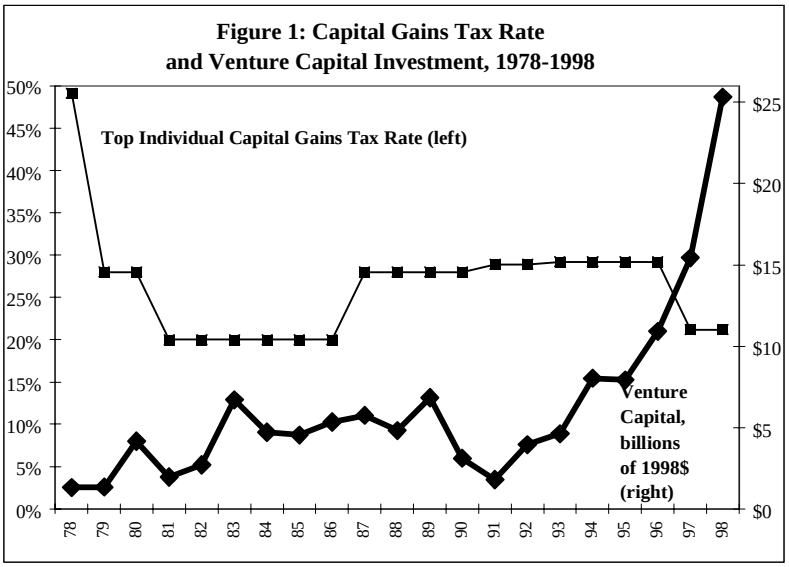
[97] *Red Herring*, August 11, 1999.
[98] *1999 Yearbook*, National Venture Capital Association.
[99] *Fostering Entrepreneurship*, OECD, p.76.
[100] Effective tax rates on capital gains from *The Labyrinth of Capital Gains Tax Policy: A Guide For the Perplexed*, Leonard E. Burman, 1999.
[101] *The Economics of the Private Equity Market*, Federal Reserve Board Staff Report, December 1995.

economy and the 1997 capital gains tax cut have fueled record high venture capital investments (see Figure 1).



Source: JEC, based on NVCA data.

One source of strength for the U.S. venture capital industry has been that investments from pension funds – the largest source of venture capital - are exempt from capital gains taxes. While reductions in capital gains tax rates do not directly affect this source of venture funds, capital gains tax rates are a determinant of taxable flows into venture capital funds. Additionally, capital gains taxes are a factor affecting other taxable private equity flows, such as entrepreneurs' own funds, and informal funds from angels whose investments are of a greater magnitude than venture capitalists.[102]

Interestingly, a recent study by two Harvard economists, Paul Gompers and Josh Lerner, concludes that venture capital commitments by tax-exempt investors are indirectly sensitive to

[102] *Fostering Entrepreneurship*, OECD, 1998, p.77.

capital gains tax rates.[103] They note that lower capital gains tax rates may induce more individuals to become entrepreneurs because most compensation for entrepreneurs, particularly in high-tech, is in the form of capital gains. This increases the demand for venture capital from both taxable and tax-exempt sources. The author's statistical analysis concludes that venture capital is sensitive to the capital gains tax rate, deregulation of pension investment restrictions, the GDP growth rate, and R&D expenditures by industry and universities.

According to NVCA figures, the United States raised five times more venture capital than Europe in 1998.[104] U.S. venture capital investments, or commitments, of $25 billion compared to just $5 billion for Europe. NVCA figures for a broader measure of private equity, which includes venture capital and buyout capital, totaled $80 billion for the U.S. in 1998, which was four times larger than the comparable figure for Europe of just $20 billion.

There are also significant differences in the nature of venture capital flows between the United States and Europe. A much higher percentage of venture capital is aimed at high-tech in the U.S than in Europe, and much less European venture capital goes towards risky early stage companies than in the U.S. [105]

One problem for European high-tech may be that the more extensive government funding schemes sidetrack high-tech start-up companies by orienting them towards public money sources. If so, start-ups miss out on the guidance provided by angels and venture capitalists. One study found that in 1996, for example, 75 percent of external financing for new technology-based firms in France came from government funds, compared to just 9 percent in the United States.[106] A U.S. high-tech executive once noted that, "in the U.S. you go to a meeting in Chicago to present a plan to a wealthy group of

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[103] "What Drives Venture Capital Fundraising," Paul Gompers and Josh Lerner, *NBER Working Paper 6906*, January 1999.
[104] *1999 Yearbook*, National Venture Capital Association.
[105] *Fostering Entrepreneurship*, OECD, 1998, p.254.
[106] See *Technology, Productivity and Job Creation*, OECD, 1998. p.231.

potential shareholders; in Europe people spend their time seducing civil servants to get funding."[107]

4. Public Equity Markets. While private equity works behind the scenes to fuel U.S. high-tech growth, initial public offerings (IPOs) and stock options are the high-profile side to high-tech financing. IPOs allow small high-tech firms to raise substantial amounts of funds for rapid and open-ended future growth.

Not only have IPOs raised billions of dollars for U.S. high-tech firms, the high volume of U.S. IPOs has led to increased private equity funding of start-ups because of the projected future benefits of going public. By contrast, in Europe one of the problems faced by the venture capital market is the lack of ability of investors to "exit" by going public. The shorter route to an IPO in the U.S. has helped entrepreneurs more easily raise venture capital money.

A central institution to U.S. high-tech success has been the NASDAQ, which was created as a market for young technology companies. Led by companies such as Microsoft, Intel, and MCI, NASDAQ now lists almost 5,000 firms including over 90 percent of U.S. software companies and over 80 percent of U.S. computer manufacturers. The simpler and less costly listing requirements on NASDAQ have allowed high-tech firms to quickly raise money for expansion. A recent *Washington Post* column described the importance of NASDAQ to the U.S. biotech industry:

> To a large extent, the biotech industry is the legacy of NASDAQ – just as today's Net stocks probably could not exist if there were not a ready market for shares of companies that fall short of the stringent listing requirements of the New York Stock Exchange. Biotech financing also is a phenomenon that could only have been produced by the U.S.

[107] *Upside Today*, 1993, p.9.

> capital markets, with their diverse and democratized sources of funds.[108]

The success of NASDAQ has spurred both Europe and Japan to try to copy it, but with limited success so far. This is a big handicap, because as the *Washington Post* notes, with the tougher stock listing requirements of a country like Japan, many well-known U.S. high-tech firms would have never gotten off the ground.[109]

5. Stock Options. Many high-tech start-ups have a great idea and need experienced workers to move their vision ahead, but don't have the cash to pay them. For example, new biotechnology and Internet companies often don't generate much revenue, let alone profits, for perhaps years after start-up. But such firms need the skills of top-level computer programmers, scientists, and experienced business managers.

Stock options are a useful tool to attract these key knowledge workers to high-tech start-ups. In biotechnology, for example, over 80 percent of industry employees belong to a stock option plan.[110] The *Washington Post* reports that more mid-level managers are eschewing the stability of large businesses, and being lured to small high-tech firms with the potential of a big stock option payoff.[111] Some Silicon Valley start-ups are even paying suppliers with stock options because they are so cash-short.[112]

The *Economist* has noted the importance of stock options to U.S. high-tech success: "Silicon Valley ... is built on options, not just for the bosses, but for most of the staff. Some would even argue that America's uniquely generous use of options may explain America's

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[108] "From Biotech, a History Lesson for Internet Investors," Jerry Knight staff reporter, *Washington Post*, September 6, 1999.
[109] "From Biotech, a History Lesson for Internet Investors," Jerry Knight staff reporter, *Washington Post*, September 6, 1999
[110] "Some Facts About Biotechnology," Web site of BIO at <www.bio.org>.
[111] *The Washington Post*, August 2, 1999.
[112] "Sweet Equity," *Wall Street Journal*, September 2, 1999.

uniquely successful economy."[113] Compare this to the U.K., which has less favorable tax treatment of stock options – small, cash-poor tech companies are finding it difficult to attract top talent, according to the magazine.[114]

[113] *Economist*, August 7, 1999.
[114] *Economist*, August 7, 1999, p.46.

3. DIVERSITY

I. A Million Experiments

America's leadership position in high-tech owes much to the diversity of its businesses, entrepreneurs, and research labs which generate multiple and competing technological visions. The generation of diversity is an often unheralded strength of market economies. The *Economist* says that it favors free markets "because a million experiments are safer than one big plan handed down by the Chief Engineer; markets weed out mistakes rather than entrenching them; their solutions to economic problems are always provisional, always adapting."[115]

The "Chief Engineer" approach used to be favored by many high-tech pundits who thought that the best technology strategy was to pick particular firms, industries, or standards for special treatment and subsidy. But the lack of knowledge about the future path of high-tech markets and technology is pervasive, thus making picking winners a losing strategy. As noted in Section 2.III., many of the diagnoses and prescriptions recommended for U.S. high-tech in the 1980s have turned out to be wrong, and sometimes counterproductive.[116]

Luckily, the Chief Engineer approach has been utilized less often in the United States than in Europe and Japan. In a new National Research Council report, innovation expert Professor David Mowery contrasts the "pluralistic" American approach to innovation, with the top-down approach of Europe and Japan:

> Previous large-scale regional European programs of 'strategic-technology' R&D in information technology have failed to prevent the decline of large segments of the European information technology

[115] *Economist*, July 31, 1999.

[116] "America's Industrial Resurgence: How Strong, How Durable?," David Mowery in *Issues in Science and Technology*, Spring 1999.

> industry. Recent Japanese initiatives, such as the Fifth Generation computer technology program that sparked a hysterical reaction in the United States, as well as other collaborative efforts in software technology, have had little effect on the competitive fortunes of Japanese electronics and computer firms. Many European programs have been hampered by cumbersome and inflexible administrative structures, as well as continuing pressure to distribute R&D funds among EU member states in some equitable fashion. In addition, regulatory, trade, and competition policies within EU member states often have insulated domestic firms from competition, reducing pressure to adopt and implement the results of these R&D programs more rapidly. [117]

European governments have funded an alphabet soup of high-tech initiatives, such as EUREKA, ESPRIT, MONITOR, RACE, and SPRINT, in a generally unsuccessful effort to catch up to the United States.[118] The poor performance of such "strategic" policies leads the *Economist* to caution governments against spending money on the next Big Thing.[119] The magazine notes that Japan "now unofficially admits that they are a waste of time."

The U.S. approach has been to generate a "million experiments" from its diverse range of businesses and R&D labs. This approach makes sense because technology creates new frontiers with huge uncertainties - no one knows which technologies will end up being the most profitable. In e-commerce, new ideas and "business models" are being tested constantly on the Internet, with consumers the ultimate arbiters of the best approach. Diversity is the market solution for

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[117] "The Global Environment of U.S. Science and Technology Policies," David Mowery *in Harnessing Science and Technology for America's Future*, National Research Council, 1999.
[118] *The Economic Laws of Scientific Research*, Terence Kealey, 1996.
[119] *Economist*, February 20, 1999. p.28.

uncertainty – consumer uncertainty, economic uncertainty, and technological uncertainty.

High-tech financing operates on the diversity principle as well. Venture capitalists diversify their investments because a rough rule says that 10 percent of a venture firm's portfolio of companies will provide 90 percent of the return.[120] Many investments fail or perform well below expectations. The *Wall Street Journal* notes that, "Wall Street firms freely admit that they do not know where all this [technology] will end up, so they are putting eggs in as many baskets as possible."[121]

An interesting case study of the benefits of diversity is the rapid recovery of Silicon Valley from the tough Japanese competition in the 1980s. In semiconductors, the competition displaced one in five Silicon Valley workers. But the huge number of small and medium-size firms in Silicon Valley allowed it to pursue a multiplicity of responses to the Japanese challenge, and the industry quickly came back with a stream of higher-value, customized, and innovative computers and components that put it on top again.[122] The U.S. company share of world semiconductor sales has risen from 37 percent in 1989 to 53 percent by 1998.[123]

Like the composition of U.S. high-tech businesses and funding sources, the U.S. R&D effort is very complex and diverse. Rich networks of businesses, universities, government labs, and hundreds of partnerships and collaborations have played an important part in U.S. high-tech success. Most funding for basic research – research that may not have an immediate economic payoff - comes from federal spending. Most funding for market-oriented research comes from private industry. In 1998, the shares of total U.S. R&D funding

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[120] *Washington Post*, August 15, 1999.
[121] *Wall Street Journal*, August 7, 1999.
[122] *Fostering Entrepreneurship*, OECD, 1998. p.94.
[123] Semiconductor Industry Association Web page at <www.semichips.org>

were 65 percent for industry, 30 percent for the federal government, and 5 percent for universities and other institutions.[124]

The types of companies doing industrial R&D are getting more diverse. The share funded by nonmanufacturing industries has grown from 8 percent in 1987, to 24 percent by 1997. Also, the share of R&D being funded by small and medium-size companies (those with less than 25,000 employees) has grown from 45 percent in 1987, to 60 percent by 1997.[125] Thus, R&D decision-making is becoming more decentralized, allowing the economy to pursue many different approaches to technology challenges.

The diversity of the American R&D effort is complemented by the effectiveness of its implementation. Innovation experts are finding that it is not just the dollars spent on invention that is important; so is the efficient and rapid diffusion of inventions.[126] The *Economist* suggests that, "rather than trying to back winners in the laboratory, governments may be better off encouraging downstream industries to take full advantage of innovations."[127] American industry has done this successfully as a result of its open and flexible markets, and high levels of entrepreneurship.

One important reform which helped spur quick adoption was the Bayh-Dole Act of 1980, which gave universities greater incentives to commercialize technology. The Act allowed universities to patent the results of federally-funded research and license the resulting technology to businesses and other entities. By contrast, in some OECD countries government-funded researchers have restrictions on

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[124] *Science and Engineering Indicators*, National Science Foundation, 1998.
[125] *Research and Development in Industry*, National Science Foundation, 1998.
[126] "The Global Environment of U.S. Science and Technology Policies," David Mowery *in Harnessing Science and Technology for America's Future*, National Research Council, 1999. p.84.
[127] *Economist*, February 20, 1999. p.28.

engaging in research that has commercial applications, and on cooperation with the business sector.[128]

Numerous areas of federal policy can affect the speed of adoption of new technologies. For example, the rapid obsolescence of many new technologies is sometimes not reflected in the depreciation rules of the federal income tax code, thus creating disincentives to upgrade equipment. Semiconductor manufacturing equipment must be written off over five years, but rapid changes in this industry means that the equipment often becomes obsolete in three years. One study found that the United States lags behind some other industrial countries in terms of competitive depreciation treatment for technology equipment.[129]

Open international trade and investment policies are also very important because technology embodied in imports generates domestic economic growth. The share of total G-7 country R&D performed by the United States has fallen from about 70 percent in 1960, to 48 percent today. Therefore, while there is great diversity of ideas in the United States, there are many inventions created outside the U.S. that U.S. companies need to adopt and exploit. In fact, an important reason why multinational corporations have steadily increased their foreign presence is to tap into foreign innovations. As the OECD notes, foreign R&D and technology has a major impact on domestic productivity in advanced economies.[130] As a result, U.S. policy should encourage liberalized international investment flows so that domestic industries learn and adopt the ideas and "best practices" of their competitors around the globe.

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[128] *OECD Observer*, OECD, Summer 1999.

[129] Testimony by the American Council for Capital Formation before the Senate Budget Committee, January 20, 1999. The Treasury Department is currently conducting an extensive study of depreciation periods and methods to be completed in 2000.

[130] *Technology, Productivity, and Job Creation*, OECD, 1998. p.48.

II. America's Diverse and Efficient Knowledge Workers

It is sometimes claimed that there are benefits to cultural homogeneity for an economy. Similar consumers allow for large production runs at factories, thus creating lower average costs. Additionally, business communications are easier with people of a similar language and culture. Some economists believe that Japan's cultural homogeneity was an economic strength up until the 1980s.

However, in the new entrepreneurial economy, homogeneity appears to be more of a liability than an asset. Computerization has increased manufacturing flexibility, thus lowering the costs of producing products for a wide variety of tastes. As the economy becomes more knowledge-based, a diversity of ideas generated by a diverse population is an engine of innovation and growth.

Individuals from different backgrounds are more likely to have differing experiences and sources of information. Immigrants will be familiar with the cultural factors important for marketing a U.S. product abroad, and immigrants may bring with them novel business ideas that are not yet adopted in the United States. As a result, America's population diversity – fed by an individualistic culture and inflows of immigration – appears to be an important strength in today's knowledge economy.

By contrast, commentators believe that part of the trouble with Japan's economy today can be attributed to "suppressing individuality; encouraging group behavior and conformity," as noted by the *Economist*.[131] The *Washington Post* expressed a similar view about Japan: "business and government leaders fret that the educational system, with its emphasis on discipline and communal harmony, fails to turn out graduates with the creative skills and entrepreneurial drive animating the founders of Silicon Valley."[132]

Helping to spur Silicon Valley's creative and entrepreneurial spirit has been waves of immigration. About one-third of scientists and engineers in Silicon Valley are foreign born. As the CEO of

[131] *Economist*, February 13, 1999.
[132] *Washington Post*, August 16, 1999.

software firm Adobe notes, Silicon Valley high-tech firms are "rainbow coalitions" of people with diverse backgrounds.[133]

Foreign-born workers don't just fill U.S. high-tech jobs, they create them. Some of the largest high-tech firms, such as Intel and Sun Microsystems, were founded by immigrants, as were more recent start-ups such as Hotmail. In fact, a recent study by the Public Policy Institute of California found that a remarkable 24 percent of Silicon Valley high-tech firms started since 1980 are run by Chinese and Indian immigrants.[134]

Immigrant groups often bring unique entrepreneurial skills to bear on business start-ups. Joel Kotkin finds, for example, that Korean and Middle Eastern immigrants have particularly strong propensities to start businesses.[135] Many source countries of immigrants have particularly strong trading traditions or work ethics. Additionally, immigrant companies may have an advantage in the global marketplace because their ties to home countries can be both a source of financing, and a market for U.S. export sales.

In addition to workforce diversity, a strength of the U.S. entrepreneurial economy appears to be the efficiency with which it utilizes knowledge workers. Less entrepreneurial economies have higher unemployment, thus wasting the skills of trained people. For example, OECD data for university-educated people aged 25-29 shows that just 3 percent are unemployed in the U.S., compared to 14 percent unemployed in France and 31 percent in Italy.[136] A country like France, which has a large government sector, may also inefficiently siphon off skilled workers from productive private employment, to less productive civil service positions.

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[133] *Harnessing Science and Technology for America's Future*, National Research Council, 1999. p.123.

[134] The study by Anna Lee Saxenian is forthcoming by the Public Policy Institute of California. See the *Wall Street Journal*, June 25, 1999.

[135] "Welcome To the Casbah," Joel Kotkin in *The American Enterprise*, January 1999.

[136] *Education at a Glance*, OECD, 1998. p.256.

A similar question of efficiency arises with respect to the deployment of R&D scientists. United States and Japan lead the world in terms of the number of R&D employees as a percentage of the labor force.[137] But the more highly mobile U.S. labor force may create a more efficient usage. The *Economist* notes that Japanese firms are behind their U.S. counterparts in joining the wired world because "they cannot turn to a plethora of small domestic third-party systems houses and software boutiques such as those that have helped corporate America to embrace the Internet. Although Japan has no shortage of talented software engineers, most work for large electronic firms, not independent start-ups."[138]

[137] *Human Capital Investment*, OECD, 1998.
[138] *Economist*, August 7, 1999.

4. CONCLUSION

The success of the U.S. high-tech sector illustrates America's mutually reinforcing strengths of entrepreneurship, open markets, and diversity. Entrepreneurs have flooded into open and competitive high-tech industries because of the huge opportunities and rewards available to successful innovators. Diverse sources of financial and human capital have ensured that good ideas don't get overlooked, and that many paths to innovation are pursued.

No strategic plan was responsible for the success of U.S. high-tech industries such as semiconductors, software, and biotechnology. Rather, decentralized decision-making in technology and capital markets has allowed many good ideas to be tested and developed. Diverse angel and venture capital funding, and efficient public equity markets, have allowed entrepreneurs to quickly grow business start-ups into multibillion dollar enterprises.

A virtuous circle of wealth creation has fueled growth in U.S. high-tech as successful entrepreneurs recycle their income and expertise into new start-ups. Public policy can promote the virtuous circle by encouraging business start-up activity, and by minimizing disincentives to equity investment in risky entrepreneurial ventures. Countries with labor market rigidities, barriers to competition, high tax rates, and heavily-regulated financial markets have not had the explosion of high-tech growth that the United States has enjoyed.

One important factor in U.S. high-tech success has been the efficiency with which innovation inputs are employed. High levels of entrepreneurship and competition ensure that R&D, education, and investment capital are used to maximum advantage. For example, some industrial countries have high savings rates, but inefficient financial systems, with the result that young high-tech companies don't get the financing that they need for expansion. Similarly, the benefits of R&D and education investments are not maximized in countries that have a shortage of entrepreneurs to turn inventions into innovations that grow the economy.

Other advanced economies will, no doubt, make gains in many high-tech industries as globalization continues to increase competition and the diffusion of technological know-how. The challenge for U.S. policymakers is to keep the United States one step ahead by reducing barriers to entry in product markets, encouraging further financial market innovation, and removing barriers to entrepreneurship.

This staff report was prepared by Chris Edwards, Senior Economist to the Chairman. Contact the Joint Economic Committee (202-224-5171) with any questions or comments.