

Chapter 1: Managerial Economics Basic

Introduction

What is Economics?

The most fundamental fact of economics is that people must make choices. We cannot have everything we want. This simple fact applies to societies as well as to individuals. It applies to the rich and to the poor. Simply stated:

Economics is the study of how people choose to use their limited resources (land, labor, and capital) to produce, exchange, and consume goods and services. It explains how these scarce resources are allocated among competing ends by the economic system.

During the past one and a half centuries, as nations and their citizens have made economic choices, they have been influenced by one of two competing philosophies. The philosophy of capitalism maintains that private ownership and private decision making provide the best framework for creating growth and prosperity; that is, if people are simply left alone to pursue self-interests, good things will happen. The competing philosophy of socialism teaches that private ownership and self-interest lead to bad economic results—inequality, poverty, and depressions. Socialism argues that the state can better look after the interests of society at large through state ownership and central planning.

How we organize our economic affairs—the blend of capitalism and socialism that we select—depends on how we understand the events that shape our lives. Economists offer a framework for interpreting such events. Robert Heilbroner called the great economists of the past the “Worldly Philosophers” because, while they command no armies, they influence the way we run our world by determining what we believe about the economy and how it works.

1.1 Defining moments of economics: From Industrial Revolution to Information Revolution

Our understanding of the economic aspects of our lives is conditioned by past events and ideas. Our material circumstances were not created overnight. We didn't wake up one day to discover high-technology factories, a complex legal system, an information superhighway, a transportation network, and sophisticated financial markets. All these resources and institutions are the consequence of past events.

Change occurs sometimes gradually, sometimes rapidly. Sometimes monumental changes take place that we recognize only after the fact. There are even times when we think change has occurred when it has not—and so it is with economic change.

Over the past two centuries there have taken place a number of changes so important that they have defined the direction of economics and influenced the lives of millions of people. These “defining moments” have provided the stimulus for the great economic thinkers to provide explanations that became the great theories of economic science.

A Defining Moment of economics is an event or idea, or a set of related events or ideas over time, that has changed in a fundamental way the manner in which we conduct our everyday lives and the way in which we think about the economy.

We focus on five Defining Moments of economics:

1. The Industrial Revolution
2. The Rise (and Fall) of Socialism
3. The Great Depression

- 4. Globalization
- 5. The Information Revolution

Each of these Defining Moments illustrates a fundamental idea of economics. The Worldly Philosophers developed powerful and influential theories to explain why each moment happened and what its consequences were. You will frequently encounter these Defining Moments throughout the text, for they define the basic themes, concepts, problems, and puzzles not only of the past but also of contemporary economic life. The issues raised by the Defining Moments—growth, affluence, poverty, cycles, trade, ownership, economic institutions—constitute the major economic issues of the past, the present, and the future.

1. The Industrial Revolution: The Benefits of Voluntary Exchange

In the early eighteenth century, enormous economic changes began to take place, first in England and then in Europe and North America. These changes are now known as the Industrial Revolution.

The Industrial Revolution occurred as a result of extensive mechanization of production systems that shifted manufacturing from the home to large-scale factories. This combination of scientific and technological advances and the expansion of free-market institutions created, for the first time, sustained economic growth.

In 1700, England was primarily an agricultural nation of only 10 million people. Most of its citizens were peasants tilling the soil with simple plows; a few were merchants and artisans; a very few were the ruling aristocracy living on large estates. Their lives were not much different from those of their ancestors a century or two earlier.

At first slowly and then more quickly, factories powered by water mills and later by steam engines sprang up. Employment in industry began to outpace employment in agriculture. People flocked from the countryside to the industrial centers of London, Birmingham, and Glasgow. Inventors and scientists sought and found better ways of making products that people wished to buy. With the development of mass production techniques, costs of production fell. Products that had previously been inaccessible to the average household became affordable. The Industrial Revolution created the conditions for those increased levels of living standards that we enjoy today.

Adam Smith (1723–1790), the founder of modern economics, explained simply and eloquently the Defining Moment of the Industrial Revolution. Smith's 1776 masterpiece, *An Inquiry into the Nature and Causes of the Wealth of Nations*, combined simple theory with his prodigious learning and insights. One of the most important books ever written, *The Wealth of Nations* brought Smith lasting fame and changed forever the way we view the economy.

In his work, Smith explained the ongoing Industrial Revolution with one powerful insight. He realized through careful observation that a massive increase in production and wealth could take place spontaneously without government direction and control. Smith proposed that self-interest could be relied upon to organize our economic affairs. He wrote:

It is not from the benevolence of the butcher, the brewer, or the baker, that we expect our dinner, but from their regard to their own interest.

Adam Smith's key insight was that two parties to a voluntary exchange will both benefit. It is not necessary to direct people to engage in transactions from which they benefit. Through the pursuit of self-

interest, individuals voluntarily engage in those activities in which they themselves earn the most income. Individuals contribute to the well-being of the entire society not just through charitable impulses but by self-interest. Each person, as Adam Smith said, "intends only his own gain," but is "led by an invisible hand" to promote the general interest of society through the magic of the marketplace.

Smith argued that free enterprise solves economic problems better than did the pervasive government monopolies and intrusive regulations of his day. Individuals must be allowed to make their own decisions in the pursuit of their self-interest. If they make the right decisions, the result will be profit; wrong decisions mean losses. This insight paved the way for a hands-off approach of government that allowed England, through the benefits of the Industrial Revolution, to become the world's most prosperous nation.

Much of this book describes how we compete with one another in the marketplace. One Internet service provider competes with another for customers by trying to offer better prices and better quality. Airlines fight for survival by learning how to provide safe service at a cost lower than that offered by their competitors. One architect competes with another by offering more original designs at a better price. In such a system, success is measured by profit; failure is measured by losses. It is this competition that guides the invisible hand.

Adam Smith's lesson of history is that economic growth and progress come from spontaneous interaction of self-interested individuals.

2. The Rise (and Fall) of Socialism

Spontaneous interactions create change. The Industrial Revolution was an event of monumental change. It increased the real wages of workers and created a middle class. People began to live longer. Birth rates rose, death rates fell, and population grew. Farmers and villagers voluntarily left their homes to seek a better life in the city. The Industrial Revolution benefited many more people than just the rich. From 1760 to 1860, the poorest 65 percent of the British population increased their average real income by over 70 percent.

Adam Smith taught that economic life consists of successes and failures. We must compete to prosper. We pursue our self-interest, while others pursue their self-interest. There will be winners and there will be losers.

The supporters of socialism, however, chose to focus on the misfortunes imposed by the Industrial Revolution. Whereas Smith saw economic progress, they saw struggle and failure. The Industrial Revolution centralized production by shifting workers from the farm or household shop to the factory.

Industrial workers in the coal mines of England, the steel mills of Germany and France, and the textile factories of New England began to question the fairness of a system in which they performed the work and only the owners appeared to reap the rewards. They saw themselves in a class struggle with the capitalists. They formed labor unions, struck factories, and formed political parties to represent the interests of workers. The ground was fertile for socialism, our second Defining Moment.

The foremost philosopher of socialism, Karl Marx (1818–1883), wrote about the unfairness of the capitalist system in his masterwork *Das Kapital*. He explained why class struggle would lead to the eventual overthrow of capitalism and its replacement by a superior economic system called communism. In 1848, 72 years after the publication of *The Wealth of Nations*, Marx issued his Communist Manifesto, calling for the workers of the world to revolt against their capitalist bosses. Marx promised that, under

communism, class conflicts would disappear, people would work for pleasure, and distribution would reflect need.

After several failed attempts, socialism's next Defining Moment came with the formation of the world's first socialist government in Russia as a consequence of the Bolshevik Revolution in 1917. The Soviet communists under Lenin and Stalin began the twentieth century's greatest social experiment—the creation of a socialist economy based on state ownership and the use of state planning to replace the market. The state actions of Marx replaced the spontaneous interactions of Smith. Instructions came from the state and from the Communist party; personal initiative and innovation were discouraged; and people were told to think of the interests of society, not of their own interests.

The Soviet experiment at first appeared to yield successes. Russia escaped the Great Depression that overwhelmed the capitalist world in the 1930s. Communism spread to one-third of the world's population, engulfing Eastern Europe, China, Vietnam, Cuba, and North Korea. By the late 1950s, the leaders of the Soviet Union promised to "bury capitalism." The reverse has happened: capitalism buried communism, not by waging war, but by providing living standards to ordinary people far above those available under communism. The Soviet Union was disbanded in 1991, and other countries from the former socialist world soon followed suit. The former socialist countries now face the difficult task of transition from socialism to capitalism.

The failure of socialism was predicted as early as the 1920s by two powerful economic thinkers. Ludwig von Mises and Friedrich Hayek, both Austrian economists, were early skeptics concerning the ability of a socialist economy to sustain itself. Like Adam Smith, von Mises and Hayek taught that we can best understand economic behavior by logically analyzing the actions of individuals. Capitalism works by making people pay for failure and benefit from success. Rewarding success and penalizing failure encourage people to work effectively. Under capitalism, the shoe manufacturer that produces at a high cost shoes no one wants will fail and disappear. Von Mises and Hayek predicted that socialism must fail because in that system, errors of judgment need not be corrected. If a shoe manufacturer loses money in a socialist state, the losses will be covered by the state. After all, it was the state that told the shoe manufacturer what to do in the first place. There is little or no incentive to keep costs low or to produce a product that people want. Unlike the capitalist shoe manufacturer, whose investment and property are at stake, under state ownership everyone and hence no one is the owner. And, thus, no one really cares. Indeed, we shall discuss the importance of incentives throughout this text.

The lesson of socialism regarding economics is that if people do not have the incentives to use goods and services efficiently, then waste and inefficiency will result. Capitalism corrects mistakes by forcing those who make them to pay for them.

The Soviet Union was socialism's great experiment, but it was not socialism's only legacy. While Russia reacted to socialism's appeal with revolution in 1917, the rest of Europe reacted by introducing the welfare state.

The welfare state provides substantial benefits to the less fortunate—unemployment insurance, poverty assistance, old-age pensions—to protect them from further economic misfortune.

First in Germany and then in other parts of Europe, governments enacted social security legislation, government health insurance, progressive income taxes, worker safety laws, and unemployment insurance. This legislation was designed to make capitalism more humane—to reduce the risks of capitalism and to make the state responsible for those bearing the costs of capitalism.

The welfare state raises a fundamental question: To what extent are the enormous benefits of capitalism, as described by Adam Smith and Ludwig von Mises, jeopardized by a mixed economic system that makes the state rather than individuals responsible for its risks?

3. The Great Depression: The Cost of Progress

The Industrial Revolution in England, Western Europe, and North America created long-term economic growth. Prior civilizations (for example, the Greeks and Romans) had achieved growth but could not sustain it. The economic growth that followed the Industrial Revolution was not perfectly even, but occurred in cycles. Although newspaper headlines spoke of financial panics and depressions, each downswing seemed to correct itself and upward progress continued. Throughout the nineteenth century and during the early part of the twentieth century, bad times were followed by good times in a seemingly endless cycle—until the late 1920s.

The Great Depression—our third Defining Moment—took hold first in Europe, and then in the United States. Overnight, people saw their paper fortunes disappear. On Wall Street, bankrupt investors hurled themselves out of skyscrapers in despair. Banks closed. Ordinary citizens lost their homes. The stock market crash of 1929 was only a financial manifestation of a larger economic phenomenon. The Great Depression itself constituted a severe and sustained drop in output and jobs.

The Great Depression was a sustained period of high unemployment and falling output that occurred in Europe and North America in the 1920s and 1930s.

Those who did not live through the Great Depression cannot possibly comprehend its effects on millions of lives. Some three years after the start of the Depression, output in the United States had fallen by one-third, and one of four people who wished to work did not have a job. It was not until the late 1930s that the economy recovered to the level of output before the market crash, and it was not until 1942 and the beginning of World War II that the unemployment rate recovered to its previous low.

The main effect of the Great Depression was to cause many Americans and Europeans to question whether growth and prosperity are automatic. *The Depression created a sense of concern about the future.* Prosperity was no longer something to be taken for granted. The government came to be viewed as an instrument of good to protect people against further economic downturns, both large and small.

The Great Depression was an unanticipated event of such magnitude that it required a great economist to develop a new theory explaining it. That economist was John Maynard Keynes (1883–1946), an English intellectual, teacher, journalist, and statesman.

Smith and his followers had argued that the free market would promote economic progress. In his 1936 General Theory of Employment, Interest and Money, Keynes advanced a theory that showed why capitalist economies are subject to periodic breakdowns that can be corrected only by massive doses of government spending. While Smith emphasized the incentives to produce goods and services, Keynes emphasized the incentives of people to buy goods and services.

Keynesian economics is the source of the idea that buying a car or a house is “good for the economy.” The importance of spending was hard to deny in the years following the Great Depression. Keynes argued that the Great Depression occurred because we did not spend enough. If there is not enough private spending, then government spending must make up the difference.

Keynes provided a justification for government spending to achieve macroeconomic objectives: If government spending is needed to keep the economy healthy, politicians can spend more without taxing.

They can make their constituents happy without the pain of higher taxes. While households and businesses must be subject to financial discipline, the government need not be. Indeed, most of us are aware that until 1998 the federal government had been running deficits year after year for 50 years.

The rise in government spending and the expansion of the welfare state raise the question of the extent to which we can reap the benefits of capitalism if we protect individuals from the risks and competition of capitalism.

Another great economic thinker presented a different picture of the Great Depression. The Austrian-born American economist Joseph Schumpeter (1883–1950) developed the theory that the Great Depression had roots in technological changes that were transforming the twentieth century. His main insight was that the business cycle is necessary for economic progress. New products always displace old products. The automobile replaced the horse-drawn carriage; the personal computer replaced the typewriter. Schumpeter considered the Great Depression to be an event in which many different forces converged. According to Schumpeter, it was no accident that the Soviet Union escaped the Great Depression, because it also escaped the opportunity for economic progress. Progress requires the freedom to develop new goods and new markets. Progress requires the competition of old and new ideas; progress requires winners and losers.

4. Globalization

Archaeologists are astonished by evidence of trade in remote times. Bronze artifacts cast in the Middle East in 3500 B.C.E. have been found thousands of miles away in ancient French villages. Through the ages, school children have been fascinated by Marco Polo's thirteenth-century accounts of traveling from his native Venice to China in search of exotic silks and spices. Human beings have always sought out for their own use new and exotic products produced by other societies. Human beings have, as Adam Smith remarked, a "propensity to truck, barter, and exchange one thing for another." He wrote:

Nobody ever saw a dog make a fair and deliberate exchange of one bone for another with another dog. Nobody ever saw one animal by its gestures and natural cries signify to another, this is mine, that yours; I am willing to give this for that.

Although we are naturally drawn toward trading with one another, trade has grown unevenly. Trade depends on the ease of communication and the costs of transporting goods and services long distances. Marco Polo's journey to China consumed more than half his lifetime; today, the same trip can be made in one day on a commercial jet. His letters from China to Venice took years to deliver; now, such messages can be delivered in seconds by fax or e-mail.

Like the Industrial Revolution, the socialist revolution, and the Great Depression, the globalization of the world economy is a Defining Moment.

Globalization refers to the degree to which national economic markets and international businesses are integrated and interrelated into a world economy.

The participation of any economy in global markets may not take place swiftly and continuously; it may be a long-term process with stops and starts.

Globalization, like the other Defining Moments, was a response not only to inexorable events but also to a powerful economic insight—that trade benefits both parties irrespective of their strengths and weaknesses. This insight had already paved the way for the expansion of trade in Great Britain in the nineteenth century.

Adam Smith had to argue against those who claimed that trade with other nations could lead to national bankruptcy. However, the great English economist David Ricardo (1772–1823) demonstrated that both weak and powerful nations benefit from trade by doing those things they do relatively more efficiently than others. His discovery of the surprisingly simple yet subtle law of comparative advantage (explained in later chapters) is perhaps one of the greatest contributions economics has made to our understanding of the world about us. As we will show, this law demonstrates that every country can specialize in those goods in which it has a comparative advantage, regardless of how rich or poor the country might be or how high or low its wages.

It was Ricardo's law of comparative advantage that persuaded the English Parliament to adopt a free trade policy in the first half of the nineteenth century, with the passage of the Corn Laws. The remarkable success of England's experiment with free trade forced other countries to reduce barriers to trade imposed by narrow special interest groups.

The Industrial Revolution brought forth the first strong and sustained wave of globalization of the world economy. Coal-powered boats and railroads linked markets; the telegraph and later the telephone made long-distance communication possible. The Industrial Revolution was accompanied by strong and sustained growth in international trade. Two world wars and the Great Depression halted the globalization of the world economy. However, the major powers entered the postwar era determined to avoid the mistakes of the past and to promote the growth of trade and commerce.

Thus, in the past 50 years we have experienced an explosion of international commerce and trade. We can rightly say that we are a world economy, made possible by the revolutionary developments in transportation and communication and the conscious decisions of countries to lower their barriers to trade. In the 1990s agreements to create common markets in Europe and North America provided new impulses for globalization.

A world economy has benefited our lives in a variety of ways. We now have a wealth of choices among cars, foodstuffs, computers—almost every product that we consider. Companies are no longer national in nature: A Japanese Company located in Germany can be headed by an American president. Stocks of U.S. companies are traded in Japan as we sleep, continue to be traded in London as we begin our day, and complete their trading in New York as we finish lunch. The car you drive might be made in Korea, your neighbor might work for British Petroleum, and your business loan could be from a Canadian bank. Despite its complexities, globalization has enriched our lives not only in terms of economic opportunities and options but also in a broader philosophical sense.

International trade brings broad benefits, but it hurts special interest groups. Markets that were secure are threatened by foreign competitors. Everyone must take part in competition to win customers with superior products, lower prices, or a combination of both. For example, domestic beef producers are threatened by lower-cost foreign producers. Automobile companies and their unions warn against the threat of foreign imports.

Although it brings broad benefits, globalization is opposed by special interest groups. Thus, the progress of globalization is not steady or guaranteed.

5. The Information Revolution

We require information to carry out economic activity. If I don't know you want to buy my product, I cannot sell it to you. The better the information businesses have on prices and competitive products, the more efficiently they can be run. Stock markets cannot function without up-to-date information on who

wants to buy, who wants to sell, and at what prices. When information is costly, economic activity is limited; when the costs of information decline, prosperity should increase. Economists also have long recognized that improving knowledge is the major factor behind rising living standards. If information on newly created knowledge can be spread and used rapidly, prosperity should increase. Information is like the cost of labor and materials. Producers and consumers get the same benefits when information becomes cheaper than they get when material costs become cheaper.

The monumental increase in information technology over the past two decades is our fifth Defining Moment:

The staggering improvements in our ability to create, use, and exchange information that have accompanied the vast improvements in information technology (computerization, the Internet, wireless telephones) are termed the Information Revolution.

The Information Revolution is entering its third decade. Therefore, we still do not know what its long-run effects will be. It was initiated by a series of inventions—the transistor, the semiconductor, the silicon chip, fiber optics, microprocessors, cable TV—all of which brought together the computer's ability to generate and process information with telecommunications' ability to transmit it.

The Information Revolution was not caused by science alone; it would not have occurred without changes in economic policy. Key steps in creating the Information Revolution were the U.S. government's decision to deregulate telecommunications and television broadcasting—steps followed by governments in England, Europe, Japan, and Latin America. Competition in telecommunications created new broadcast frequencies, which provided entrepreneurs with new ways to transmit information by regular phone lines, wireless transmissions, and underground television cable. Improvements in our ability to transmit information would have been meaningless if there were no one to receive this information. Our ability to receive and process vast amounts of information was made possible by the spread of ever cheaper and ever more powerful personal computers.

As with the Industrial Revolution, the Information Revolution was spurred by farsighted entrepreneurs and entrepreneurial companies, such as Bill Gates (Microsoft), Gordon Moore (Intel), Steve Jobs (Apple Computer), CompuServe and AOL, the inventor of the World Wide Web, Timothy Berners-Lee, or the developer of the Web browser, Marc Andreessen, all of whom saw profit opportunities in information technology.⁴ A short 15 years ago, callers could make their local or long distance calls through only one provider, and international long distance calls cost several dollars per minute—if they could be placed at all. Documents could be sent only by the U.S. Postal Service; there was no FedEx or UPS to promise overnight delivery. There were no fax transmissions. A business wishing to send papers across town had to use messenger services. Businesses used to have throngs of clerks, armed with pencils and paper, to keep track of inventories; now inventories are tracked by electronic scanners that place automatic orders for goods in short supply. Retailers previously could sell goods only by setting up expensive stores; now they can sell through the Internet. Scientists can disseminate their latest results instantaneously on the World Wide Web.

When economists are confronted with a new Defining Moment, like the Information Revolution, they must study its effects. Some economists, such as Nobel laureate George J. Stigler, anticipated the effects of an Information Revolution by pointing out the advantages of reducing the cost of information. Others, such as Paul Romer, are currently studying the effects of an Information Revolution on long-term economic growth and concluding that the future of the world economy is bright. At some point in the future, we will have a new Defining Moment economist, whose work will be forever associated with the Defining Moment of the Information Revolution.

1.2 Technological Change in a Global Economy

During the 1970s, Alvin Toffler authored an influential book called *Future Shock*. A central thesis of this work is that change occurs so rapidly in modern society that people find it difficult to adapt to their evolving environment. He argued that the average person is emotionally and intellectually left behind by the rapid pace of technical and cultural change. If Toffler's ideas had any relevance for the 1970s, they are even more applicable as society moves into the next millennium. The last two decades brought radical changes in world political alignments, different societal values, and the availability of thousands of new and improved products because of advances in technology.

Faced with rapid change, many firms have found it difficult to keep pace. The demise of communism opened new markets in the former Soviet Union and Eastern Europe, but also reduced the demand for some products (such as military hardware) and intensified global competition as firms sought to take advantage of emerging opportunities. Complicating the situation is the need for firms to stay abreast of new developments within their own industry. Electronics companies must be competitive in using the new digital technologies for their audio and video equipment. Automobile manufacturers survive only if they keep costs down by using advanced robotics for assembly. Computer suppliers can stay profitable only if their machines include state-of-the-art chips, display terminals, and storage devices.

The Impact of Technological Change

Technological change may involve new products, improvements or cost reductions for existing products, or better ways of managing the operations of a business. In some cases, the changes may seem simple and the results rather trivial, such as coating paper clips with colored plastic to prevent them from leaving marks on a page or tapering one side of the buttons on a shirt to make them easier to fasten.

In other cases, the technological advance may be brilliant and the impact on society highly significant. Consider the development and evolution of the electron microscope. The best optical microscopes can focus on objects as small as 1,000 angstroms in width. During the 1930s, scientists learned to focus streams of electrons in the same way that optical devices focus light. The first electron microscopes achieved resolution of about 100 angstroms- ten times better than the optical microscopes. During the next 60 years, research efforts significantly improved the instruments. Today, commercially available electron microscopes can focus on objects as small as one angstrom- a thousand times better than the best optical devices. This capability has allowed biologists, chemists, and physicists to make important discoveries. For example, it has enabled medical researchers to examine and manipulate bacteria, viruses, and genetic structures as they search for cures for diseases.

Technological Change and the Production Function

Technological change can be thought of as altering the firm's production function. Technological change allows the firm to use fewer inputs to produce the same output. Some technological advances are primarily laborsaving, while others are mainly capital saving. For example, the use of industrial robots in automobile manufacturing reduced the number of workers needed. In contrast, the development of the transistor conserved on capital by eliminating expensive and unreliable vacuum tubes and mechanical switches from television sets, radios, and other electronic equipment.

Neutral technological changes equal reduction in inputs to produce same output as before. Non-neutral technological changes do not have the proportionate changes in the inputs. For example, non-neutral technological change increases the marginal product of capital relative to the marginal product of labour.

Technological Change, Productivity, and Economic Growth

Economists use several measures to assess the performance of the economy. One of the most important is productivity, defined as the ratio of output to one or more inputs. Productivity is a key concept because it determines the standard of living that a country can achieve. In any given year, the total value of income received by individuals is based on the total value of goods and services produced. Thus, the only way for all consumers to have more real income is for the productivity of the inputs used to produce those goods and services to increase.

The most common productivity measure is labor productivity- output divided by the quantity of labor. If labor productivity can be increased, workers may be able to earn higher wages. Labor productivity has increased over time. However, there have been significant differences between countries.

Technological change is an important source of increased labor productivity. Labor saving technological change allows the same number of workers to produce more output. However, technological change is not the only component of increased labor productivity. Productivity increases as workers accumulate more human capital and as the capital stock of the economy increases. Changes in relative input prices can also affect the measured rate of labor productivity. For example, if capital becomes relatively more expensive, firms will use more labor and less capital. Thus, the ratio of output to labor input will decrease. Conversely, higher wage rates tend to reduce labor usage and to increase the measured rate of labor productivity.

The output-labor ratio is commonly used to measure productivity because it is easy to quantify. However, a better indicator is total factor productivity, which compares changes in output with changes in both labor and capital inputs. Using this approach, it is possible to identify the sources of economic growth over time.

Note that the single most important source of economic growth between 1929 and 1982 was technological change. Almost one-third of the increase is attributable to improvements in technology. It is also important to observe that about 20 percent of growth was due to higher education levels of workers. Clearly, knowledge, whether associated with new or improved products or embodied in workers, is crucial to economic progress.

Technological Change and Market Structure

The importance of technological change in facilitating economic growth is generally accepted. But an issue that has not been completely resolved is the relationship between alternative market structures and technological change. One question is, What type of market structure best facilitates the generation of new knowledge? Another is the direction of causality. Does the market structure determine the rate of technological change or does the nature of technology dictate which market structure will prevail?

Effect of Market Structure on Technological Change

Some economists believe that market power is a necessary condition for rapid technological change. They argue that most modern research and development activities require huge investments and can take years before they yield results. Small firms operating in competitive markets may not have funds to allocate to such efforts and may be unable to take advantage of scale economies associated with complex R&D projects. Also, firms in competitive markets may be unable to capture all the economic profits resulting from their efforts. If competitors can easily imitate new products and product improvements, firms will be less likely to allocate their resources to R&D.

Clearly, large firms have been responsible for many important developments. AT&T's Bell Labs devised the transistor and Dupont introduced nylon. But small firms have also had an impact. Steven Jobs started Apple in his garage and revolutionized the computer industry. Photocopying was invented by a patent attorney, Herbert Carlson, and commercialized by a small firm that later became the Xerox Corporation. A study by Jewkes, Sawers, and Stillerman investigated the origins of 70 major inventions since 1880. They found that 54 percent of those inventions could be attributed to people working alone and another 11 percent involved individuals working with research institutions. Only about one-third of the inventions came out of industrial research laboratories.

The case can be made that small firms in competitive markets might be more progressive than larger firms with monopoly power. Small firms may be more likely to provide an environment in which new ideas can flourish, while larger firms may impose bureaucratic rules that stifle creativity. Also, a young, small firm may have to be innovative to survive. In contrast, large, established firms that are partially insulated from competition may have very little motivation to change their product lines or production methods.

In evaluating the effect of market structure on technological change, the key is to consider both the ability and the incentives to be progressive. Ability involves being able to fund expensive R&D projects, withstand failures, and wait for results. Incentives include the need to remain competitive and being able to capture the rewards of technological advance.

The Effect of Technological Change on Market Structure

Market structure can affect the rate of technological change, but technology can also significantly affect the structure of the market. Telecommunications is a good example. The basic telephone patent was issued to Alexander Graham Bell in 1876. This patent right provided the Bell System a monopoly until it expired in 1893. For a few years, there was vigorous competition in some cities, but the available technology soon caused the industry to evolve into a virtual monopoly. In each city, the local network required that lines be deployed to every home and business in the community. This involved obtaining rights of way, putting wires under streets, and erecting thousands of telephone poles. Establishing a nationwide long-distance network required that tens of thousands of miles of copper wire be run over great distances and through often difficult terrain. The necessary capital equipment was extremely expensive and there were significant economies of scale associated with the endeavor. As a result, smaller firms were unable to compete, and AT&T was the dominant firm for almost one hundred years.

In the late 1960s, development of microwave technology provided opportunities for competitors. As an alternative to running cable, firms could establish communication links by setting up microwave towers every twenty or thirty miles. Microwave Communications, Inc. (MCI) offered the first serious challenge to AT&T by offering data transmission service between St. Louis and Chicago. After ten years in court and numerous challenges to the Federal Communications Commission, MCI finally established itself as a viable competitor. More recently, satellites and fiber optics have emerged as alternative technologies.

Today, AT&T still dominates the long-distance market, but it faces significant competition from firms such as MCI and Sprint.

At the local level, technological change is having a similar effect on telecommunications market structure. Until the mid-1980s, most industry analysts believed that local telephone networks were natural monopolies and that regulation would always be necessary. But in the last few years there have been some dramatic changes. Large businesses have begun to establish their own microwave, satellite, and fiber optic links to meet their communication needs. Cellular systems provide an alternative to using the Bell networks. Potentially most important, many cable companies are installing new technology that allows two-way communications. In the near future, it is very likely that cable and telephone companies will be competing with one another. The cable firms will offer telephone service and the telephone companies may offer movies, games, and shopping services to their customers. Another scenario is that these firms will merge and provide a broad range of services.

Some casual observers of the industry have suggested that the recent dramatic changes in telecommunications market structure are primarily the result of changes in regulatory policy, as the courts and Federal Communications Commission have permitted competition in markets where monopolies had been protected. But a closer examination reveals that government was simply responding to the forces of technological change. When telecommunications technology no longer dictated the existence of natural monopoly, it was impossible for bureaucrats to perpetuate this structure. The new technologies made increased competition inevitable.

The same forces have caused structural change in the computer industry. Technological change has resulted in faster computer chips and storage devices. This has changed the market because many applications that previously required a large mainframe computer can now be performed on personal computers. The result is that the industry has evolved from an oligopoly dominated by a few firms such as IBM into a competitive market with hundreds of firms selling personal computers. As with telecommunications, the new market structure reflects changes in technology.

Industrial Innovation

To this point, the term technological change has been used rather loosely. Sometimes it can be useful to distinguish among invention, innovation, and diffusion. Invention can be thought of as the creation of new ideas. Innovation represents taking those ideas and transforming them into something that is useful for society. Diffusion is the process whereby the new product or process becomes available throughout the society.

In many cases, inventions never get to the innovation stage. In other cases, innovations fail to become widely adopted. Sometimes the problem is that an invention or innovation provides no real technical advantage or is not economically viable. But there are also instances when truly beneficial ideas languish for many years. In the early days of sailing, scurvy was the worst killer of sailors. In 1601, an English sea captain found that two or three teaspoons of lemon juice a day provided almost complete protection against the disease. His finding was quite well known at the time, but it was not until 1865, over two hundred and fifty years later, that the remedy was widely used and scurvy ceased to be a threat among British sailors.

Product versus Process Innovations

Innovation can be divided into two broad categories. Product innovation involves the bringing of new goods or services to the market, while process innovation is concerned with new techniques that reduce costs of producing and distributing existing products.

For a successful product innovation, the good or service will generate a stream of economic profit. In the early years, the firm may lose money as it attempts to launch the product and gain consumer acceptance. Later, there may be a period of rapid growth as the good or service becomes widely used and competitors provide substitutes. After the product has been available for a number of years, sales may stagnate or even decline.

In evaluating a product innovation, the firm can use the techniques of capital budgeting. An innovation usually involves a substantial initial cost and a stream of future profits. Basically, the question is whether the present value of profits is likely to exceed the up-front cost of bringing the product to the market.

Evaluation of process innovation is similar. The initial cost of implementing the innovation must be balanced against the future cost savings that will result from the proved process. If the net present value is positive, then the new technique should be incorporated into the production process.

Both product and process innovations should be evaluated by comparing the initial cost to the present value of the expected incremental profit. Often, the keys to successful product innovation can be marketing and the ability to provide service. Profitable process innovation involves secrecy and being able to exploit economies of scale and scope.

Innovation is more likely to be successful if the firm stays within its core competencies.

Patents and Innovation

Advocates of a patent system usually make their case on the argument that market forces may fail to provide sufficient economic incentives to reward innovation. If imitators are able to move in rapidly and capture a substantial share of the market, the initial profits earned by innovators may not provide adequate compensation for the costs and risks they bear. However, if there is a substantial delay between the time of innovation and successful entry by competitors, the economic profits earned in the interim may make invention and innovation a more attractive activity. The patent system, by establishing a period of time during which the firm faces reduced competition, increases the expected return for innovative effort.

By stimulating technological change, the patent system can increase the flow of new products and processes to the market. The case for patents rests on a benefit/cost analysis. The assumption is that new products and processes available because of the patent incentive more than compensate society for the higher prices that temporarily result from the monopoly status given patent holders.

In the United States, patents confer the exclusive right to the use of an idea for a period of 17 years. Under U.S. law, "any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof" can be patented. However, there are three criteria that must be satisfied to obtain a patent. First, the invention must be new. Specifically, it must not have been known to the public before the inventor completed it or for more than 1 year prior to a patent application. Second, it must be useful. In practice, this test can be satisfied if there is at least some indication that the idea can be put to a practical use. Finally, it must be nonobvious. This provision has been controversial, but the present standard is that an invention cannot be patented if the subject matter as a whole would have been obvious at the time the invention was made to a person with ordinary skill in the art."

The award of a patent does not guarantee that the patent holder's rights will be upheld in court. U.S. patents are awarded based on who is first to conceive of an idea, while other nations use a first-to-file standard.

1.3 Market Failure, Externalities and Public Goods

Market Failure (Why Markets Fail)

Market failure is the situation that exists when the market fails to function properly. Competitive markets fail for four basic reasons: market power, incomplete information, externalities and public goods.

a. Market Power

We know that inefficiency arises when a producer or supplier of a factor input has market power. Suppose, for example, that the producer of food has monopoly power. It therefore chooses the output quantity at which marginal revenue (rather than price) is equal to marginal cost, and sells less output at a price higher than in a competitive market. The lower output will mean a lower marginal cost of food production. Meanwhile, the freed-up production inputs will be allocated to produce clothing, whose marginal cost will increase. As a result, the marginal rate of transformation will decrease, because $MRT_{FC} = MC_F/MC_C$. Producing too little food and too much clothing is an output inefficiency because firms with market power use a different price in their output decisions than consumers use in their consumption decisions.

A similar argument would apply to market power in an input market. Suppose that unions gave workers market power over the supply of their labor in the production of food. Too little labor would then be supplied to the food industry at too high a wage (w_F), and too much labor to the clothing industry at too low a wage (w_C). In the clothing industry, the input efficiency conditions would be satisfied because $MRTS_{LK}^C = w_C/r$. But in the food industry, the wage paid would be greater than the wage in the clothing industry. Therefore, $MRTS_{LK}^F = w_F/r > w_C/r = MRTS_{LK}^C$. The result is input inefficiency because efficiency requires that the marginal rates of technical substitution be equal in the production of all goods.

b. Incomplete Information

If consumers do not have accurate information about market prices or product quality, the market system will not operate efficiently. This lack of information may give producers an incentive to supply too much of some products and too little of others. In other cases, some consumers may not buy a product even though they would benefit from doing so, while other consumers buy products that leave them worse off. For example, consumers may buy pills that guarantee weight loss, only to find that the pills have no medical value. Finally, a lack of information may prevent some markets from ever developing. It may, for example, be impossible to purchase certain kinds of insurance because suppliers of insurance lack adequate information about who is likely to be at risk.

Each of these informational problems can lead to competitive market inefficiency.

c. Externalities

The price system works efficiently because market prices convey information to both producers and consumers. Sometimes, however, market prices do not reflect the activities of either producers or

consumers. There is an externality when a consumption or production activity has an indirect effect on other consumption or production activities, that is not reflected directly in market prices. The word "externality" is used because the effects on others (whether benefits or costs) are external to the market.

Suppose, for example, that a steel plant dumps effluent in a river, which makes a recreation site downstream unsuitable for swimming or fishing. There is an externality because the steel production does not bear the true cost of waste water and hence uses too much waste water to produce its steel. This causes an input inefficiency. If this externality prevails throughout the industry, the price of steel (which is equal to the marginal cost of production) will be lower than if the cost of production reflected the effluent cost. As a result, too much steel will be produced, and there will be an output inefficiency.

d. Public Goods

The last source of market failure arises when the market fails to supply goods that many consumers value. A public good is a good that can be made available cheaply to many consumers, but once the good is provided to some consumers, it is very difficult to prevent others from consuming it. For example, suppose a firm is considering whether to undertake research on a new technology for which it cannot obtain a patent. Once the invention is made public, others can duplicate it. As long as it is difficult to exclude other firms from selling the product, the research will be unprofitable. Thus, markets undersupply public goods. The government can sometimes resolve this problem either by supplying the good itself or by altering the incentives for private firms to produce it..

Externalities

Externalities can arise between producers, between customers, or between consumers and producers. Externalities can be negative when the action of one party imposes costs on another party or positive when the action of one party benefits another party.

A negative externality occurs, for example, when a steel plant dumps its waste in a river that fishermen downstream depend on for their daily catch. The more waste the steel plant dumps in the river, the fewer fish will be supported. The firm, however, has no incentive to account for the external costs that it imposes on fishermen when making its production decision. Furthermore, there is no market in which these external costs can be transmitted into the price of steel.

A positive externality occurs when a home owner repaints her house and plants an attractive garden. All the neighbors benefit from this activity, yet the home owner's decision to repaint and landscape probably did not take these benefits into account.

Because externalities are not reflected in market prices, they can be a source of economic inefficiency. Externalities generate long-run as well as short-run inefficiencies. We have seen that firms enter a competitive industry whenever the price of the product is above the average cost of production, and exit whenever price is below average cost. In long-run equilibrium, price is equal to (long-run) average cost. When there are negative externalities, the average private cost of production is less than the average social cost. As a result, some firms remain in the industry even when it would be efficient for them to leave. Thus, negative externalities encourage too many firms to remain in the industry.

How can the inefficiency resulting from an externality be remedied? If the firm that generates the externality has a fixed-proportions production technology, the externality can be reduced only by encouraging the firm to produce less. This can be achieved through an output tax. Fortunately, most firms can substitute among inputs in the production process by altering their choice of technology. For

example, a manufacturer can add a scrubber to its smokestack to reduce its emissions. Consider a firm that sells its output in a competitive market. The firm emits pollutants that damage air quality in a neighborhood. The firm can reduce its emissions, but only at a cost.

We can encourage the firm to reduce emissions in these ways: Emissions Standard, Emissions Fee, Transferable Emissions Permits, Recycling, Refundable Deposits, Property Rights, and Common Property Resources.

Public Goods

A public good is a good that can be made available cheaply to many consumers, but once the good is provided to some consumers, it is very difficult to prevent others from consuming it. The marginal cost of providing a public good to an additional consumer is zero, and people cannot be prevented from consuming it. Thus, markets undersupply public goods. The government can sometimes resolve this problem either by supplying the good itself or by altering the incentives for private firms to produce it.

Public goods have two characteristics: They are nonrival and nonexclusive. A good is nonrival if for any given level of production, the marginal cost of providing it to an additional consumer is zero. For most goods that are provided privately, the marginal cost of producing more of the good is positive. But for some goods, additional consumers do not add to cost. Consider the use of a highway during a period of low traffic volume. Because the highway already exists and there is no congestion, the additional cost of driving on it is zero. Or consider the use of a lighthouse by a ship. Once the lighthouse is built and functioning, its use by an additional ship adds nothing to its running costs. Finally, consider public television. Clearly, the cost of one more viewer is zero.

Most goods are rival in consumption. For example, when you buy furniture, you have ruled out the possibility that someone else can buy it. Goods that are rival must be allocated among individuals. Goods that are nonrival can be made available to everyone without affecting any individual's opportunity for consuming them.

A good is nonexclusive if people cannot be excluded from consuming it. As a consequence, it is difficult or impossible to charge people for using nonexclusive goods—the goods can be enjoyed without direct payment. One example of a nonexclusive good is national defense. Once a nation has provided for its national defense, all citizens enjoy its benefits. A lighthouse and public television are also examples of nonexclusive goods.

Nonexclusive goods need not be national in character. If a state or city eradicates an agricultural pest, all farmers and consumers benefit. It would be virtually impossible to exclude a particular farmer from the benefits of the program. Automobiles are exclusive (as well as rival). If a dealer sells a new car to one consumer, then the dealer has excluded other individuals from buying the car.

Some goods are exclusive but nonrival. For example, in periods of low traffic, travel on a bridge is nonrival because an additional car on the bridge does not lower the speed of other cars. But bridge travel is exclusive because bridge authorities can keep people from using it. A television signal is another example. Once a signal is broadcast, the marginal cost of making the broadcast available to another user is zero, so the good is nonrival. But broadcast signals can be made exclusive by scrambling the signal and charging for the code that allows it to be unscrambled.

Some goods are nonexclusive but rival. Air is nonexclusive but can be rival if the emissions of one firm adversely affect the quality of the air and the ability of others to enjoy it. An ocean or large lake is nonexclusive, but fishing is rival because it imposes costs on others—the more fish caught, the fewer fish available to others.

Public goods, which are both nonrival and nonexclusive, provide benefits to people at zero marginal cost, and no one can be excluded from enjoying them. The classic example of a public good is national defense. Defense is nonexclusive, as we have seen, but it is also nonrival because the marginal cost of providing defense to an additional person is zero. The lighthouse mentioned earlier is also a public good, because it is nonrival and nonexclusive, i.e., it would be difficult to charge ships for the benefits they receive from it.

The list of public goods is much smaller than the list of goods that governments provide. Many publicly provided goods are either rival in consumption, exclusive, or both. For example, high school education is rival in consumption. There is a positive marginal cost of providing education to one more child because other children get less attention as class sizes increase. Likewise, charging tuition can exclude some children from enjoying education. Public education is provided by local government because it entails positive externalities, not because it is a public good.

Finally, consider the management of a national park. Part of the public can be excluded from using the park by raising entrance and camping fees. Use of the park is also rival-because of crowded conditions, the entrance of an additional car into a park can reduce the benefits that others receive from it.

Consumer or producer who does not pay for a nonexclusive good in the expectation that others will are known as free riders. With public goods, the presence of free riders makes it difficult or impossible for markets to provide goods efficiently. Perhaps if few people were involved and the program were relatively inexpensive, all households might agree voluntarily to share its costs. However, when many households are involved, voluntary private arrangements are usually ineffective, and the public good must be subsidized or provided by governments if it is to be produced efficiently.

Majority-rule voting is one way for citizens to voice their preference for public goods. Under majority rule, the level of spending provided will be that preferred by the median voter. This need not be the efficient outcome.