Dale Neef • G. Anthony Siesfeld • Jacquelyn Cefola

The Economic Impact of Knowledge

RESOURCES FOR THE KNOWLEDGE-BASED ECONOMY

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Dale Neef

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Introduction to Series—
Why Knowledge, Why Now?

Why is there such an upsurge of interest in knowledge? In 1996 there were at least six major conferences on the subject; three new journals focusing on knowledge (sometimes loosely called intellectual capital or organizational learning) were published; and many major firms in the United States and Europe added positions such as chief knowledge officer, organizational learning officer, and even a few vice presidents for intellectual capital!

Why the focus on a subject that, at some levels, has been around since the pre-Socratic philosophers? Is it yet another one of the multitudinous management enthusiasms that seem to come and go with the frequency of some random natural phenomena? We don't think so! Many of us doing research on this subject have seen the rise and fall of many of these varied nostrums—all of which attempted to offer firms a new road to achieving a sustainable competitive advantage. However, when much of the shouting dies down, we conclude that, excluding monopolistic policies and other market irregularities, there is no sustainable advantage other than what a firm knows, how it can utilize what it knows, and how fast it can learn something new!

However, this still does not answer the questions why knowledge, why now? Let us list some very broad trends that seem to be playing a significant role in the current development of knowledge:

A) The globalization of the economy, which is putting terrific pressure on firms for increased adaptability, innovation, and process speed.

B) The awareness of the value of specialized knowledge, as embedded in organizational processes and routines, in coping with the pressures of globalization.

C) The awareness of knowledge as a distinct factor of production and its role in the growing book value to market value ratios within knowledge-based industries.

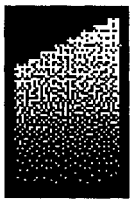
D) Cheap networked computing, which is at last giving us a tool for working with and learning from each other.

While many can argue for and against the significance of these trends, we feel that the preponderance of evidence points to the increasing substitution of brain for brawn within our organizations and our social lives. Yet we have developed few conceptional tools to better work with "wetware."

It is with these forces in mind that we offer the following volume to you. While there are, as yet, few agreed-upon standards and analytic frames and definitions, there are enough serious articles and books to help managers get some real traction in dealing with the crucial yet elusive subject of knowledge.

After all, we have had about five hundred years of thought concerning the other major factors of production, for example, land, labor, and capital. Let these volumes start the process of codifying knowledge about knowledge in order for us to better manage in the twenty-first century.

Laurence Prusak,
Series Editor



Part One

The Effect of Knowledge on National Economies

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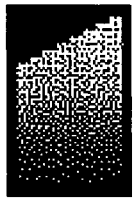

Introduction—
Rethinking Economics in the Knowledge-Based Economy

Dale Neef

What happens to our understanding of economics when the vast majority of people within our economy are employed to create ideas, solve problems, or market and sell services rather than to produce any tangible goods? How do we monitor and influence an economy in an "unbounded" global environment where land in the form of office space or manufacturing infrastructure is no longer important, where labor can be employed wherever it is most cost-effective worldwide, and where capital is equally available to finance a project in Bangkok or in Detroit? How must we rethink our standard economic models in a knowledge-based economy where the only "natural" resources of real value—those which give our nation "comparative advantage"—are intangible, that is, dependent upon what our people "know"? These are the types of issues with which economists are now beginning to wrestle as the transition to a knowledge-based economy continues to create changes as fundamental to our economic infrastructure as those witnessed during the Industrial Revolution.

In the first section of this three-part anthology I have selected six articles through which we will be examining the changing global environment and exploring some of the most contentious economic issues of our time, including:

- The effects of knowledge-based, "weightless" growth on advanced economies;
- How nations and organizations need to prepare for the accelerated pace of technological change;
- The effect of the newly emerging global market framework on organizations and nations;

- How governments need to create Research and Development strategies in order to best support their nation's own "comparative advantage" in knowledge in an era of "non-national" organizations;
- The need for a global "knowledge police" to protect the rights of individuals and organizations in a global economic environment where intellectual property and newly invented technologies are easily "pirated" or reverse-engineered.

As we explored in volume four of this series, *The Knowledge Economy,* a fundamental change in the behavior of all major developed economies is now taking place, characterized by a marked shift away from traditional manufactured goods production and toward a service-based economy dependent upon high-skill professional service and technology companies. Today nearly 85 percent of Americans are employed in the service economy and some 65 percent of these in the "high-skill" areas. Indeed, this high-skill, high-technology arena in the United States is now the fastest growing area for investment, and accounts—directly or indirectly—for nearly 8 out of 10 new jobs being created.[1] It is also where the money is being accumulated: by the millennium, the top 20 percent of the labor force considered to be knowledge workers—design engineers, research scientists, software analysts, lawyers, biotechnology researchers, financial, business and tax consultants, marketing specialists, etc.—will earn more than the other four-fifths of the workforce combined.[2]

The effects of this shift toward a knowledge-based, "weightless" economy are also reflected in the more traditional realm of manufacturing, where high-skill industries have doubled their share of manufacturing output to 25 percent since 1975.[3] Even the manufacturing process itself is becoming knowledge based, as raw material or physical assembly costs have plummeted to a national average of only 15–30 percent of total product value. As Alan Greenspan pointed out in 1996, America's total output, measured in tons, is little more than it was 100 years ago—despite a twenty-fold increase in real GDP value.[4]

In the past, the cost of producing manufactured goods came predominantly from raw materials, plant and labor costs. Very little value was added through the highly standardized labor processes of the production line. Today, that formula has been reversed. Intangible inputs that are dependent upon employee knowledge and skills—creativity and design proficiency, customer relationships and goodwill, innovative marketing and sales techniques—account for an average of 70 percent of the value of automobiles, and an incredible 85 percent of the value of high-technology goods such as microchips or CDs.[5] Today, and in the future, it is "brain" and not "brawn" that is the key to economic growth.

1. Wyckoff, Andrew, "The Growing Strength of Services," *OECD Observer,* No. 200, June 1996.
2. Tapscott, Don, *The Digital Economy,* p. 7.
3. "The Knowledge-based Economy," *OECD,* 1996
4. "The World Economy Survey," *The Economist,* September 28, 1996, p. 43.
5. "The World Economy Survey," *The Economist,* September 28, 1996, p. 43.

All of this means that unlike our typical goods-production economies of the past, an ever-increasing proportion of the output of the economy today is in the form of "intangibles"—services whose effect are not easily measured by traditional accounting methods of quantity or volume. Equally important, it means that companies and therefore the nation as a whole are growing increasingly dependent for their financial success upon high-skill knowledge workers—a group who are making up an ever-increasing proportion of every organization, in both the service and manufacturing sectors alike. In short, the knowledge-based economy is already upon us.

CHAPTER 1: KNOWLEDGE-BASED GROWTH AND THE ACCELERATED PACE OF CHANGE

Most contemporary economists agree that the knowledge-based economy has characteristics that may be very different from those found in traditional economic models, and although it is by no means certain yet that we need to scrap the fundamental tenets of economic theory that we have worked with for the past 200 years, changes in the global economy challenge many of our traditional economic notions.

In the past, it was usually a unique combination of land, labor, and capital that gave a nation its "comparative advantage." Today, things are different. As an ever-increasing percentage of economic growth arises from the burgeoning knowledge sector, a nation's comparative advantage comes instead from its collective ability to leverage what its citizens know. Traditional factors of economic growth—that is land, labor, capital, and indeed, to a large extent current fiscal policies—seem less relevant (if not obsolete) when seen in the context of a global, knowledge-based economy.

Until recently, for example, land—location, availability of natural resources, transportation advantages such as rivers or natural harbors—was part of the basis for economic development and success. "Where" something was done often dictated "what" was done. But traditional factors such as natural resources and raw materials are far less important now than they were just ten years ago. Not only are raw materials now an ever-decreasing proportion of the value of goods within the advanced economies, but modern extraction, production, and transportation methods have meant that natural resource prices themselves have fallen some 60 percent since 1975 (and will probably fall 60 percent more in the next twenty years). This all makes traditional natural resource–based production much less profitable, and the natural advantages of land much less important.[6]

Physical assets, too, are less important. As the manufacturing base continues to shrink from the effects of automation, the "workerless factory," outsourcing, and relocation of plants to nations with lower labor costs, less and less physical plant of any sort is required in advanced economies. A similar trend can be seen in

6. Thurow, Lester, *The End of Capitalism,* p. 67.

the service sector, where modern computing and communications tools tied together in an electronic environment have revolutionized the way in which companies view the need for physical assets. Many organizations now consist of little more than a sales force, coordinating management offices, and a series of distribution hubs. Office space has been rationalized with new "hotelling" techniques greatly reducing traditional office requirements. Many workers today are mobile and essentially nomadic, spending their time in airports or in hotels, working on laptops connected to "virtual" networks. Although innumerable social and personal difficulties arise from this new scenario, the fact remains that organizations in the knowledge-based economy are maintaining only a fraction of the physical assets that they had in 1980, and land as a key factor for providing comparative advantage has been rendered virtually meaningless.

Similarly, the traditional notion of labor itself providing the means for retaining a national comparative advantage requires rethinking in the global, knowledge-based economy. Since the onset of industrialization, the vast majority of employment (and thus national economic prosperity) in advanced economies has traditionally been found in low- to medium-skill, "make or move" type jobs, where virtually anyone could be trained to complete the work. In the past, labor was seen as a commodity much like any other—as interchangeable as the assembly-line parts with which the employees worked—and over the past fifty years advanced economies have come to expect a continued high standard of living to be gained from those low- and medium-skill jobs. However, all of that is changing. Most employment in advanced economies is now within the service sector, and as labor-based manufacturing continues to be shed or outsourced globally, low- and medium-skill work in advanced economies will become increasingly less well paid and more difficult to find. To make matters more difficult, unlike the low- and medium-skill labor markets of the pre-1990s, inclusion in the highly skilled labor force of the knowledge-based economy is unlikely to be automatic or universal. The transition from blue-collar to knowledge work is not an easy one.

The economic principles concerning capital, too, have changed dramatically. With the development of electronic currency trading and financial markets in major cities worldwide, capital is no longer restricted to local investment boundaries. With global capital markets exchanging some 1.3 trillion dollars every day, investment funds can be obtained quickly for development anywhere in the world.[7] The very nature of the concept of capital intensity—where investment was once restricted only to those nations which had the indigenous wealth and infrastructure—is no longer applicable. In 1995 an amazing $170 billion in private capital was invested in developing economies, and between 1991 and 1995 total flows of foreign direct investment doubled to $315 billion as American and European companies invested in low-wage nations such as Mexico, Brazil, or China. Indeed, some 10 percent of U.S. pension funds are invested in Asia alone.[8] In the global,

7. Mathews, Jessica, "Power Shift," *Foreign Affairs,* January/February 1997, p. 57.
8. "All of a Sudden Every Banker is a World Banker," *The Economist,* July 27, 1996, p. 61; "Balancing Act," *The Economist,* January 4th, 1996, p. 71.

knowledge-based economy, capital investment is no longer restricted to wealthy nations. Global capital markets and their complex, interactive exchange networks make investment impersonal, unencumbered by national sentiment or long-term planning. Today, finance seeks out profits, wherever they may be around the globe.

Finally, we also know that one effect of concentrating an ever greater number of our most knowledgeable people on high-skill problem solving and the development of high-technology products (and paying them more to do it) is that the pace of change will continue to accelerate. Because knowledge-based business seems to grow under its own effect—creating markets that never before existed, attracting and producing more innovation, unconstrained by land, labor, or capital—it is in large part unpredictable. The computer industry provides a typical example, where some 70 percent of revenue today comes from products which didn't even exist two years ago. Even at the national level a sharp comparison can be drawn between the four decades which it took for Japan to become a leading car and computer manufacturer and the little more than five years it has taken for Taiwan to gain a large share of the world's PC markets, or other new Asian "Tiger" economies, such as Thailand and South Korea, to develop highly competitive automotive industries.

An entirely new level of volatility permeates the world economy today. In fact, of the Fortune 500 companies in 1955 (most of which were natural resource–based), 70 percent are now out of business. One of the most curious economic characteristics of knowledge is that it often makes previous goods, services, and knowledge obsolete. Entire industries may spring up, thrive, and be eliminated in a decade, as knowledge-based growth continues to shorten product life cycles, compress development cycles, drive new product prices downward, and increase the competition for technical standards.[9] Just a few examples illustrate the enormity of technological improvement resulting from this focused commercialization of knowledge-based work over the past several years.

In agricultural, manufacturing, and low-skill service sectors, machines are quickly replacing the need for low- and medium-skill human labor. So extensive have the technological advances been in agriculture that the percentage of farm-based workers has dropped from 75 percent in 1900 to some 25 percent of the U.S. working population after World War II. Farm labor accounts for less than 3 percent of employment in America today.[10] Similarly, in the realm of manufacturing, the scale of productivity improvement from automation is astounding. During the last thirty-five years the world's largest 500 multinational corporations grew by some 700 percent in real terms (from $721 billion in sales in 1971 to $5.2 trillion in 1991) even while decreasing the total number of employees.[11] One good

9. "The World Economy Survey," *The Economist,* September 28, 1996, p. 10.; James M. Utterback, "Mastering the Dynamics of Innovation," Harvard Business School Press, Boston, 1994, as cited by Tapscott, *Digital Economy,* p. 10.; Howitt, Peter, "On Some Problems in Measuring Knowledge-based Growth," *Implications of Knowledge-based Growth for Micro-Economic Policies,* p. 15.
10. "The World Economy Survey," *The Economist,* September 28, 1996, p. 7.
11. Greider, William, *One World, Ready or Not,* p. 21.

example of near-automated production is US Steel, which in 1980 employed 120,000. Today the company employs fewer than 20,000.[12] In fact, the percentage of the workforce involved directly in manufacturing in the United States has dropped from 33 percent post-war to less than 17 percent—and may drop as low as 12 percent by the end of the decade. Some estimate that within thirty years as little as two percent of the world's current labor force may be needed to produce all the goods necessary for total demand, worldwide.[13]

In high-technology areas such as computing and telecommunications, the pace of change is even more incredible. Communications and computing capabilities—capturing, codifying, and disseminating information and knowledge—has improved exponentially in terms of speed and cost. Since 1975 the combination of global telecommunications and computing has increased its information-carrying capacity by over a million fold. In telecommunications, new optic fiber networks—each wire smaller than the size of human hair—are each able to transmit the data equivalent of the entire *Encyclopedia Britannica* in five seconds. In 1960 a transatlantic cable from the United States to Britain could carry only 138 conversations at one time. Today new fiber-optic design allows for 1.5 million conversations simultaneously. The same accelerated pace of improvement can be seen in the computing industry, where today's $2,000 laptop computer is much more powerful than a $10 million mainframe computer was in 1975, and a typical CD-ROM can now hold 360,000 pages of text.[14]

So how do businesses find their way ahead in such a rapidly changing global marketplace? In Chapter 1, "Uncertainty and Technological Change," Nathan Rosenberg, Professor of Public Policy and Economics at Stanford University, explores the difficulties associated with anticipating the future impact of successful innovation—those discoveries, which have the effect of producing further innovations and investments broadly throughout business and society—when we can only think of new technologies in terms of old frameworks. No one, for example, could have predicted that the invention of the laser would be the basis for fundamental and diverse new CD, surgery, printing, and telecommunications technologies. Similarly, no one anticipated that the computer—developed for the purpose of rapid calculation, but now used for everything from complex design to aircraft cockpits, satellite technology, and worldwide reservation systems—would so fundamentally change technology, economics, and society.

Part of the problem, he explains, is that new technology begins in a primitive state and with properties whose usefulness cannot be immediately appreciated. This is why some 80 percent of R&D funding is devoted to improving products that already exist. Moreover, many inventions have origins in an attempt to solve very specific, narrowly defined problems, whereas major innovation often requires a combination of "complementary technologies" in order for any single

12. Drucker, Peter, *Post-Capitalist Society,* p. 64.
13. Rifkin, Jeremy, *The End of Work,* p. 8.
14. "The World Economy Survey," *The Economist,* September 28, 1996, pp. 3–4.

technology to be effective. Optic fiber technology, after all, is of no value unless placed within the context of computer-driven, digital telecommunications. In today's climate of "relevance" funding by government, Professor Rosenberg examines what incentives, institutions, and policies are likely to lead to a lessening of uncertainties and provide the greatest "foresight" in promoting future innovation.

CHAPTER 2: CONVERGENCE—GLOBAL COMPETITION IN THE KNOWLEDGE-BASED ECONOMY

In the knowledge-based economy it is the production of ideas, not goods, that is the source for economic growth, and the reason that new computing and telecommunications technologies are so economically revolutionary in their nature is that they allow ideas—in the form of techniques, research results, diagrams, drawings, protocols, project plans, chemical formulae, marketing patterns, etc.—to be distributed instantaneously and in a coherent way to anyone, anywhere around the world. As a result of these advances in computing and telecommunications the emergence of an interconnected global environment is becoming more apparent. This "unbounded" economic framework, in turn, provides organizations not only with vast new market opportunities, but also with an enormous potential pool of labor worldwide as improved communications and low-cost transport allow direct access to low-wage, low-skilled workers globally.

But this trend has gone well beyond simply allowing advanced economies to take advantage of low labor costs in foreign countries. Developing economies (those that we used to think of as "third world") themselves have rapidly adapted to the advances in operational techniques, automation, computing, and telecommunications technologies and are quickly building a highly competitive production infrastructure capable of manufacturing high-quality products at a fraction of the labor costs of the traditional "advanced" economies.

Their success can be illustrated, in part, by looking at the tremendous growth rates they have witnessed in the last several years. Since 1969, East Asia's proportion of the world's economic output has leapt from 4 percent to over 25 percent, with the average Asian national growth rate rising to 7.5 percent in the first quarter of 1997. In 1978 China's exports totaled only $9.8 billion, but by 1994 their exports had shot to $121 billion—making China the eighth largest exporter of manufactured goods in the world. South Korea's GDP has grown 177 percent since 1980, and Thailand's GDP has risen 235 percent in the past twenty years.[15]

Moreover, this growth is not exclusively low-skill, low-wage labor. In many cases Asian education levels meet or exceed those of the traditional developed economies (United States student scores were 28th and 27th, respectively, among

15. Tapscott, Don, *The Digital Economy,* p. 6; "China," *The Economist,* August 17, 1996, p. 18.

nations in high school mathematics and science achievement tests), and the R&D and productivity investment rates rival OECD levels.[16]

Accordingly, not only are new markets being opened up for consumer-based goods, but for the first time these developing economies are able to contribute directly to the development of those goods at every stage of production, often in cooperation with other developing economies. Samsung, for instance, invested $1 billion on TV set and white goods production in Brazil and Mexico in 1996, and Hyundai just set up a $500 million regional reciprocal manufacturing center in Brazil, Colombia, and Venezuela. As a result, much of the work that was once the exclusive domain of the OECD nations is now quite competently done in India, Singapore, Thailand, Latin America, or Eastern Europe at much lower labor costs.[17]

All of this means that for the first time in history products can be made and sold almost anywhere on the globe. Design and test elements of manufacturing can be accomplished in parallel, and the results conveyed electronically. Market trends can be sensed and responded to with much greater accuracy and speed. The entire supply chain, when organized effectively, can be accomplished globally, without boundaries, at a fraction of the cost it would require to complete in a single domestic economy subject to traditional high- and low-skill labor supply and demand. Transportation-based technologies have revolutionized the speed and cost structures of shipping goods around the world. New sea-going carriers, electronic scheduling, advanced port management, and revolutionary new designs for the container-carrying fleet have combined with an ever-growing air cargo fleet to crisscross the globe twenty-four hours each day.

Since the 1950s, the United States has prospered, at least in part, because it boasted a uniquely low-leveraged economic infrastructure where raw materials, low- to medium-skill labor, and the availability of capital were more abundant and less expensive than in other economies. Many economists now warn that within the next decade, those same characteristics, and therefore the traditional economic mainstays of the post-war Western economic miracle (automobiles, white goods, textiles, and even high-value electronics) may be permanently transferred to low-wage, developing economies. In advanced economies like the United States, Sweden, or Britain, low- and medium-skill production will increasingly be either moved away to low-cost labor markets globally, or abandoned altogether, forcing a further shift toward the "knowledge-based" industries or services where advanced economies still retain a "comparative advantage."

One particularly worrying aspect of these changes is the issue of convergence, where the United States, in particular, seems to be falling behind other advanced economies in crucial measurements of productivity. The United States now maintains less than 25–30 percent of world GDP—a figure which has dropped

16. "World Education League: Who's Top?," *The Economist*, March 29, 1997, pp. 21–23.
17. "Crossing the Pacific: Asian Investment in Latin America," *The Economist*, August 24, 1996, p. 51.

from 70 percent post-war, and halved since 1960 when the United States boasted over 50 percent.[18] In 1971, 280 of the largest 500 multinationals were American owned and based. Today the United States can claim ownership of only 157, while Europe has surpassed the United States with 168 and Japan has jumped from 53 to 199.[19] Part of the problem is that knowledge- and service-based work—which now makes up some 70–80 percent of an advanced economy's output—is notoriously difficult to measure accurately (as Tony Siesfeld discusses in Part 3 of this anthology). But some economists believe that there are more sinister implications behind this trend.

Is there danger in convergence, or is it a natural evolution toward post-war equilibrium to be expected and encouraged? There is much debate about how quickly the gap is closing and what it will mean to the United States. In Chapter Two, two of the most distinguished political economists of our time, Robert Heilbroner from the New York School for Social Research and Lester Thurow, former Dean of MIT's Sloan School of Management, explore the key issues around these contentious issues in "Falling Behind: The Productivity Problem."

Heilbroner and Thurow contend that despite strong growth and the appearance of a healthy economy, there are many indications that productivity levels in the United States, particularly, are falling behind European and Asian nations. Part of the problem is no doubt related to the severe shift toward services that is becoming apparent in the U.S. economy. After all, security guards, doctors, and lawyers, by the nature of their work and pay structure, are peculiarly resistant to measures that reduce cycle time or create broad productivity increases. Indications are that even as the blue-collar sector is shrinking its productivity levels are rising; while as the white-collar service sector grows (now over two thirds of the workforce) productivity rates continue to fall.

But the shift toward a "weightless" economy can only explain part of the productivity issue. Although the service sector is larger in the United States than in Europe as a whole, many European and Asian nations are only marginally behind in the growth of services. More importantly, say Heilbroner and Thurow, key areas of the American economy such as mining, petrochemical, and construction have witnessed a steady decline, comparatively, in output per worker. Why?

One reason is that the American public—and therefore industry—has failed to invest, both in terms of capital equipment and in terms of medium- to long-range R&D. German families, for example, save about 15 percent of their annual income, the Japanese save some 20 percent, while Americans, by comparison, save less than 5 percent. Because of notoriously high levels of consumer spending, over the past fifteen years there has been very little available capital in America for making the key investments necessary in order to take full advantage of new operational technologies.

18. Spence, Michael, "Science and Technology Investment Policy in the Global Economy," *The Mosaic of Economic Growth,* edited by Ralph Landau, p. 176.
19. Greider, William, *One World,* p. 22.

A second reason, according to Heilbroner and Thurow, is that unlike most European and Asian countries, the trend in the United States is for less, not more, cooperation with government in terms of public/private, long-term economic planning. This, combined with unprecedentedly high levels of consumption, a focus on short-term over long-term investment, an emphasis on military-based R&D, and the tendency of U.S. businesses to focus locally rather than globally, has resulted in an alarming trend which finds the United States "falling behind."

CHAPTER 3: TECHNOLOGY, R&D, AND ECONOMIC GROWTH

So how do highly developed economies like the United States, the EU 15, and Japan continue to compete in the knowledge-based economy? It is becoming apparent that it certainly won't be effective in the long term to attempt to subsidize low-wage, low-skill manufacturing industries which can ultimately never hope again to compete with developing economies with their low-wage infrastructure and expectations. Most economists agree that the answer is to use our "comparative advantage" in the knowledge-based work that we do best, and many contend that government sponsored investment in research and development will remain the key to retaining and exploiting that knowledge-based comparative advantage.

Richard Nelson, Professor of Economics at Columbia University, and Paul Romer, Professor of Economics at Stanford University and the key intellectual force behind new knowledge-based growth theories, contend in their article "Science, Economic Growth and Public Policy," that the United States, with its increasing focus on individual and direct R&D grants, is ignoring and thus underestimating the enormous indirect value that "open" public-funded research has on society and the economy as a whole. Focusing on "mission-oriented" research within individual and knowledge-retentive companies rather than broader "core research" at universities and government institutions may mean that valuable fundamental knowledge from which might spring thousands of new ideas is not shared throughout the economy. In the knowledge-based economy, those nations which promote a broader "sharing" of knowledge gained through R&D, they contend, will see greater benefits to society as a whole. Ultimately, in its drive for efficiency, the United States may well be restricting, rather than encouraging, the free flow of knowledge and innovation.

Yet, at a time of general reduction of government spending and influence, calls for lower taxes, and the shift of traditional government responsibilities to a local level, the debate surrounding the most effective focus and method for supporting research and development is heating up. The debate is further fueled by the growing realization that as organizations become more "non-national" in nature, governments in the United States, Germany, or Britain may find themselves essentially subsidizing R&D which is then "absorbed" by companies in foreign markets, adding to the prosperity of other national economies. In his essay "Sci-

ence and Technology Investment Policy in the Global Economy," A. Michael Spence, Dean of the Stanford Graduate School of Business, suggests that the mechanisms that the United States uses for developing and deploying technology have changed little since they were put in place after World War II, when America was in a unique position, by virtue of its enormous economic dominance, of being both the largest producer and greatest user of technology. In the global, knowledge-based economy, the current flow of knowledge is almost exclusively one-way, however, and the United States risks becoming a large net supplier of technology and human capital to the rest of the world. What is the solution?

One alternative is to attempt to "close" the system through protectionist measures which would guard our return on investments in R&D and innovation. Such a course in a global, knowledge-based economy, suggests Spence, is rife with difficulties. A second approach is to begin to agree with industrialized nations around the globe to all invest similarly proportionate amounts in science and technology R&D with the goal of developing an open, "free trade" in ideas to governments, universities, and companies worldwide.

CHAPTER 4: WHO WILL BE THE GLOBAL KNOWLEDGE POLICE?

As the previous articles make clear, one of the most compelling problems arising from the unbounded, knowledge-based economy is that historically there has been little agreed international law governing such critical issues as antitrust, copyright, or patents. This international "free-for-all" market has resulted in a general hesitancy to distribute new products and services in emerging markets, and has meant tremendous losses for those who create new products only to see them reverse-engineered or copied outright in foreign markets. The scale of the problem is enormous. As Bruce Lehman points out, up to 8 percent of all products and services worldwide are pirated with costs to the United States alone estimated to be as high as $200 billion annually. China, for example, is thought to have a market for "pirated" music (primarily CDs) worth $168 million—almost the same size as its entire "legitimate" music market in total.[20] Similarly, software piracy accounted for lost sales estimated to be as high as $15 billion in 1996, with piracy rates emerging as high as 43 percent for Britain, 67 percent for Japan, and an amazing 94 percent for Russia.[21]

So how do we protect the knowledge that helps us as a nation to leverage our comparative advantage? In Chapter 4, Bruce Lehman, Under Secretary of State for Labor, explores some of the key issues to be resolved in a global, knowledge-based economy where new ideas, products, or services can be copied in-

20. Lehman, Bruce, "Intellectual Property," *Columbia Journal of World Business,* Spring 1996, p. 15; "Chinese Piracy: A Case for Copying," *The Economist,* November 23, 1996, p. 73.
21. "Intellectual Property," *The Economist,* July 27, 1996, p. 58.

stantly, and presents an upbeat assessment of recent developments in this key area in his article "Intellectual Property: America's Competitive Advantage in the 21st Century."

CHAPTER 5: THE RISE OF THE NON-NATIONAL ORGANIZATION

The last chapter of Part One examines one final aspect of the global, knowledge-based economy: the growing influence of "non-aligned" multinational companies. As the world moves toward an "unbounded" global economy, organizations of all types are becoming more geographically decentralized, and thus less aligned with any particular nation than in the past. New regional agreements on tariff reductions, combined with growing market saturation for consumer goods domestically, have driven many companies toward global extension and the development of a more "non-national" character, where cross-border operations extend into complex loose alliance networks of vendors, outsourcing agents, and distribution channels worldwide.

A new breed of international conglomerates is beginning to emerge as large firms scramble to gain influence in this new global marketplace. The global economy can create strange bedfellows: IBM and Siemens, for example, are working together to produce a 16-megabyte chip in France. Daimler-Benz executives are in talks with Mitsubishi on joint ventures, and Ford completes joint production with Nissan while owning one quarter of Mazda. It all can be alarmingly complex, as William Greider notes, when "NEC and IBM both own equity stakes in Bull, the French computer company, which own a majority of Honeywell, and Honeywell is in alliance with NEC, which, of course, competes with IBM.[22]"

Similarly, in the telecommunications field national giants are scrambling to align, creating new and alarmingly powerful "non-national" communications giants such as World Partners (AT&T and sixteen other companies in thirty-one countries), and Global One (Deutsche Telecom, France Telecom, and Sprint). As these and other telecommunications giants continue to emerge, it will mean that any activity that can be conducted through a screen and a telephone wire—writing software, secretarial services, airline revenue accounting, processing insurance claims—will be able to be done without regard to geography or nation.[23] This trend is already well advanced, with some 100 American firms outsourcing their software "code cutting" overnight via electronic networks to India where programmers are typically paid less than 25 percent of the American rate. In fact, it is estimated that some four million "virtual aliens" are already employed directly in the American workforce, existing outside of the nation's borders, undercutting domestic labor rates, working in an ill-defined tax framework, connected only through a growing electronic communications network. Indeed, this global tele-

22. Greider, William, *One World, Ready or Not,* pp. 174, 180–183.
23. "A Marriage of Convenience," *The Economist,* November 9, 1996, pp. 71–72.

communications infrastructure already essentially exists beyond the controlling powers of any single nation.[24]

If burgeoning markets and low-cost labor regimes are the "pull" that draws organizations into new global markets, the high tax rates and high labor costs that are now integral to the economic framework of advanced economies are increasingly being seen as the "push" for companies to relocate. Nestlé, a Swiss company, now has some 98 percent of its production capacity outside of their host nation. Similarly, Toyota is now over 70 percent non-Japanese, and Motorola's American employee level has declined to 56 percent.[25] This continued evolution toward truly global markets may mean that, for large-scale enterprises, it will no longer be possible to remain wholly domestic either in production or sales. In the next few years, as companies continue to become more and more global in nature, the traditional commitment to national prosperity and patriotism will give way to organizational loyalty.

As a result, the very nature of the role of national governments in the global, knowledge-based economy is changing. In the past, a nation's comparative advantage was based upon a combination of natural resources, labor, capital, and a balance of governmental, social and economic stability within its borders. National governments could monitor and to some extent control what goods were produced within their borders, what products and services were sold by their people, and how much money their citizens were eventually allowed to keep in the local currency. Indeed, internally, their ability to tax and control interest rates have been their two main tools for wielding influence and power over capitalist organizations and the economy as a whole.

However, our traditional understanding of economic activity which arose from the theories of Adam Smith, Alfred Marshall, or even John Maynard Keynes, was based on the idea that even accounting for import and export trade, every nation's economy was essentially "bounded." Borders could be sealed, taxes could be raised or lowered, tariffs imposed, duties focused on specific goods in order to provide incentives and punishments. Governments could assist indigenous industry through subsidies, grants for Research & Development or through advantageous trade legislation. Is this all still the case in the global, knowledge-based economy?

CHAPTER 6: POWER SHIFT: THE AGE OF NON-STATE ACTORS

Jessica Mathews, Senior Fellow at the Council on Foreign Relations, suggests in her article "Power Shift: The Age of Non-State Actors," that it is not probable that government assistance will continue in the global, knowledge-based

24. "The Software Industry Survey," *The Economist,* May 25, 1996, p. 15.
25. Rosecrance, Richard, "The Rise of the Virtual State," *Foreign Affairs,* July/August 1996, p. 52; Greider, William, *One World,* p. 91.

economy. She maintains that with the development of electronic communications, capital markets, advanced transportation, and easily transferable technologies, the very nature of multinational industrial ownership may change. In the future, governments will have less and less control over business as organizations become members of "non-national" conglomerates, deftly moving their assets and skills around the world in order to avoid any legislated pressures (such as labor laws or taxation) that governments attempt to place on them.

After all, of the world's largest economies in 1997, fifty were corporations. Sales revenues for General Motors alone were roughly equal to the combined GNP of any ten African nations, and today around 400 of the world's largest companies account for over one half of the world's total output.[26] Within the next decade we may well find that the knowledge-based economy has undermined the very nature of the nation-state.

The key characteristics, then, of the new economic framework are knowledge-based business, new technologies, and unbounded globalization. Depending upon one's perspective, this transition can mean opportunity or Armageddon, but most economists agree that however difficult it may be to adjust to these new realities, it will be much more difficult to resist them. As comparative advantage (for nations, or, in the near future, non-national organizations) becomes increasingly dependent upon access to ideas, human capital, and the ability to create innovative new products and services, understanding and adjusting to the impact of knowledge becomes paramount.

26. Stopford, John M. "The Impact of the Global Political Economy on Corporate Strategy," Carnegie Bosch Institute, Working Paper No. 94-7, p. 3.

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