



# Energy, Wealth, and the American Dream

- 7.1 Waves of Colonists to America: First Asians and then Europeans – 152
- 7.2 Industrialization and Isolationism – 154
- 7.3 Spindletop and the Beginning of the Affluent Society – 154
- 7.4 The Creation and Spread of the “American Dream” – 156
- 7.5 Two World Wars Separated by the Great Depression – 159
- 7.6 The Rise of Affluence for Many – 162
- 7.7 The Increasing Role of Government – 164
- 7.8 The “Oil Crises” of the 1970s: Hints at Limits to Economic Growth – 165
- 7.9 The Limits to Growth – 167
- 7.10 Crumbling Pillars of Prosperity – 167
- 7.11 The 20-Year Energy Breather – 168
- 7.12 Political and Economic Response to Oil Price Increases Since 2000 – 172
- 7.13 Why Does the Energy Issue Keep Emerging? – 176
- 7.14 Debt, Inequality, and Who Gets What – 176
- 7.15 Are We Seeing the End of the American Dream? – 177
- 7.16 The Future of the American Dream – 180
- References – 181

The Americas were the last major liveable continents to be settled by humans. When first Asians (“Native Americans” or “Indians”) and then Europeans (and those they brought from Africa and Asia as slaves or laborers) settled in the Americas, they found enormous lands empty (or empty-able) of other humans with incredibly rich resources. Having emigrated from relatively densely populated and socially and economically stratified Asia and Europe, the Americas represented enormous resources, per capita power and the freedom to exploit those resources and hence generate wealth. This of course is a well-known story told to most American children with a focus on the various heroic activities of our ancestors. But it is also a story about energy.

### 7.1 Waves of Colonists to America: First Asians and then Europeans

Most scientific analysis supports the idea that people first came to the Americas during the low ocean levels that occurred 10,000–20,000 years ago when huge amounts of water were tied up in glaciers during the most recent ice age. (One should respect, however, the view of many Native Americans, including some Native American scientists, that “they have been here indefinitely”). When Native Americans arrived on this continent, they found few other humans, amazing natural ecosystems, and enormous wildlife resources (their principle resource base). Since these people were skilled hunters and had very effective tools (spears and bows and arrows, as well as highly evolved social systems for hunting and, subsequently, agriculture), they had a tremendous economic boom, increasing in numbers to perhaps 50 million people in the Americas. But there was a cost to this tremendous economic growth: the extinction of many of the species that had originally been very important in their diet. For example, we know that 10,000 years ago, there were two species of elephants, 10-foot-tall beavers, and giant sloths in what is today the United States. These and many other large species (known collectively as megafauna, meaning simply “large animals”) disappeared soon after humans came. While scientists debate the degree

to which climate change vs. human hunting did in these animals, there is no question that everywhere that humans went on the planet, the large animals disappeared soon after [1, 2]. Meanwhile other humans in the Americas were overexploiting soils in many regions, leading to collapse, that is, a radical and sudden decrease in the magnitude and degree of complexity of entire societies. This happened, for example, to the Mayas of the Yucatan and present-day Guatemala [2, 3]. Whether such a collapse will occur with present-day European Americans has been discussed by these and many other authors, most of whom consider it a distinct possibility.

The second wave of humans that entered the Americas came from Europe starting in 1492. They brought with them a whole suite of plants, animals, and technologies [4]. From our present perspective, the basic result of this was that the overwhelming majority of the people that were in the Americas in 1492 were killed directly by Europeans or by the diseases they brought, as described in *Guns, Germs, and Steel* [5]. It is not a pretty story and would be called genocide today [6]. Thus, the total population again was maintained at a very low level as the new people arriving from Europe were more or less no more than compensating for the net reduction of the original human inhabitants. From the perspective of the next three centuries of economics, this meant that there were still tremendous resources on a per capita basis for each European immigrant and for their children. America was a land of opportunity indeed, for there were enormous untapped resources and not too many people with whom to share them. From roughly 1700 to about 1890, there was always an “empty frontier” to the west with land open for the taking and many opportunities for the ambitious and industrious. Of course European Americans rarely considered that these “empty” lands were already heavily populated with Native Americans, whose sometimes settled but frequently nomadic, non-industrial lifestyle was in fact very well equipped for a sustainable existence based on mostly renewable resources. The economy of the entire continent went from one relatively sustainable to one clearly not. The greatest cause for the war of independence was basically resource scarcity—the cutting off of the trans-Allegheny frontier, first in 1763 by means of the Proclamation Act and then later in 1775, with

greater enforcement, with the Quebec Act. Open rebellion soon followed [7].

The technologies that the Europeans brought (such as mining, metallurgy, the moldboard plow, deepwater fishing, and so on, plus the development of a series of self-serving myths (e.g., “Rain Follows the Plow,” “Manifest Destiny”)) led to a massive exploitation of both renewable (e.g., soil, trees, fish, bison) and nonrenewable (i.e., gold, silver, coal) resources and seemingly limitless wealth for many, although hardly all, people in a way very consistent with Polanyi’s definition of economics (► Chap. 1). The inventiveness of Americans certainly added to their ability to utilize resources, and important new products and processes were developed which included, among others, the light bulb, intercontinental railroads, steamboats, mass-produced automobiles, and the telegraph. As we said earlier, most people who thought about why the United States had become so wealthy attributed the wealth to the particular industry of the existing or immigrant European populations or to the blessing of God. Probably far fewer thought about the fact that the United States had such a huge, largely untapped resource base and very low population density compared to, for example, Europe. In other words, the United States enjoyed large resources per capita. Alfred Crosby [4] believes that Europeans were especially good at colonizing the rest of the world and exploiting the resources where they colonized because of their unique and self-serving aggressiveness. As evidence he cites that essentially all people in the world today are where they were in 1000 AD except for Europeans (who have colonized North and South America, South Africa, Australia, and New Zealand—i.e., all regions with temperate climates) or who have been moved by Europeans (African slaves and their descendants, Chinese workers to the Western United States). This view of the essential aggressiveness of Europeans and their ability to successfully exploit others and their resources is the essence of Jared Diamond’s highly successful book *Guns, Germs, and Steel* which also focuses on certain geographical advantages that Europeans had. Europeans were not necessarily good inventors, but they were extremely good adapters—of gunpowder, agriculture, animal husbandry, metallurgy, communication through the written word, and so on. All

of this was transferred to the United States, where it was applied with great gusto to a continent rich in unexploited resources, including, as we have said, timber and grass for fuel, good soils with summer rains, rich mineral deposits, and so on. Thus, immigrants from Europe found that they could own what was, by ordinary European standards, a massive amount of fertile land whose fertility depended basically upon their own initiative and energy. This was the beginning of the “American dream”—the ability to exploit large quantities of solar energy by massive numbers of ordinary individuals.

Transforming nature is a hard work. In the past when this work was done mostly with one’s own muscles, the amount of transformation an individual could do was physically difficult and limited in magnitude. Wealthy people of the past often did this through the hard work of others by means of social conventions such as low-wage labor, serfdom, and slavery. Think of the lovely houses and lives of ease of southern US plantation owners 150 years ago, an affluent lifestyle generated on the backs of dozens to hundreds of laborers working to clear forests and plant and harvest crops. In fact slavery has been a common situation mentioned frequently in the bible and in many ancient historical accounts. It was not a nice life (to put it mildly), and the concept became increasingly repugnant even to many of the owners of slaves. The Civil War ended slavery in the United States, but de facto slavery continued as former slaves continue to work the lands and as many poor immigrants were brought into the United States from Ireland, Italy, China, and elsewhere to do hard physical work at “slave wages” or as indentured servants. People were helped in this work by the physical power of horses and by the physical work obtained from burning wood and the power of falling water. Wind was exploited by sailing ships and an occasional windmill, and increasingly coal was used for railroads and in factories. But overall most work continued to be done by human labor assisted by animals through the turn of the century. This is not to say that most people were not happy, often they were. But the production of wealth was a difficult, sweat-generating process, and most people were very poor materially by today’s standards.

## 7.2 Industrialization and Isolationism

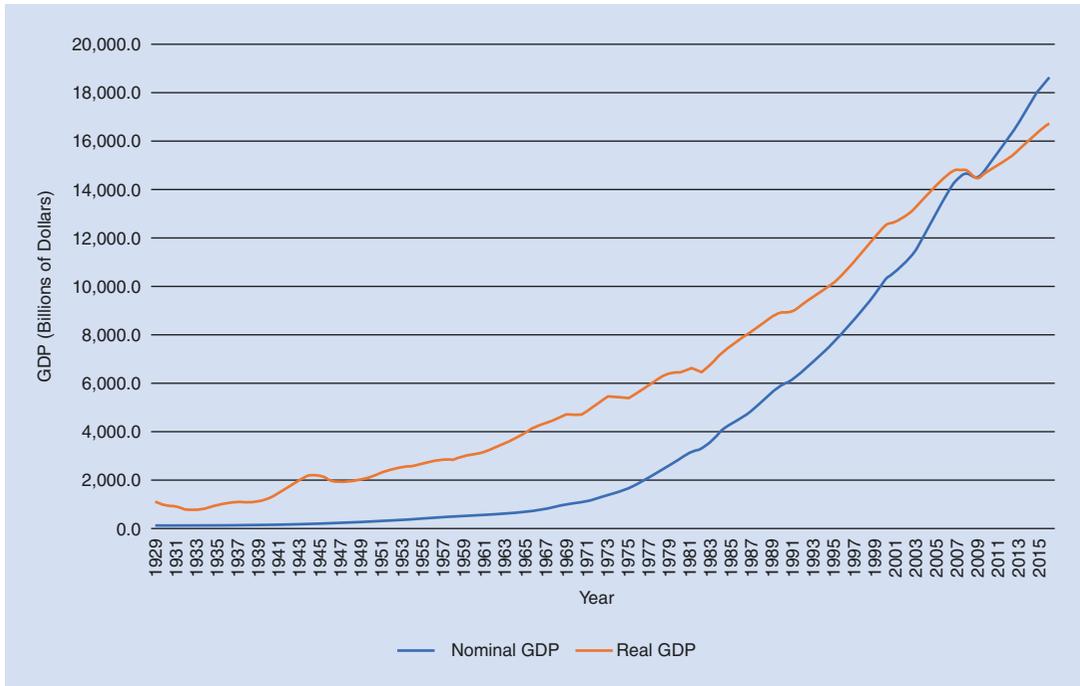
By the late eighteenth century, new sources of energy were being developed in, especially, New England where the abundant water power potential allowed enormous, by the standards of the time, new factories to be built making textiles, shoes, chemicals, and all manner of iron tools and equipment. This allowed the development of great concentrations of workers in such towns as Manchester, New Hampshire, Lowell, Massachusetts, Boston, and New York City. Water-powered machines greatly increased the amount of goods a laborer could generate in an hour (i.e., labor productivity) and the subsequent wealth of at least some in New England. Meanwhile as forests were cleared for agricultural land and for homesteads in New England, Europeans spread to the Southeast and then westward to virtually the entire Midwest, where enormous amounts of wood fuel were available for all manner of local industries [8]. Fish and other marine life were abundant too, and the world's vast numbers of whales were greatly decreased by Massachusetts seafarers in order to get whale oil, the principle source of lighting. At the start of the nineteenth century, England and Germany had begun their great industrial transformation, using the concentrated solar energy found in coal to generate enormous new amounts of high temperature heat that allowed far more work to be done than was the case with water power, wood, or charcoal. This technology was transferred to the United States which had very rich coal reserves. In 1859 Colonel Edwin Drake drilled the nation's first oil well, and kerosene began to replace whale oil as the lighting source of choice. The enormous wealth generated by the new industrialization allowed the "captains of industry" to become enormously rich by world standards. This, along with the great disparity in wealth between them and their workers, generated the phrase "the Gilded Age" for the 1890s. But it was not a smooth pattern of growth as periodic depressions caused a serious loss of wealth for many people, rich and poor. Most people continued to be poor, or at least far from affluent, making barely enough to survive and have a family. Still, in America, despite the disparities in income, the wealth distribution was quite equitable compared to Europe and

most of the rest of the world, in part due to the ability of many to have access to land and its solar energy (once the Native Americans were displaced) through farming or with an axe.

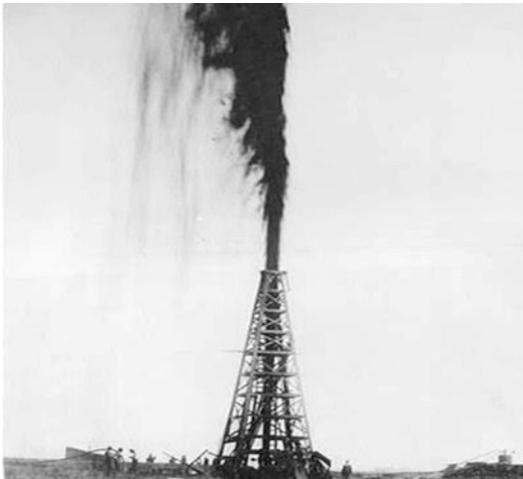
## 7.3 Spindletop and the Beginning of the Affluent Society

Then in 1901 something special happened. The generation of wealth for entire societies (especially in the United States and also much of Europe) suddenly changed and the proportion of people with at least moderate wealth took a great upswing, as did the total quantity of wealth in the world and even the wealth per capita (■ Fig. 7.1). Perhaps the single most important event in a series of similar events was the development of the Spindletop oil field in Beaumont, Texas, in 1901, which gave a new realization that serious wealth could be generated for the many by finding, selling, and using oil (■ Fig. 7.2). Before Spindletop, oil certainly had been found and developed, but individual oil fields were relatively rare, small, and difficult to develop, with production of hundreds or thousands of barrels of oil per year. Spindletop alone changed all that, by producing up to 500,000 barrels *per day*, essentially doubling the nation's petroleum production. It was then understood that a great deal of wealth could be had for many with relatively little investment from the oil business, and soon other areas were found to be nearly as productive as Spindletop. Other people looked at how relatively small investments could produce a great deal of money and by using the ideas and technologies, developed at Spindletop, oil production increased rapidly. Large additional finds were made not only in Texas and Louisiana but also in Indonesia, Persia, Romania, and many other areas. As the production of oil increased more and more every year so did the nation's wealth, far more rapidly than ever before. Oil's original use was for kerosene but soon a waste product, gasoline, found an important new use as automobile fuel. Oil and oil-driven vehicles began to be applied to all economic areas, such as growing food and transporting it to long distances, catching fish, cutting, moving and milling lumber, running all kinds of factories, and most other economic processes. While the few continued to get most of the direct wealth, its use spread afflu-

## 7.3 · Spindletop and the Beginning of the Affluent Society



■ Fig. 7.1 US nominal and real GDP (2005 dollars) from 1900 to 2016 (Source: US Department of Commerce)



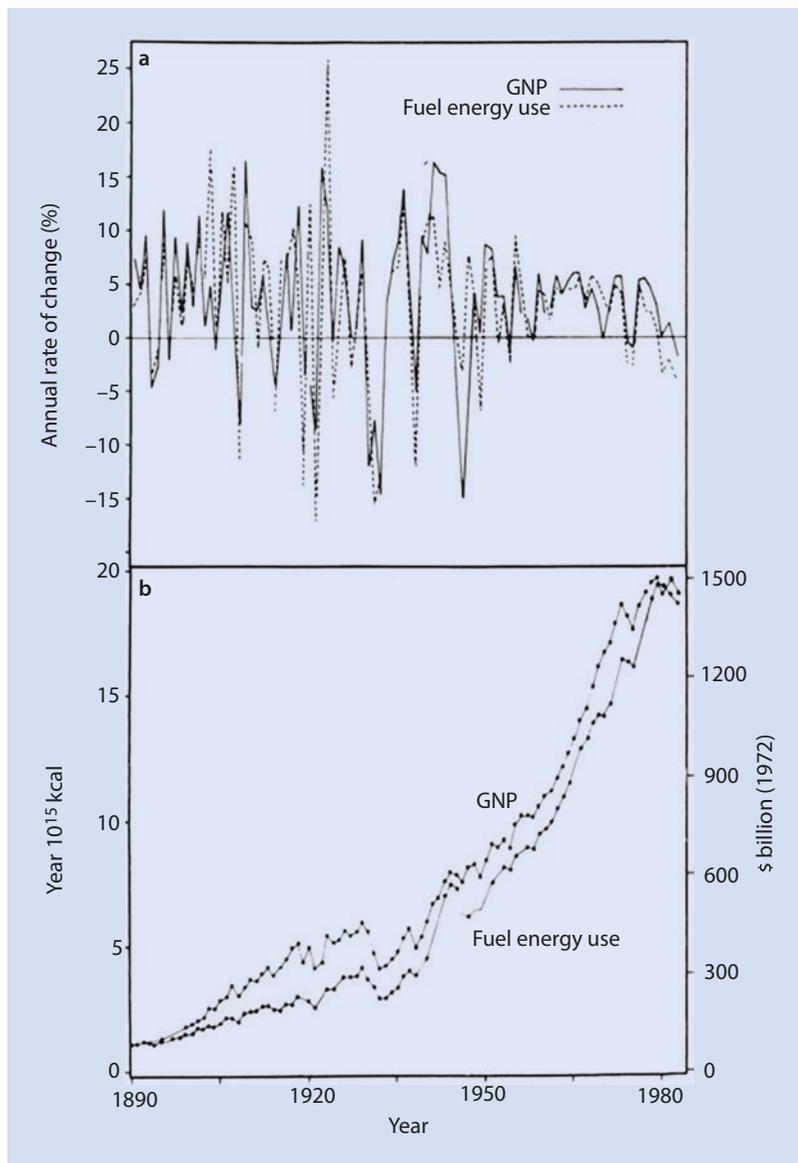
■ Fig. 7.2 Spindletop, Beaumont Texas, 1901 (Source: Texas Energy Museum)

ence to the many. The gross domestic product (GDP), an index of the total production of wealth by the country, began to grow exponentially (i.e., as compound interest), decade after decade, (although interrupted by periodic depressions in 1921 and of course 1929) something almost unheard of before. Thus began the age of affluence for the many or what can be called mega

affluence. This led many economists and politicians to consider 3 or even 5% per year economic growth as “normal” when in fact it was something very new. That oil-based growth spread increasingly around the world and has continued for many until now.

This pattern of exponential growth of oil (and energy more generally) use and wealth for the United States continued at least up to the “oil crises” of the 1970s, (■ Fig. 7.3) fits in well with our more general energy perspective, for it focuses on the raw materials needed and the energy required to do any process, including economic production. Quite simply, it is energy that has allowed our economy to undertake the transformations that extract and process those materials into the economic products and services we desire. Other things are needed of course, such as the technology to get and use energy and a supportive political and economic environment, but the driver of wealth production is the energy to do the work of economic production. To make this clearer we will examine in more detail what has probably been the largest generation of wealth to have ever occurred—the production of the vast amount of wealth represented by “the American dream.”

**Fig. 7.3** Total income produced plotted along with total energy used for the US economy 1905–1984 (Source: Cleveland et al. and Hall et al. [21]). **a** Annual rates of change; **b** raw data from US Energy Information Agency



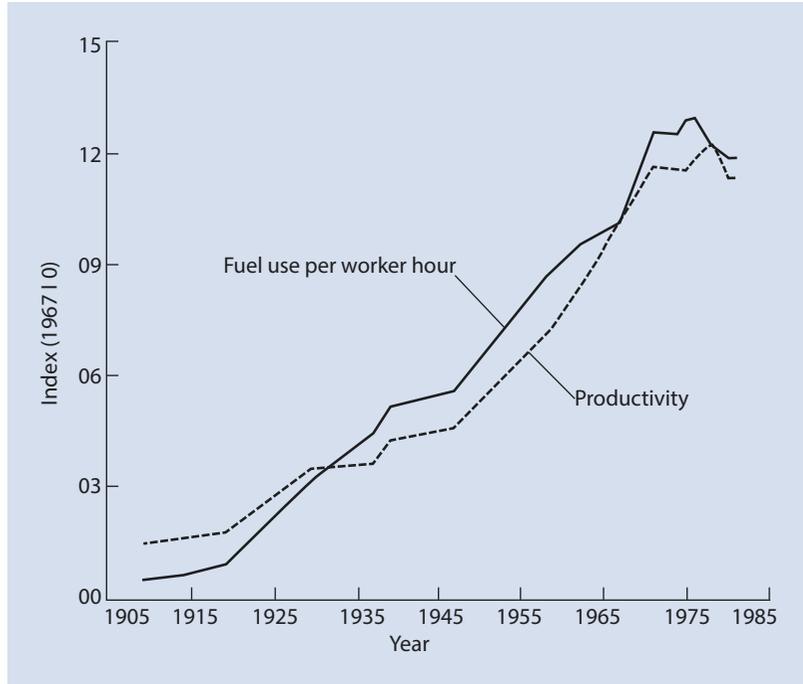
## 7.4 The Creation and Spread of the “American Dream”

At the beginning of the twentieth century, the United States, dominated by European Americans, was becoming the world’s emerging agricultural and industrial giant. In 1900 the United States ran principally on coal, wood, and animal power, but oil became increasingly important with the new oil wells and the development of automobiles, trucks, and tractors that ran on gasoline. Large dams, built with the help of massive oil and coal-powered machines, brought irrigation water and electricity to many in rural areas, resulting in huge additions to the availability of biological and physical energy

for each American. For the first time, a very large proportion of the population of an entire country was becoming fairly affluent, and some were becoming extraordinarily so. This enormous affluence was associated with, and clearly dependent upon, an increasing use of energy that expanded at almost exactly the same rate as the increase in wealth and that made each worker much more productive (Fig. 7.4 and Table 7.1).

Curiously, even as the United States became more and more dependent upon fossil fuels for basic transportation (meaning mostly railroads), people became even more dependent upon horses for transportation of people and goods at either end of the journey [9]. Because coal-fired railroads

■ **Fig. 7.4** Mean US labor productivity per worker hour (in constant dollars) and energy used per worker hour, 1905–1984, when data acquisition was stopped (Source: Cleveland et al. and Hall et al. [21])



generated a great deal of noise and were very smelly, and especially because they threw out sparks that often set houses on fire, they tended to be banned from city centers. Thus, until the dominance of the internal combustion engine after about 1920, freight and passengers tended to be delivered from the railheads to the center of the city by solar (i.e., grass)-powered horse drawn vehicles!

For the past century and a half, the United States has been considered the world’s richest nation and, perhaps of greater importance, as a place where someone with a lot of skill and effort can make a great deal of money if they work hard enough, regardless of the circumstances of their birth. For many working class Americans, the dream was not affluence, but stability—a steady job, a house of one’s own, the ability to pay one’s bills, take a vacation, have a cushion for old age, or have a better life for one’s children. This economic success is usually attributed to the characteristics of the people who live within its borders, to their genes, to their hard work, the beneficence of God, or some other such factor. Education is usually considered important, and the United States has traditionally led the world in the quantity and quality of its higher education, especially at the post-graduate level. Many of the readers of this book in the United States may be taking economics or business classes in order to learn the skills necessary to become more affluent. The idea that possessing

more money makes you better off is central to the economic theory of consumer behavior, which in turn is an underpinning of modern economic thought. We will explain this idea in more detail in ► Chap. 14, including the fact that there is no clearly convincing evidence that it is true. The idea that a better education will lead to more affluence is also deeply engrained in the American psyche, and from the first days of the Republic land was to be set aside for schools (as per the Northwest Ordinance) largely for this reason.

In fact the ability to achieve wealth in the United States is largely a consequence of the incredible resource base once found on the North American continent. These include initial endowments of huge forests, immense energy and other geological resources, fish, grass, and, perhaps of greatest importance, rich deep soils where rain falls during the growing season. While many other regions of the world also have, or had, a similarly huge resource base, the United States has several other somewhat unique important attributes. The fact that these resources have been exploited intensely for only a few hundred years (vs. many thousand as in Europe or Asia), the presence of large oceans separating Americans from others who might want our resources, and an extremely low human population density in the past and even now, results in resources per capita that was very large and is still relatively high (■ Table 7.2). There

**Table 7.1** Getting a feel for energy units and their conversions

<i>Useful conversions:</i>	
1 calorie	4.1868 joule
1 kilocalorie (Cal or kcal)	4187 joule
1 BTU	1.055 KJ
1 kWh	3.6 MJ
1 therm	105.5 MJ
1 liter of gasoline	35 MJ
1 gallon of gasoline	132 MJ (million joules)
1 gallon of diesel	140 MJ (million joules)
1 gallon of ethanol	84 MJ (million joules)
1 cord dried good hardwood	26 GJ
1 barrel of oil	6.118 GJ
1 ton of oil	41.868 GJ (= 6.84 Barrels)
<i>Some basic energy costs:</i>	
1 metric ton of glass	5.3 GJ
1 metric ton of steel	21.3 GJ
1 metric ton of aluminum	64.9 GJ
1 metric ton of cement	5.3 GJ
1 MT of nitrogen fertilizer	78.2 GJ
1 MT of phosphorus fertilizer	17.5 GJ
1 MT of potassium fertilizer	13.8 GJ
1 joule	Picking up a newspaper
1 million joules (1 MJ)	A person working hard for 3 h
3 million joules (3 MJ)	A person working hard for 1 day
11 million joules (11 MJ)	Food energy requirement for one person for 1 day
1 billion joules (1 GJ)	Energy in 7 gallons of gasoline
1 trillion joules (1 TJ)	Rocket launch

**Table 7.1** (continued)

100 10 <sup>18</sup> joules (100 exajoule)	Energy used by the United States in 1 year (2009)
607 10 <sup>18</sup> joules (607 exajoule)	Energy used by World in 1 year (2015)

Thanks in part to R. L. Jaffe and W. Taylor Energy info card, Physics of energy 8.21, Massachusetts Institute of Technology

**Table 7.2** Population numbers and density of the United States and other countries in 2009–2010

	Total population (thousands)	Density (people/km <sup>2</sup> )
<b>World (land)</b>	6,828,134	46
Bangladesh	162,221	1127
Palestinian Territories	4013	667
South Korea	46,456	487
Puerto Rico	3982	449
Netherlands	16,618	400
Haiti	10,033	362
India	1,182,328	360
United Kingdom	62,041	255
Jamaica	2719	247
Germany	82,689	229
Pakistan	169,792	211
China	1,338,153	139
Nigeria	154,729	168
France	62,793	113
<b>United States</b>	309,535	32
Argentina	40,134	14
Russia	141,927	8
Greenland	57,000	0.026

\*Source: Wikipedia

are a number of reasons that the population density is low. Probably time is most important. To the best of our knowledge, humans have been in North America, at least on any substantial scale, for only 10 or 15 thousand years vs. 50,000 for Europe and much longer for Africa and Asia. Second is the vast depopulating of the original native population that occurred after 1492. The third is the slowing of population growth rates commonly observed as humans become more affluent – which occurred in the United States (■ Table 7.2).

## 7.5 Two World Wars Separated by the Great Depression

By the early 1900s, the spirit of isolationism was strong among the citizens of the United States who were deeply suspicious of Europe and its entrenched rivalries and frequent wars. The United States had mostly isolated itself by choice from Europe and indeed most of the rest of the world. After a long delay, the United States entered the First World War, greatly accelerating our involvement with the rest of the world even as antiwar sentiment at home was especially strong. Indeed, incumbent president Woodrow Wilson based his reelection campaign on the slogan, “He kept us out of war.” The military value of oil and petroleum-based transportation was first realized by Winston Churchill who had begun the transformation of the British fleet from coal to oil just before the war. England, however, had no oil. Parliament passed the final piece of the conversion, a guaranteed contract for Anglo-Persian Oil Company (now BP) 9 days after the outbreak of hostilities, and thus began the long and often contentious association of the increasingly oil-dependent Western world and the oil-rich Middle East. The value of oil was shown clearly when the French, faced with a potential large military defeat during the battle of the Marne in 1914, rushed 6 thousand French soldiers from Paris to the battlefield in taxicabs where they helped to achieve a great victory. Petroleum was also used for the first time for airplanes and primitive tanks. The war, begun with coal-powered ships and railroads and millions of horses, ended as an increasingly petroleum-based conflict. Thus, the ability of petroleum to enhance all things, including mass murder of and by armies, was tremendously enhanced.

After the war, the United States had a decade-long period of peace and greatly increasing affluence, except for the depression of 1921, fueled in large part by ever-increasing production of oil. In retrospect it is clear that much of that affluence, however, was wealth only on paper or speculation. In contemporary terms the increase in oil prices became an asset bubble. *Speculation* refers to people purchasing land or other resources not for their own use but in anticipation of being able to sell it later to someone else at a higher price. To do this, banks in the 1920s loaned out far more money than they actually had as assets (i.e., “money in the vault” or ownership of houses) to cover the loans. Simplistically one can think of banks as the place that people put their excess money, saving “for a rainy day,” while other people can borrow that money to buy a home, for example. Since most homeowners want to keep their home and will try hard to make their payments, this is normally considered a fairly safe way to loan money, at least if the bankers have done their homework and determined that the borrowers have the means to do so. Since the early days of capitalism (which many attribute to the rise of the Medici family in Florence, Italy), banks have also loaned out some portion of this money for others to use as investment capital, that is, money to start or expand a business, to buy equipment, to build buildings, and so on in anticipation of using them to make additional money. Banks increasingly loaned out more money than they had in the vaults or even on paper. Nobel Laureate Paul Samuelson wrote that this process, called *fractional reserve banking*, probably had its origins with ancient goldsmiths who gave receipts or notes for the storage of gold. Eventually, the notes began to circulate as money when the smiths realized not all depositors were likely to return for their gold at the same time. Both processes have allowed banks to pay interest to those who put their money in the bank. Traditionally the prudence of the bank owners and directors, or sometimes government regulators, led bankers to keep a significant portion of the bank’s money in the actual bank vaults, so that the people who own the money can withdraw it if they want. All banks, however, live in fear of a “run on the bank,” that is, a time when too many people want to get their money out of the bank at the same time. Some speculation has always been with us, but it became much larger toward the end of the 1920s. This was because in the expanding economy the price of land and securities had been

pushed up to be far higher than their real worth by people paying higher and higher prices in anticipation of even higher prices in the future. Reality caught up with the speculators on October 20, 1929, a day called “Black Tuesday” because of the enormous loss of wealth and remembered today as a time when, at least according to legend, a number of investors committed suicide by jumping off their Wall Street buildings. On that and ensuing days, speculators and other investors lost 100 billion dollars, a huge sum at the time. Although no more than 2% of Americans owned stock at that time, the impacts of the Wall Street collapse filtered downward to local banks, who then loaned out far less money to protect themselves and thus to local economies. Speculators had borrowed money from their stockbrokers who, in turn, borrowed from banks. The spectacular losses in asset values left investors unable to repay their brokers, who then defaulted upon their own loans. Runs on the banks ensued and insolvencies rose to more than 5000 by 1931. Before long nearly 20% of Americans had lost their jobs.

This began the period we now know as “the Great Depression” when the country slipped into a long period of little or negative economic growth, high unemployment, and the general financial difficulties of the 1930s. President Herbert Hoover, who had previously shown great skill in combating postwar starvation in Europe, attributed the primary cause of the Great Depression to the “war of 1914–1918” and the economic consequences of the peace treaty that ended the war. This attitude encouraged American isolation and individualism, which was made even stronger by the press, especially in the Midwestern states. The publisher of the influential *Chicago Tribune* carried on an enthusiastic campaign to stop the country from any international entanglements, such as aiding Britain in the days before the United States joined the First World War. He even considered Hoover’s mild reforms to try to deal with the early days of the depression and his tepid contact with international leaders to be dangerous, going as far as to call Hoover “the greatest state socialist in history.” This is pretty ironic as today Hoover is usually considered as one of our most conservative presidents. Hoover believed that the economy would correct itself given time and used an unemployed man selling apples on a street corner as an example of someone working individually toward a recovery for all.

In fact the economy got worse, and in the next election, the country rejected Hoover and turned to Franklin Roosevelt. Roosevelt ran as a fiscal conservative and believed in a balanced budget. This belief led him to raise taxes to pay for social programs. Consequently his “New Deal” did not provide a great fiscal stimulus. Yet Roosevelt had also long believed in the idea that the government should strive to improve the life of its people, especially in hard times, and he became increasingly convinced that the government should spend more and more money, even if it were borrowed, to try to “prime the pump” of the economy. This belief (essentially, but not explicitly Keynesianism; see pp. 55) took many forms, which ranged from job creation programs such as the Civilian Conservation Corps and Works Progress Administration to Social Security and the reform of labor relations. Most economists, including liberal and Keynesian economists, agree that this approach actually did not generate enough deficit spending to add a great deal to economic recovery. That took the huge increase in public spending associated with Second World War, during which time the economy had tremendous growth fueled by massive increases in government spending and government debt. The commitment to a balanced budget disappeared during the war, and the use of deficit spending to stimulate the economy, along with the social structure that the war helped create, led to a long period of rapid economic growth. What was not so well understood was that all of this economic expansion required cheap oil, which established our long-term structural dependence upon petroleum. The combination of increased government spending and the rekindling of the moribund industrial power of the nation had been a primary factor that clearly worked for winning the war and maintaining an ever-increasing standard of living and thus the American dream.

Nevertheless there are many to whom Roosevelt’s (and later presidents’) intervention in the economy was anathema, for they believed that government should stay out of what they consider people’s own private business. But their voices were few and far between at the time. The era of the “New Economists,” who based their principles on the work of John Maynard Keynes but emphasized economic growth over all other goals, was about to begin. It was the era in which economists believed they had “conquered the business cycle.”

## 7.5 · Two World Wars Separated by the Great Depression

The New Economists believed that with wise application of prudent policies regarding taxing, spending, money, and interest, they could enhance the efficiency of markets and relegate depressions to the past. This confidence could not last beyond the 1970s, however, a period characterized by high unemployment and inflation. The questions of the effectiveness of government regulation are with us again in the 2010s, at a level of venomous discourse that few economists of the 1950s and 1960s could have possibly imagined.

What is especially interesting from our energy perspective is that the depression was a time of tremendous energy availability in the United States. The East Texas field, the nation's largest ever except for Prudhoe in Alaska, was discovered in 1930, the first full year of the depression. Oil was cheap, but there was virtually no market for it. But when the US economy finally began to recover, especially in the 1940s, there was a great deal of energy to power that expansion. Thus, it is clear that one needs not only available cheap energy but additional economic conditions to generate economic growth, an issue we addressed in ► Chap. 5.

Meanwhile Japan, a relatively small country without a large resource base and which had formerly looked inward for centuries, increasingly became industrialized and of necessity looked outward for the resources it needed. Buoyed by their success against a giant Russian fleet at the battle of the Tsushima Straits in 1905, the Japanese built a huge, modern fleet. As much as half of the gross national product of Japan went to building up their military machine, and this expansion took up such a large portion of the resources available to them that, for example, Japanese families were encouraged to feed their rice to make their boys, the future soldiers, strong, while the girls got to eat only the water the rice was boiled in. Japan invaded China and Korea for coal and iron and began to expand outward into the Pacific Ocean, for example, into Okinawa. The United States had worked to contain the imperial ambitions of the Japanese in the 1930s by both negotiated treaties and a limited military buildup in the Pacific. The Japanese realized that the expansion of their economy depended upon reliable access to oil. That oil was to be found in the Dutch East Indies (now called Indonesia). The United States, in a largely overlooked overt act of war, blockaded Japan's access to that oil using warships in 1941. The most militant voices in the Japanese military

were convinced that the only way to protect their oil resources was to deliver a knockout blow to the United States' Pacific Fleet. Thus, the desired and partly successful isolation of the United States from the rest of the world came to a screaming halt on December 7, 1941, when the Japanese attacked US Naval bases on the island of Oahu in the Hawaiian Islands. On the day after the attack, President Franklin Delano Roosevelt asked Congress for a declaration of war. Germany and Italy subsequently declared war on the United States. The Second World War that began in Europe in 1939 had begun for the United States. In many ways it was the world's first war based upon oil, and in many ways it greatly accelerated the industrialization of the world. The role of oil in the Second World War has been especially well told by Daniel Yergin [10] in *The Prize*, his very comprehensive book about oil.

Our entry into the shooting war began with the Japanese bombing of the United States fleet in 1941, although as noted this was not the first act of war in the Pacific. The war ended in Europe with the military defeat of the Italian and German militaries and the surrender of the Fascist and Nazi governments. Again, the availability or lack, thereof, of fossil fuels played a key role. Toward the end of the war, Germany, having lost access to the petroleum supplies of Africa and the Middle East, produced limited amounts of gasoline from coal, pioneering the same technologies (called Fischer Tropsch) currently being considered for making liquid fuels from coal. Their production facilities, however, were destroyed by allied bombing once the allies gained air superiority. Air superiority was itself enabled by the fact that US companies invented and then produced 100-octane aviation fuel that allowed the use of higher compression, more powerful engines, which helped the British to win the battle of Britain and the allies to eventually gain general air superiority. The Germans were so depleted of liquid petroleum by late in the war that they had to bring the first ballistic missiles (the V-II rocket) to the launching pad with mules. In the Pacific theater, the Japanese too had run so short of oil that they initially had to leave the world's largest battleship in port for lack of fuel and then sent it out to a last battle with only a one-way supply of oil. They used turpentine as fuel to fly some of the kamikaze (suicide) airplanes that were attempting to sink the ship that the father of one of this book's

authors (Hall) was on in Okinawa. Hall's friend and colleague Tsutomu Nakgatsugowa remembers clearly as a child that all of the pine trees in his Japanese village were uprooted to make turpentine for fuel. The war ended in 1945 after the first use of atomic weapons during wartime, representing again an enormous increase in the human use of energy, both in the nuclear explosions themselves but also in the huge amount of fossil and hydroelectric energy that had been used to separate the isotopes of uranium. It was only a matter of time and technology until America's vast industrial strength prevailed. Perhaps it was more accurately put by Pulitzer Prize-winning historian David Kennedy who said that the war was won with Russian lives and American machines. And, we add the petroleum to run them.

## 7.6 The Rise of Affluence for Many

On the home front, something unique occurred. The standard of living *rose* for a people engaged in war, as the war effort rekindled the US economy that had been devastated by the Great Depression. Unemployment, which stood at more than 17% of the labor force in 1939, fell to less than 1.2% in 1944. The value of economic output more than doubled in a mere 6 years. Large social changes occurred during the war years too. Women entered the paid labor force in unprecedented numbers, often earning high wages in both clerical and production jobs. There was little to spend one's money on, and savings as a percent of income rose to the highest levels in history, providing massive investment monies. People patched their clothes, recycled their metals, and, encouraged by gasoline rationing, stopped driving to aid the war effort. African-Americans found relatively high-paying jobs in the labor-scarce factories and began the slow and painful process of integrating into White society. The conflict between labor and management that so characterized the depression era declined as the major industrial unions signed a no strike pledge for the duration of the war while seeing both corporate profits and their wages and benefits increase.

Even larger changes were to come with the end of the war, changes that dramatically impacted the drive toward affluence. A new social contract between workers, employers, and the government

was in the process of creation, and this social contract provided a newly powerful nation with the "pillars of postwar prosperity" [11]. These vehicles to maintain prosperity and social stability were based on domestic economic growth and enormous international power (military and economic) internationally, specifically:

1. Basic accord between capital and labor, at least, after a period of intense strike activity following the war, especially between the largest multinational corporations and the largest manufacturing unions, facilitated by giving labor a share of productivity gains in the form of higher wages.
2. *Pax Americana*. The United States became the dominant military and economic power after the Second World War, holding most of the world's nuclear weapons and gold as well as being the largest exporter of oil. Additionally the international monetary system was reworked with the US dollar as the key currency, and the fractional reserve banking system was internationalized to allow the expansion of the money supply to accommodate growth globally.
3. Accord between capital and citizens. Large-scale oligopolies, the government, and the average citizen united around three basic premises: economic growth would replace redistribution as the means of improving well-being; government policy should be focused on the availability of cheap nuclear and other energy and anti-communism.
4. The containment of intercapitalist rivalry. The tight oligopolies constructed from the 1890s onward controlled destructive price competition and allowed large corporations to control their rivalries by means of mechanisms such as price leadership, market division, and use of advertising. Initially the United States was the dominant producer worldwide, having the only viable industrial economy at the end of the war. Stable oligopolies competed on the basis of market share, not price.

A critical component of these patterns was the large increase in labor productivity during that time. This allowed both industry owners and labor, especially of the largest corporations, to do better and better. What was less emphasized but enormously clear in retrospect was that to allow these four pillars to operate and expand, it was

both possible and necessary to massively increase the production from oil, gas, and coal fields, some new, and some old but barely tapped previously, so that once the economic engine was started, there was a great deal of high-quality energy available even though the war itself had consumed some 7 billion barrels of oil (about the same as recent annual consumption by the United States). The United States began using many times as much energy per person as had been the case relatively few decades before.

In addition, the nation was left with the enormous munitions facilities built at taxpayer expense at, for example, Muscle Shoals, Alabama. These facilities used the Haber-Bosch process, invented in Germany just before the First World War, to make ammonia [12]. This chemical process for the first time allowed humans to access directly the enormous amount of nitrogen in the atmosphere, which was extremely valuable for the munitions, agricultural, and chemical industries. Before Haber and Bosch perfected their chemical synthesis, the primary sources of nitrates were manure, the large deposits of bird guano found off the South American coast and the sodium nitrate deposits in the Atacama Desert. Peru and Chile had fought the guano wars over access to the bird droppings. But eventually the mining of the guano exceeded the replenishment and the resource vanished. Another source needed to be found. Seventy-eight percent of the atmosphere is nitrogen ( $N_2$ ), but this nitrogen is very difficult to access because of the triple bonds in the di-nitrogen molecule (i.e.,  $N_2$ ). Until 1909 only the tremendous energy of lightning or some very selected algae and bacteria could break these bonds. Gunpowder and fertilizer depended upon the exploitation of rare deposits of nitrates concentrated by birds over millennia. Fritz Haber, in one of the most important scientific discoveries ever made, found that by heating and compressing air mixed with natural gas, that is, by adding hydrogen and large amounts of energy to the nitrogen in the air, and with the right catalyst, the  $N_2$  molecule could be split and turned into ammonia ( $NH_3$ ). This in turn could be combined with nitrate (itself created by oxidizing ammonia) to generate ammonium nitrate which is the basis for both gunpowder and the most important fertilizer. When in 1946 there was no further need for massive amounts of explosives, the US Federal Government asked whether there might be any other use for these factories. The answer came back from the agricultural

colleges: yes, we can use it to greatly increase agricultural yield, and this is what happened. This “industrialization of agriculture” freed food production from its former dependence upon manure, and, encouraged by the concurrent development of machinery, far fewer Americans were needed to grow our food. This increased the exodus to the growing number of urban industrial jobs, the increased use of oil, gas, and coal, and the massive generation of wealth. Over the course of the twentieth century, America continued to change from a relatively poor, largely agricultural, rural country into an increasingly industrialized and urban country while becoming vastly more wealthy, by most accounts, in the process. Meanwhile the energy required to do all this economic work was increasing exponentially (■ Fig. 7.3). New economic theories were launched to explain the enormous increase in wealth with, however, essentially no mention of the energy enabling and facilitating the expansion by those chronicling the process.

European and Japanese industry had been destroyed by the fighting. Every warring nation except the United States saw their industry and infrastructure in ruins, and the allies, especially Britain, were deeply in debt to the United States. The new peace was to be an American-dominated peace, with the terms dictated by Americans. The American-led Marshall Plan helped rebuild the war-devastated economies of Europe. After some 15 years of depression and war, the international monetary system was in need of serious rebuilding. The gold standard, which had served as the foundation of international trade since the mercantile days of the 1600s, was a casualty of the depression. In 1944 an International Monetary Conference was convened at a ski resort in New Hampshire called *Bretton Woods*. Under the auspices of the new system, known as the Bretton Woods Accords, the US dollar replaced gold as the basis for international trade and investment. Only the dollar was stated in terms of gold; the value of all other currencies was expressed in dollar terms. In essence, the rest of the world was willing to give the United States interest-free loans in their own currencies just to hold our dollars. The United States reaped several benefits from the new configuration on the world level. The value of US investments abroad grew at nearly 9% per year from 1948 to 1966. The terms of trade or the ratio of export prices to import prices grew by 24% over the same period. People of this country bought in a buyer’s market (i.e., in conditions

favorable to the buyer), and US corporations sold in a seller's market. Finally, US business gained access to crucial raw materials and additional cheap energy, despite the fact that the United States was the world's leading exporter of oil at the time. America's industrial might and monetary control formed an important foundation for growing affluence. America became extremely powerful both economically and in terms of energy use.

The depression era had witnessed a considerable amount of strife between labor and capital. By the late 1930s, strong industrial unions organized to win recognition, higher wages, and better working conditions. But the large spending of the war brought jobs, relative prosperity, and relative peace between capital and labor. After a flurry of strike activity immediately following the war, relations between large businesses and their employees stabilized. In 1948 an epoch-making contract was signed between General Motors and the United Auto Workers. In this contract the UAW gave up their claim to joint management of the company and control over the trajectory of technology. In return they received a larger share of the company's profits in the form of higher wages and benefits. The contract linked increases in wages to increases in productivity or output per worker. In this climate of American peace, labor stability and productivity (i.e., value added per hour of worker input) grew at a brisk pace, and the after-tax earnings of American manufacturing workers grew by more than 50% from 1948 to 1979. This was responsible for spreading some of the wealth earned by business to the pockets of the American worker. More than most factors, this new social contract, based on shared gains from increased productivity, helped establish the American dream. One specific example of the link between energy and economic prosperity rarely understood by most economists is that of the roll of energy in the dollar value of the products generated by a worker working for 1 hour. Increased labor productivity allowed the employer to pay his or her worker more even while making a larger profit. This increased productivity is normally assigned to technological progress. What is less understood is that labor productivity increased in direct proportion to the amount of energy used per worker hour (■ Fig. 7.4). At that time labor productivity in the United States was two or three times that of a European worker, not because the worker worked harder or was more clever, as com-

monly assumed, but because he or she had big machines using two or three times more energy helping him do the job! Again what is often attributed exclusively to technology was in fact equally based on increasing the availability and the use of cheap energy, which was much cheaper in the United States than in most other nations.

## 7.7 The Increasing Role of Government

The idea that government participation in the economy should be minimal, which had been around at least since the time of the Physiocrats and Adam Smith, went by the wayside starting with the Great Depression and continuing into the postwar years. The strategy for ending the depression, the New Deal, created not only an alphabet soup of government agencies but also an attempt to involve the Federal government in economic planning. This planning was augmented and extended in the Second World War, undoubtedly the greatest public works program in the history of the United States. After the war Congress passed a law entitled The Employment Act of 1946. This law mandated the government to pursue taxing and spending policies that would result in reasonably full employment, stable prices, and economic growth. In this era of "New (Keynesian) Economics," budget deficits were sometimes purposefully created. They became an important tool of economic policy rather than a dangerous aberration that must be avoided at all costs. The increased spending, which was often financed by debt rather than taxes, injected increased purchasing power into the economy to help maintain postwar affluence. Government created new programs to subsidize home mortgages and home ownership, an important component of the expanding realization of the American dream. Spending on social programs also increased. In 1968 a state-supported health initiative for the elderly called *Medicare* was passed into law to supplement the retirement insurance program (Social Security) created during the Great Depression. For the first time, being old no longer meant being poor for the majority of American workers. This act represented the culmination of a whole series of social spending programs during the 1960s. Spending for income maintenance programs and education increased during the presidency of Lyndon

Johnson, who envisioned a “Great Society.” But spending also rose for military purposes, as the United States became more deeply involved in a prolonged war in Vietnam. While this expansion of spending eventually helped to initiate the end of the American dream, more than two decades of prosperity and increasing affluence for a growing number of Americans ensued. The United States was affluent enough to spend more on health care and education and create more opportunities for those formerly left out of the general economic expansion. General affluence increased even while waging war—at least initially. Wages and profits continue rising, at least for a large proportion of the population.

The engine that held this increasing prosperity together was economic growth, that is, the increase in the material economy expressed in the dollar value of the goods and services we produced in a year (this is called gross domestic product or GDP). The fuels for that were a social structure that prompted growth, expanding international markets and the exponentially increasing use of oil and coal and gas, as all through this period energy use increased in almost direct proportion to the economy—the fossil energy was there to do the actual work of an expanding economy. GDP more than doubled from 1945 to 1973, increasing from about \$1.8 trillion to over \$4.3 trillion in inflation-corrected (e.g., year 2000) dollars. Energy was readily available and very cheap, and the incentives to use it abounded as “the good life” was increasingly sold using advertising.

## 7.8 The “Oil Crises” of the 1970s: Hints at Limits to Economic Growth

As the 1970s approached, all four pillars of the American success story began to fracture. Europe and Japan caught up and surpassed the United States in terms of technology and economic growth. New technologies, a more restrictive regulatory climate, and a new type of mergers (international conglomerates) destabilized the tight oligopoly control of manufacturing. This would further destabilize corporate structure in the 1980s and 1990s. The rise of state-owned oil companies in the Middle East and elsewhere presented another threat to the control of intercapitalist rivalry. Bretton Woods was abandoned, and US

oil production peaked in 1970. In 1973 the United States experienced the first of several “oil supply shocks” that seemed, for the first time, to inject a harsh note of vulnerability into the united chorus of the American dream for all. Before the 1970s nearly all segments of American society—including labor, capital, government, and civil rights groups—were united behind the agenda of continuous economic growth. The idea that growth could be limited by resource or environmental constraints or, more specifically, that we could run short of energy-providing fossil fuels was simply not part of the understanding or dialog of most of this country’s citizens. But this was to change during the 1970s.

In the popular phrase of economists, the economy began to “overheat.” Consumer spending had more than doubled from \$1.1 trillion in 1945 to nearly \$2.5 trillion in 1970 (in 2000 dollars) as workers spent the dividends from the social contract from 25 years earlier on the many goods they had been deprived of in the depression and the war and as general affluence increased. As the US economy retooled in the postwar era, investment spending likewise rose from about \$230 billion to \$427 billion in 2000 dollars, aided by steadily increasing numbers of people, consumer credit, and corporate profits. Government spending, driven by the expansion of social programs during the time of President John Kennedy’s “New Frontier” and President Lyndon Johnson’s “Great Society,” while the costs of fighting the Vietnam War, in constant 2005 dollars, increased from \$405 billion in 1950 to more than \$1 trillion during the same 20-year period. Unemployment fell at a relatively steady pace, dropping from about 6.5% of the labor force in 1958 to only 4% in 1969. Hourly earnings of manufacturing workers after taxes rose from about \$2.75 per hour in 1948 to about \$4.50 in 1970 when both were expressed in 1977 dollars. As spending increased faster than the ability to produce goods (given the relatively modest levels of unemployment), prices began to rise. The specter of “creeping inflation” began to enter the lexicon of economists and citizens alike.

In 1973, the United States (and much of the world) experienced the first “energy crisis.” Crude oil, selling for \$2.90 per barrel in September (a price that had been nearly constant for decades), soared to \$11.65 by December. The price of gasoline shot up suddenly from 30 to 65 cents a gallon in a few weeks, while the available

supplies declined. Americans became subject to gasoline lines, large increases in the prices of other energy sources, and double-digit inflation. Home heating oil became much more expensive, as did electricity, food, and even coal! Few people understood that the production of oil in the United States had reached a peak in 1970 and had begun to decline. While the specific initiation of the price increase began with a bulldozer that in 1970 ruptured a pipeline carrying oil from the Persian Gulf to the Mediterranean, the peak of oil production in the United States, the United States resupplying the Israeli military in their war with Egypt, the long history of Western arrogance in the Middle East, and the exponential increase in the use of oil set up the circumstances in which a minor event could generate an enormous impact. In 1979 the world experienced another oil shock. According to the Energy Information Agency, the current dollar price of domestic crude oil rose from \$14.95 in 1978 to \$34 per barrel in 1980. This would amount to nearly \$90 per barrel in 2017 prices. Consequently, the 1980 price of gasoline increased again to an average of \$1.36 per gallon, equal to \$3.70 in 2017 prices. The increases were directly in response to the withdrawal of supply by the new Islamic Republic in Iran, after the collapse of the US-backed government of Reza Pahlavi, but again the inability of the United States to supply its own consumption underlay all. Many of the economic ills of 1974, such as the highest rates of unemployment since the Great Depression, and rising prices were repeated in the late 1970s and early 1980s when oil once again became less available and more expensive due to restrictions in supply brought about by the Organization of Petroleum Exporting Countries (OPEC—including many oil-rich countries in the Persian Gulf, Venezuela, and Indonesia).

Americans became used to energy as a topic that was in the newspaper every day, and especially in the colder Northern Tier of the United States, conversation was often about wood as a fuel to heat one's house or the fuel efficiency of the then-new Japanese imported cars vs. the familiar Fords and Chevrolets. The American economy, used to being overwhelmingly the strongest in the world, suffered as businesses in the countries American aid helped restore after the Second World War now became effective competitors. This was partly due to energy prices, which were

once much cheaper in the United States, became effectively the same around the world, with the result that higher-priced American labor was no longer compensated for by cheaper American energy. On the contrary, real wages began to fall in the United States. By the end of the 1970s, Japanese autoworkers were earning more per hour than their American counterparts. The unemployment rate increased to nearly 10% in 1982, a number unheard of since the Great Depression of the 1930s, while prices of everything increased at nearly 10% per year. But unemployment and inflation were supposed to be inverse to each other according to the economist's well-established Phillips curve! Here they were simultaneously increasing, something called *stagflation*. Labor productivity ceased to increase, also something formerly unheard of (■ Fig. 7.4). The news was so bad that the Reagan administration stopped gathering data on this important economic parameter. For many, it seemed like the world was falling apart.

Stagflation, which was difficult to explain by means of standard Keynesian theory, is easy to explain from an energy perspective: as energy prices increased and supplies declined the dollars circulating in the US economy were increasing more rapidly than new energy was added to do economic work. As a result each dollar bought fewer goods and services, which was perceived as inflation. In addition the relatively monopolized corporate structure allowed business to pass on increased costs of production in the form of higher prices. As more of society's output was required to get the energy necessary to run the economy, costs of everything from food to packaging were pressured upward. This resulted in an increase in joblessness as there was less money available for purchases. In fact adding the energy and historical perspective provides a ready explanation for stagflation: as energy use was increasingly restricted (by supply and higher prices), the economy contracted. And, as we said, since the energy supply contracted more than the dollar supply, there was also inflation. This explanation shows the power of energy analysis and the inadequacy of pure economic models that exclude the fundamental role of energy. In systems language, the economic models focused almost entirely on the internal dynamics of the system but were insensitive to changes in forcing functions because they had not been included in the model structure.

## 7.9 The Limits to Growth

As we developed in ► Chap. 4 at about this time, a series of quite pessimistic reports about the future came out, most importantly the “Club of Rome’s” *Limits to Growth* [13], *The Population Bomb* by Paul Ehrlich [14], and analyses of the likely future of oil production by Hubbert [15]. These reports implied in various ways that the human population appeared to be becoming very large relative to the resource base needed to support them—especially at a relatively high level of affluence—and that it appeared that some rather severe “crashes” of populations and civilizations might be in store.

## 7.10 Crumbling Pillars of Prosperity

In retrospect, we can now say that the pillars of postwar prosperity began to erode in the 1970s and early 1980s and that changes in the social sphere also began to complicate and add to the biophysical changes derived from the decline in the availability of cheap oil. Even though the oil market had stabilized and cheap energy returned to the United States in the late 1980s, the changes in the structure of the economy were long lasting. The economy ceased growing exponentially, although it continued to grow linearly but at a decreasing rate, from 4.4% per year in the 1960s to 3.3, 3.0, 3.2 to 2.4 to about 1% in the following decades. Many formerly “American” companies became international and moved production facilities overseas where labor was cheaper, and oil, no longer cheaper in the United States compared to elsewhere, was the same price, although cheap enough to pay for the additional transport required. The decrease in labor costs when production facilities were moved to other countries outweighed the costs and the process of globalization accelerated. Productivity growth (formerly strongly linked to increasing energy used per worker hour) in manufacturing industries began to slow, falling from 3.3% per year in the 1966–1973 period to 1.5% from 1973 to 1979 to essentially zero in the early 1980s. Reductions in the rate of growth in the energy-intensive sectors of utilities and transportation were even greater, while construction and mining showed actual declines in output per worker hour. As productivity growth slowed so did the growth in workers’

hourly income, from a substantial 2.2% per year from 1948 to 1966 (which would lead to a doubling of incomes in 32 years) to 1.5% in 1973 to 0.1% in 1979. Corporate profits also decreased from nearly 10% in the mid-1960s to a little more than 4% by 1974. Things seemed bad for both capital and labor [16, 17].

Mainstream economists seemed at a loss to explain this phenomenon. Their statistical models, which relied on the amount of equipment per worker, education levels, and workforce experience, left more factors unexplained than explained. Even the profession’s productivity guru, Edward Denison, had to admit that the 17 best models explained only a fraction of the problem. Fortunately two other approaches yielded far better explanations. Economists associated with the “Social Structure of Accumulation” (SSA) approach (Bowles et al. [18]) developed a statistical model that explained 89% of the decline and attributed most (84%) of the slowdown in productivity growth to decreases in work intensity. Under the social contract of the postwar era, unions were able to limit speedup by a series of work rules that limited how hard workers could be driven. Despite increases in the numbers of supervisors, businesses (especially manufacturing firms) could not increase the amount of output per worker at will, especially without increasing wages. The biophysical approach also yielded promising results. Howard Odum had been writing about the importance of energy in the economy for a decade, as had others [19, 20]. In a 1984 article in the prestigious journal *Science*, Cutler Cleveland, Charles Hall, Robert Costanza, and Robert Kaufmann [21] found that they could explain 98% of the decline in output growth by the decline in fuel energy after the oil crises of the 1970s. They also explained many basic attributes of economics in energy terms, an approach that introduced the concept of biophysical economics. The two concepts (biophysical economics and the social structure of accumulation) are linked because the increase in fuel-intensive machinery is one factor in how intensive work can be made [22, 23].

Things looked increasingly difficult for the United States in the international arena as well. The United States had rebuilt Europe and Japan with the latest technology soon after Second World War, and by the 1970s these former “second rate trade partners” turned into fierce competitors. The commitment to energy efficiency in

Europe and Japan far surpassed that of the United States, and they had much newer capital equipment because of needing to rebuild after the war. Moreover, labor relations in the countries were far less contentious than they were at home. Terms of trade or the ratio of export prices to import prices fell from about 1.35 in the early 1960s to only 1.15 by 1979. Adding to the difficulties faced by the United States, the world monetary system came unglued by the early 1970s. The system, developed in Bretton Woods, New Hampshire, depended upon the United States being the world's most productive economy and upon its willingness to let other countries redeem their dollar holdings in gold. However, when declines in productivity and the terms of trade, and the mounting costs of the Vietnam War, came home to roost the value of the dollar relative to other currencies plummeted. President Richard Nixon suspended the convertibility of dollars to gold. The international trade system was now a free-for-all, and the new and more chaotic system contributed to a fall in corporate profits. Something had to give, but Presidents Nixon, Ford, and Carter were unable to break the political stalemate of rising labor costs caused by union power and a commitment to low rates of unemployment in spite of their best efforts. Something had to give.

In 1979 the editors of *Business Week* opined that to restore the nation's affluence, labor would have to learn to accept less. The *Wall Street Journal* was calling for "supply-side economics," an approach associated with increasing the rate of exploitation of natural resources by decreasing government environmental and other regulations. In the same year, on the steps of the Statehouse in Concord, New Hampshire former actor and California Governor Ronald Reagan, then a presidential candidate, declared that "for the country to get richer, the rich have to get richer." Reagan won the 1980 presidential election and instituted what the Social Structure of Accumulationists termed "a program for business ascendancy" or what the *Wall Street Journal* praised as "supply-side economics." This constituted a sharp turn to the right in American politics. The Reagan administration focused far more on inflation than on the restriction in growth, immediately confronted unions, and further disciplined workers by moving to create a sharp recession by means of policies that raised interest

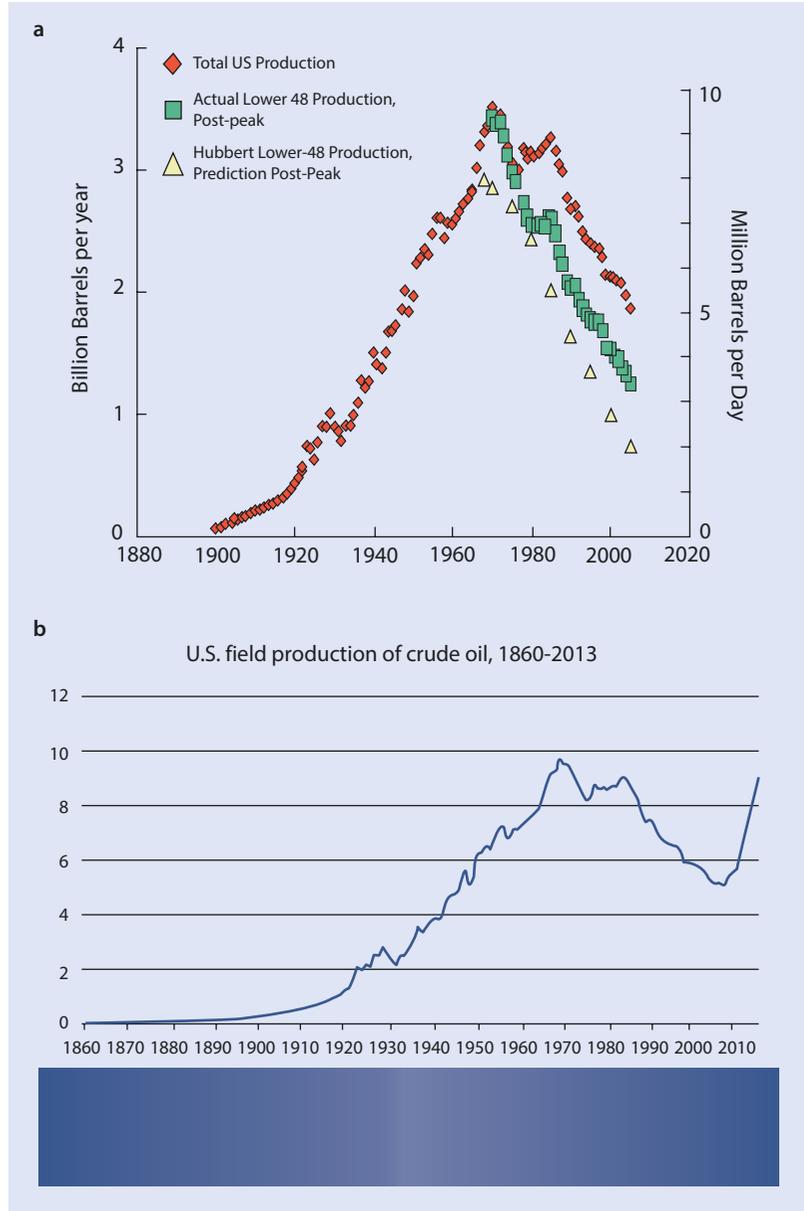
rates and hence severely restricted the amount of money in the economy and, consequently, jobs. By the mid-1980s, home mortgages carried 20% interest rates, and business loans were nearly as expensive. In order to increase America's power in the world, they instituted an aggressive program of military buildup and returned to what former President Theodore Roosevelt termed "big stick diplomacy." Inflation rates subsided and corporate profits rose, but these victories came at a cost. Unemployment rose to almost 10%, inequality increased as the percent of Americans living in poverty jumped from about 11% to a little more than 13%, while the number of rich households (who earned more than nine times the poverty level) went from less than 4% in 1979 to nearly 7% in 1989. Compared to earlier times, most Americans thought that the economy was a mess. Few blamed it on energy, but in retrospect we can say that the pillars of postwar prosperity were eroded in the 1970s and early 1980s because there was no longer unlimited supplies of cheap energy, which caused changes in the economic and social sphere that had begun to impact prosperity.

## 7.11 The 20-Year Energy Breather

By the mid-1980s, the price of gasoline had dropped again as the inflation-adjusted (2010) price of crude oil fell from \$98.52 per barrel in 1980 to \$15.84 in 1998. The new Prudhoe Bay field in Alaska, the largest ever found in America, added to our oil production and helped mitigate, to some degree, the decrease in production of other domestic oil. Around the world many earlier discoveries had become worth developing in the 1970s, and cheap foreign oil flooded the market. As a result, energy as a topic faded away from the media and so in the perception of most people. For most people who thought about it at all, the reason that the energy crisis was "solved" was that the market was allowed to operate by generating incentives from the higher prices. In fact this was largely true, for although domestic production continued to fall year by year (■ Fig. 7.5), foreign-derived oil was increasingly imported to the United States from other countries, and we shifted the production of electricity away from oil to coal (a generally dirtier but more abundant form of energy) to natural gas (generally a cleaner form) and to nuclear energy. So it indeed did look

## 7.11 • The 20-Year Energy Breather

**Fig. 7.5 a** Production of conventional oil in the United States (with and without Alaska) compared to Hubbert's 1969 prediction for the lower 48 (Source: 2006 Cambridge Energy Research Associates) **b** Oil production extended to 2017 (in millions of barrels per day) and including unconventional oil. Even with the increase in domestic production the United States as of 2017 imports nearly half the oil it uses

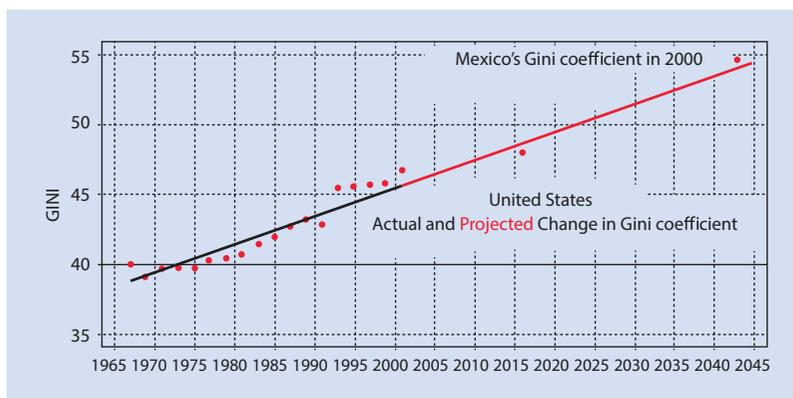
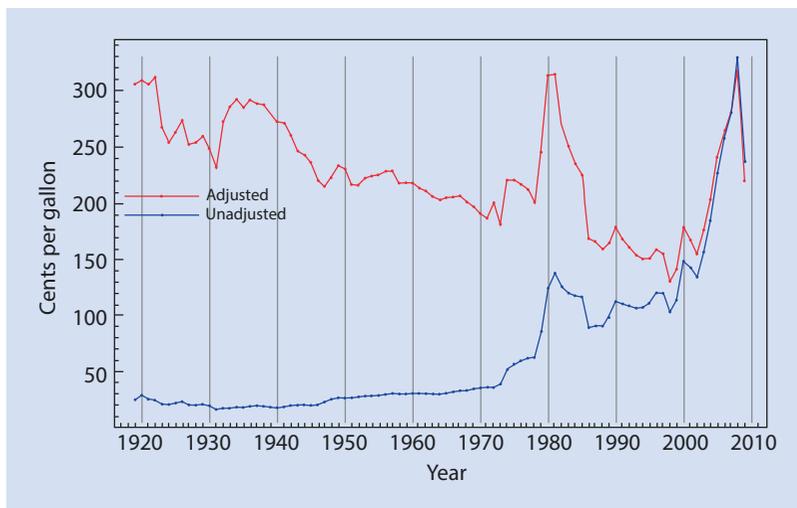


like the economy, through price signals and substitutions, had in fact responded to the “invisible hand” of market forces. Conservative economists felt vindicated, and the resource pessimists beat a retreat, although the economic stagnation of the 1970s, as indicated by declining rates of GDP growth, continued until the present day in the world’s mature economies.

By the early 1990s, inflation had subsided and the world economy grew at about 3% a year. Inflation-corrected gasoline prices, the most important barometer of energy scarcity for most

people, stabilized and even decreased substantially from \$3.41 per gallon in March 1980 to \$1.25 in December 1998, in response to an influx of the foreign oil (Fig. 7.6). Much of this new wealth was generated not through working for wages but by owning stocks. Wages fell while assets surged, but, as in earlier times in history, stock ownership was not spread evenly throughout the economy. The majority of stock market gains accrued to the top 1% of the income distribution. Increasingly many landscapes were filled with very large houses that were far larger than

**Fig. 7.6** Gasoline price corrected and not corrected for inflation (2005 dollars) in the United States (Source: USDOE)



**Fig. 7.7** Gini coefficient for the United States, which is the ratio of the income earned for by the top 20% compared to the income earned by the bottom 20%. This graph shows that since about 1970, there has been increasing inequality of

wealth in the United States, with the wealthiest 20% gaining an increasingly large proportion of the economic pie, while the poorest 20% get a smaller and smaller portion (Source: [SustainableMiddleClass.com](http://SustainableMiddleClass.com))

the basic needs of a family and purchased primarily as luxury items, for the perceived status or on speculation—that is, to sell for a higher price a few years in the future. This process was driven by market forces, as housing represents both investment and shelter for most Americans. One's house is generally a person's greatest asset or repository of wealth. However, large houses, especially those filled with myriad electronic appliances, are also extravagant energy users. So declining real energy prices combined with market forces produced a growing stock of larger houses that used more energy even though many appliances had become much more efficient. Discussions of energy or resource scarcity largely disappeared from public discourse or were displaced by new concerns and

courses about environmental impacts on tropical forests and biodiversity. Income inequality between the rich and poor, as measured by the Gini index, increased greatly both absolutely and in comparison with other industrialized nations (Fig. 7.7; Table 7.3). Indeed it seemed that some 100 years after the first “Gilded Age,” America had entered a new one.

In the United States conservatives led by President Ronald Reagan were successful in convincing many formerly apolitical or even labor union people that their own personal conservatism in issues such as family, society, religion, and gun ownership could be best met through conservative economic and political groups whose agendas were historically opposed to the interests of the working

**Table 7.3** Recent Gini indexes for a select group of nations. The lower the number, the more equitable the distribution of wealth

Japan	24.9
Sweden	25.0
Germany	28.3
France	32.7
Pakistan	33.0
Canada	33.1
Switzerland	33.1
United Kingdom	36.0
Iran	43.0
<b>United States</b>	<b>46.6</b>
Argentina	52.2
Mexico	54.6
South Africa	57.8
Namibia	70.7

Source: Sustainable ► [middleclass.com](http://middleclass.com)

people. These groups and their representatives in government were very much opposed to the government in general and any interference with individual “freedom,” especially intervention in the market. Thus, they opposed, for example, government programs to generate energy alternatives (such as solar power or synthetic substitutes for oil), believing that market forces were superior for guiding investments into energy and everything else. They also tended to be opposed to restrictions on economic activity based on environmental considerations and even mounted campaigns to discredit scientific investigation into environmental issues such as global warming. (However, it is important to point out that many conservative people are extremely interested in conservation of nature.) One specific thing that President Regan did was to remove the solar collectors installed by President Carter on the roof of the White House even though they were working fine.

These new conservative forces tended to be opposed to government policies that restricted such freedoms (i.e., gas mileage standards and speed limits). Both liberals and conservatives tended to support free trade and hence contributed

to the movement of many American companies or their production facilities overseas where labor was cheaper and pollution standards often less strict. One effect was probably a substantial contribution to the improved efficiency of the economy (GDP per unit of energy used) as polluting and expensive heavy industries were moved overseas. For example, strong federal programs to improve solar collectors and the like were often eliminated as government interferences. By 2000 the country seemingly had recovered from the stagnant 1970s and the recessions of the 1980s and early 1990s, although the prosperity was based on a growing level of debt, just as it was in the mid-1980s. Stock values began to increase steadily, and the general economic well-being of many Americans led to a general sense of satisfaction in market mechanisms. The collapse of the Soviet Union and the end of its influence in Eastern Europe effectively brought the Cold War to an end, and the free market approach to economics came to dominate the economics profession. The ideas of John Maynard Keynes, emphasizing government intervention and considered to be orthodox in the golden age of postwar prosperity, fell into disrepute in many of the nation’s leading graduate schools. The apparent success of England in the late 1980s under conservative Margaret Thatcher led to additional impetus that the conservative free market approach to economics worked. The presidential administrations of George Herbert Walker Bush and Bill Clinton alike pressed a free trade agenda and reduced spending on social programs. As markets became “liberalized,” prices of basic commodities from coffee to cotton to oil declined by more than 100%. The terms of trade greatly improved for the United States, but poverty rates and debt soared in Africa and other developing regions where coffee growers, for example, had to compete with each other for the limited markets in the rich countries.

Our energy perspective has a different view, of course. First of all, much of the economic expansion of Presidents Reagan and George H. W. Bush was paid for with debt, so that the administrations of these supposedly fiscally conservative presidents (and Congresses at the time) actually generated far more debt, even when corrected for inflation and increased GDP, than even the supposedly “free spending liberal” Franklin Roosevelt did for domestic programs in earlier times. It is important to understand that while the United States and Great Britain, for example, appeared to be doing

7

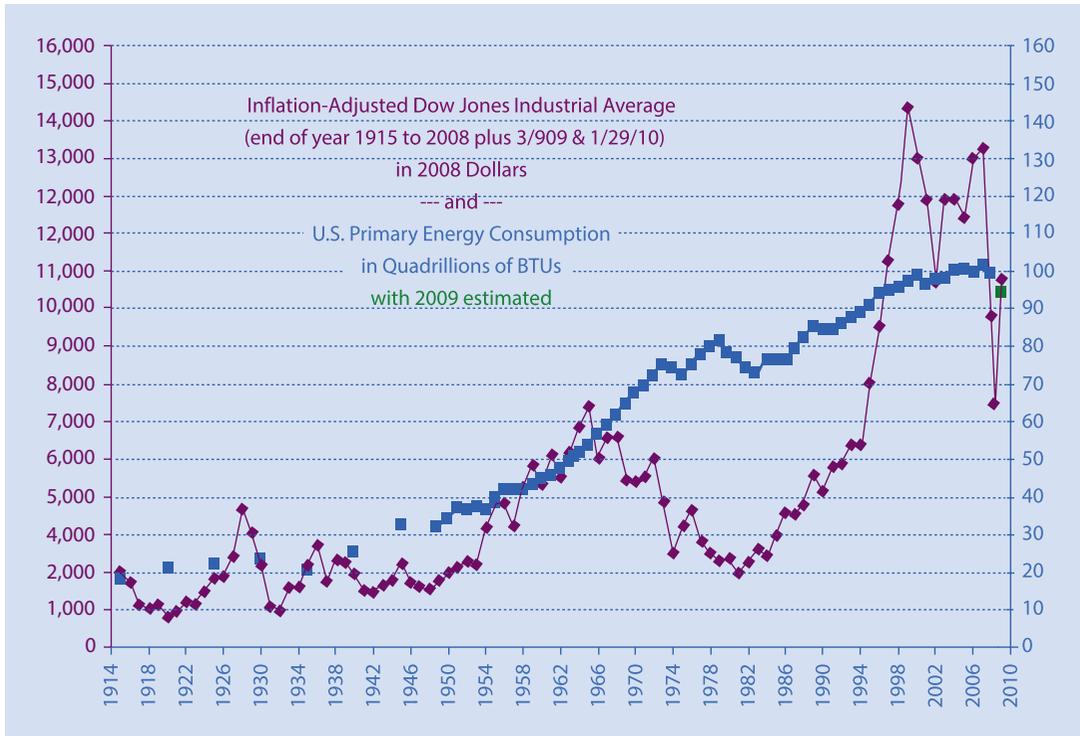
much better economically under “conservative” administrations, both countries happened to enjoy low prices for oil and for energy in general while there were conservative leaders. (Less conservative Bill Clinton and Tony Blair benefited too.) In the United States, there was a decline in the proportion of GDP needed to pay for energy, from a maximum of 14% in 1981 to about 6% in 2000. This effectively gave the US people some 6–8% additional discretionary income (that not required for basic food, shelter, and clothing), which could be spent on big houses and stocks. In addition, declining oil prices, an input to most basic commodities, reduced general inflation. In England Margaret Thatcher received a great deal of credit for her nation’s economic recovery, but few attributed her success to the simple fact that the vast North Sea oil field came on line during her administration, greatly reducing former costs for imports. Since a large part of that oil was sold abroad, very large revenues for the government were generated, allowing the reduction of other taxes. Clearly conservatism alone could not explain fully England’s success, as nominally socialist Netherlands was also doing very well economically at that time fueled by the vast Groningen gas field, whose profits allowed for social benefits to be extended to everyone. Energy analyst Doug Reynolds [24] generates a strong case that the collapse of the Soviet Union, often attributed to strong actions by the United States, was actually mostly a consequence of the partial collapse of Soviet oil production over the previous 3 years, greatly reducing the revenues that went to the central government and leading to many problems such as the inability to pay military pensions. So, again, these historical data about energy help explain what is normally attributed solely to political or economic leadership. A more difficult question, of course, is how to govern well when the abundant resource “rug” is pulled out from under the economy, a question of great importance as we write this book.

### 7.12 Political and Economic Response to Oil Price Increases Since 2000

A rather comfortable economic situation in America became subject to some disquiet as oil prices once again increased in the early 2000s and the overpriced stock market fell by nearly

20% as the “technology bubble” burst. Those who particularly benefited from the extensive surplus wealth of the 1990s often shifted their money into the housing market, as real estate was perceived to be a safer investment than technology. Government programs initiated by the Clinton Administration, and encouraged through the Bush campaign, were designed to put more people into their own homes for political and social reasons. Oil prices relaxed a bit through about 2006 but then increased rapidly in 2007 and enormously more in the first half of 2008. For those who read widely, there was a new set of economic predictions emanating from various oil industry analysts. Followers of M. King Hubbert, including Colin Campbell and Jean Laherrere [25], warned that the “peak” in oil production was soon upon us and that the end of cheap oil would almost certainly follow—and with it significant economic consequences. The new Bush Administration, apparently with its own inside information on declining oil production prospects, called for the drilling of oil in the Alaskan Wildlife Preserve and enhanced oil and gas development. Something that was barely noticed was that global oil production stopped growing in 2004. Colin Campbell had predicted at the Association for the Study of Peak Oil meeting in Lisbon that we were likely to see an *undulating plateau*, rather than a steep peak, for global oil. He reasoned that initial shortfalls in oil would lead to price increases, which would lead to economic recession, a reduction in demand, economic recovery, and a new cycle. This basic pattern seems to have been exactly what has happened from 2004 to at least mid-2017.

The stock market continued to be sensitive to oil price changes, and the value of the Dow Jones kept struggling to increase beyond its inflation-adjusted peak in 1998 when corrected for overall price increases (■ Fig. 7.8). While in some senses (high employment and increasing wealth of the more affluent) the economy was doing quite well in the first 7 years of the 2000s, many questioned how much of the apparent affluence was real and how much was based on debt, as both real estate speculation and debt soared. From 1997 to 2005, the financial sector debt grew from 66 to more than 100% of GDP. Household debt rose accordingly, from 67% to 92% of GDP. Many private and public pension systems were based on the assumption that stocks would continue to grow at historical rates of 8% or

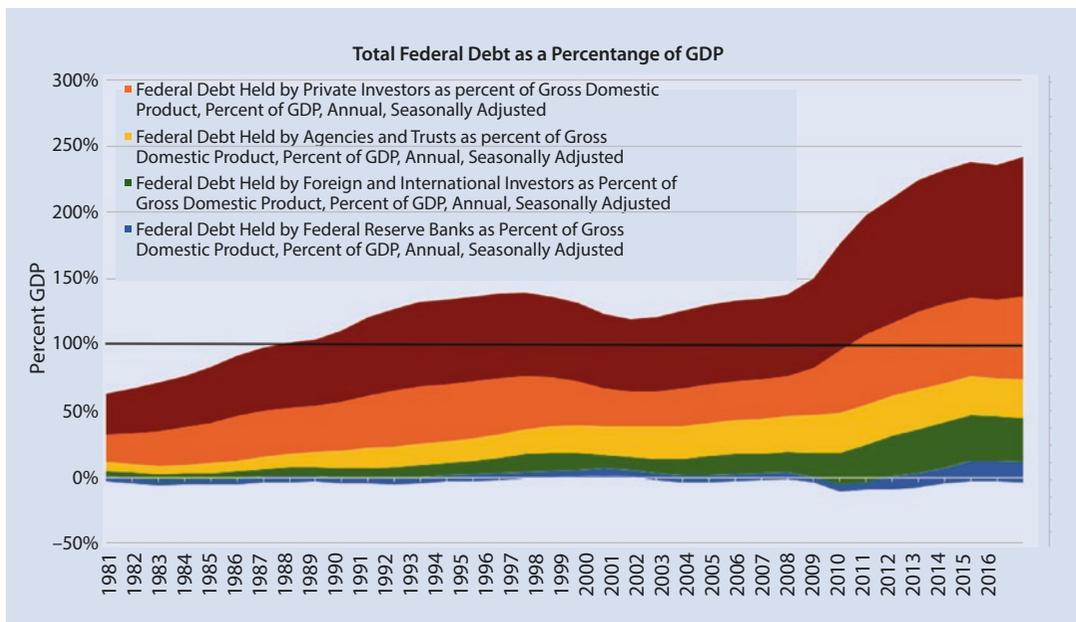


■ **Fig. 7.8** Inflation-corrected Dow Jones industrial average (2008 dollars) scaled to plot in the same graph space as total energy used by the US economy. Over long periods of time, the slopes are very similar, but

the Dow Jones snakes around the total US energy use, with the deviations from that line presumably reflecting psychological aspects (Figure courtesy of William Tamblin)

more, as had been seen in the “good times” (but speculative) period during the late 1990s. When the stock bubble disappeared in 2000, many large companies were found to have placed not nearly enough money into their pension funds. Many workers who had worked hard all their lives with the expectation that they would have a good, solid pension found they had little or nothing. Some were fortunate in having the Federal government bail them out, but there is not enough money in that fund to cover even a fraction of the people who will have lost their pension. Public entities, which are required by law to meet their pension obligations, fell about 500 billion dollars in the hole. All forms of debt, including that of the Federal government, increased faster than did the economy as a whole, as measured by the growth of gross domestic product. The Federal Government took in about \$55 billion dollars more in taxes than it spent in the last year of President Clinton’s administration. By 2003, powered by tax cuts at the top end of the income distribution and increased military spending, the debt soared to an

annual deficit of more than \$500 billion by 2006. The Federal government, attempting to avoid inflation, did not “print” more money but became increasingly dependent on loans from Asia, especially China, to pay its bills. These loans, and those of the 1980s, will be a tremendous financial burden on young people who are reading this as undergraduate or graduate students, yet our government is unwilling to raise taxes or reduce total spending. As of 2006 wars in Iraq and Afghanistan cost more than \$8 billion *per month!* The situation only got worse following the financial meltdown of 2008, and Presidents Bush, Obama and now Trump are setting new deficit records (■ Fig. 7.9). Various health-care initiatives imply enormous future federal spending requirements. In addition, individuals had been living far beyond their means by borrowing heavily on credit cards. There is another unseen debt as well, that of delayed maintenance of society’s infrastructure such as bridges, roads, levees, schools, and so on, not to mention degradation of the natural infrastructure of clean water, soil, and biodiversity.



■ Fig. 7.9 Cumulative debts for the United States in trillions of dollars (Source: Wikimedia Commons)

What does this debt mean in energy terms? In 2008 the United States owed various entities such as banks and pension funds in Japan and China and other countries some 8000 billion dollars. If we were to pay off this debt all at once and those who received these dollars (say retired Japanese Toyota workers) chose to spend it on beef, fish, rice, or Ford automobiles from America, it would take at the average energy use per unit of economic activity of the US economy (about 8 MJ/dollar then) an estimated 64 exajoules worth of energy to make those goods, equal to 10 billion barrels of oil or half of US known oil reserves remaining then to make the products those foreign people purchased. Meeting the interest payments transfers income to the holders of debt and has nearly the same effect. In other words with our massive foreign debts, people in other countries have a huge lien (i.e., obligation to repay a debt) on our remaining energy reserves or whatever their replacements might be. If this debt becomes too burdensome, one way out of this problem is hyperinflation. After the Treaty of Versailles in 1918, Germany was obligated to pay some \$30 billion in “reparations” to France and England. They paid the international debt in “hard currency,” mostly borrowed from US banks, while they paid off their own domestic debts in deflated marks. The impact was to enormously devalue their currency (■ Fig. 7.10). Prices rose by

nearly 21% per day and doubled every 3.7 days. In 1918 it took 1 mark to purchase about 0.4 gram of gold. By November 1923 it took 100 billion Reichsmarks to buy the same quantity. This greatly undermined the entire financial system and helped lead to the rise of the Nazi party. Moreover, when the crises of the early 1930s crippled the US banking system, American banks were either unwilling or unable to continue the loans to Germany, the Germans defaulted on their reparations, and Britain and France suspended the repayment of their war debts to the United States. The ensuing collapse of international trade and the gold standard was a primary factor in the depth and length of the Great Depression. The East African nation of Zimbabwe recently experienced just such hyperinflation with an inflation rate so that prices doubled each day. Thus, while the United States continues to have enormous wealth and potential for creating wealth, it may be increasingly constrained by the new a shortage of cheap energy. Our debt to other nations and to nature also makes our financial future potentially precarious. We need a careful systems analysis using both conventional and biophysical accounting to determine what is real wealth production and what is not, whether there is, as in the past, much potential for future growth to pay off this debt, and what might be the effects of future increases in energy costs.

■ **Fig. 7.10** Elderly Germans buying a loaf of bread with a very large number of hard-earned marks, which had completely lost their value



The financial “crises” that occurred in the second half of 2008 add another dimension to our analyses. Many financial firms, highly respected for decades, collapsed or were accused of excessively risky and even quite shady financial undertakings. The government was asked to bail out all kinds of financial entities, and many people lost from one-third to one-half of their savings as housing and Wall Street prices collapsed. As of this writing, it is far too early to tell whether the stock market expansion of 2017 is excessive speculation and “irrational exuberance” or a genuine new direction for Wall Street. We suspect that if Wall Street is to grow again in the future sustainably beyond where it was in 2007, huge new energy supplies or an unprecedented and unlikely increase in efficiency will need to be found. Barring that, many Americans will have to readjust greatly and permanently their perspective on wealth production through the stock market and probably in regard to economic growth in general. That this transition would be difficult, financially, intellectually, and emotionally, for many, is an understatement.

We leave an examination of whether the vast increase in oil prices in the first half of 2008 was directly responsible for the economic meltdown of the second half of 2008 for a more comprehensive analysis in ► Chap. 18. In the meantime note that the total increase in energy use in the United States began to flatten out considerably starting in about 2000 (■ Fig. 7.8). Thus, if the production of real wealth is as dependent upon the use of energy,

as we believe, then we have left a long period of increasing energy and wealth and entered a period where it may no longer be possible to produce much more, or perhaps even as much, of either.

As we prepare the second edition in 2017 the United States economy is doing well or poorly—depending on who you are. A radically different president and suite of advisors promise to “make America great again” without quite telling us what that means. He also promises to bring back economic growth of 4% a year. Environmental regulations and protections are relaxed wherever one looks which is supposed to assist economic growth but is likely to have adverse impacts on many people. Oil and especially natural gas prices are low which according to our analysis should help economic growth—but so far the results are lukewarm at best. Many petroleum companies are not making profits and investments are decreasing, which is likely to constrain future production. Wealth is increasingly concentrated in the hands of the most wealthy, so that about half the nation’s wealth is owned by 1% of the people. The president says we are becoming a large energy exporter, but we still import half our oil. Renewable energy is growing but still represents only a few percent of our energy supply. The increasing use of robots is likely to have adverse effects on the need for labor. Some sectors of the American economy have recovered, more or less, from the 2008 crash, but others have not. The stock market valuation is high but potentially unstable, and employment is higher. But wages

have not recovered and middle class incomes have stagnated at best. Oil prices are moderate at this writing so we might expect some growth from that perspective. This issue is considered further in ► Chaps. 10 and 13. There are still no economists of national influence attempting to understand the relation of the economy to resources.

### 7.13 Why Does the Energy Issue Keep Emerging?

Given the very large jumps in the price of crude oil and gasoline, both down and up, that have occurred in the first 17 years of the new millennium, many people have started to think about energy again. Why do “oil crises” keep reoccurring? Despite conservative claims that market processes and technology make considerations of any “limits to growth” and physical restrictions on energy resource supplies obsolete, world shortages and price fluctuations continue. Why have middle class incomes been failing so frequently to increase in value as it had in the past?

In the long term, markets and technologies have been a means of enabling humans to increase their wealth and material well-being. But wealth does not come out of thin air but only from the use of energy and the exploitation of physical resources. Thus, an associated and necessary aspect of this increase in wealth is that the same factors, markets and technologies that have enabled and encouraged us to become wealthy have also enabled and encouraged us to run through the world’s resources more rapidly. It is quite possible that we are beginning to reach the limits of the Earth’s ability to provide cheaply and easily the resources we have taken for granted. The periodic oil price increases are small reminders that, eventually, the piper must be paid, for as we like to say, Mother Nature holds the high cards. Humans are indeed industrious and ingenious, but that industriousness and ingenuity still require the Earth itself to provide the raw materials and fuels that are the basis for most wealth production and the capacity to absorb our wastes. Humans appear to be increasing energy and economic costs to the economy through indirect impacts of industrialization, for example, increased damage from hurricanes from a warmer ocean, increases in sea level, possible crop production declines, tropical soil drying, increased rates of flooding and tornadoes, and so on. The *Stern Report* [26] says that the

price for mitigating future environmental impacts from global warming might be 20 times more than the cost of acting now to reduce our impact on the planet. This is one of many reasons why we must include more natural science in our economics, which we do throughout this book.

### 7.14 Debt, Inequality, and Who Gets What

Whatever the future of the total production of wealth in the United States, there are several clear and unsettling trends that will affect the future of energy supplies. The first is the enormous increase in debt in recent years (► Fig. 7.9). Thus, much of the apparent prosperity of the recent past was based on debt and the ability to run an economy when debt expands more rapidly than income and wealth is highly suspect. The limits to debt constitute a limit to growth. The US generated huge debts (at the time) as the administration of Franklin Roosevelt, especially during World War II, spent far more money than it took in. Since then the debt economy has escalated even further. The standard answer of mainstream economists is that economic growth allows us to carry the debt without peril to the rest of the economy. The crucial question for the world economy is whether there is the energy available today to facilitate or even allow the growth that might make the debts of today and the future fundable? If the traditional internal limits to growth, such as demand and productivity, coincide with the biophysical limits, every economic problem will be rendered more difficult. The era of peak oil is likely to be the era of degrowth.

The long history of the United States is based upon the strength of the middle class. Since about the 1960s, however, capital and wealth more generally have been concentrated increasingly in the hands of the wealthy (► Fig. 7.7). The postwar history of the United States was based upon the spreading of income among workers and the poor. This provided the income to purchase the tremendous increase in the world’s output after the Second World War. But increasingly in recent years, the wealth of the United States has been concentrated in the hands of the rich, mostly as a consequence of expanding financial markets and tax policies that increasingly favor them, at least relative to earlier past tax policies that would (in the Second World War) tax up to 94% of a wealthy

person's income. As we will describe in greater detail in ► Chap. 10, progressive taxes were curtailed in the 1980s, and the corporate tax burden has been falling since the early 1950s. Historically, increases in inequality have faced limits as well. When income becomes too concentrated at the top, as it did in the 1870s, 1890s, and 1920s, a depression followed, as citizens lacked the purchasing power to buy the products of industry. Excess capacity increased, investment declined, and unemployment soared. By many measures this is the situation the United States faces today.

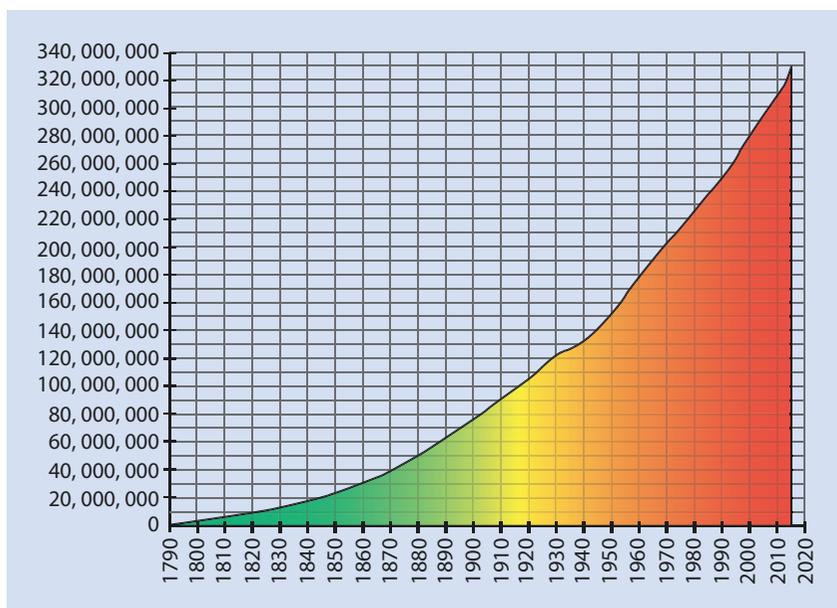
### 7.15 Are We Seeing the End of the American Dream?

A central question that we will continue to explore in this book is whether this American dream (or European or Chinese or whoever else's dream) is sustainable, and what we might do to maintain it over the long term. Sustainability is a relatively new issue in economics but one that is increasingly on many economists' agenda. What sustainability is, of course, is highly dependent upon the perspective of who is asking the question. To an anthropologist or developmental economist, a sustainable economy might mean one that persists in time in the face of competition or aggression from other cultures or entities; to a conservation biologist, sustainable economy might mean one that does not degrade biodiversity, and to a resource-oriented person (like ourselves), it might mean not "living beyond the planet's biophysical means of supporting one's culture." We prefer a concise biophysical definition of sustainability. To be sustainable, an economy must live indefinitely within nature's limits. In other words an economy must persist over the long haul without excessive depletion or degradation of the energy and material flows—and the physical milieu—of the biophysical system that contains and supports economic activity. A sustainable economy must be able to provide not only jobs but, ideally, also meaningful work and meaningful lives for those human beings who make up "the economy." By this definition we are very, very far from sustainable. To us it is dishonest and unethical to declare as sustainable so many "green" entities, as we see daily in the media, that in fact require the use of fossil fuels and nonrenewable fuels or other depletable resources. The fact that a product or process is marginally better or greener

in these respects than their competition (or can be made to look so) does not make them sustainable.

Historically, especially in the post Second World War era, the vehicles to maintain prosperity and social stability were economic growth domestically and enormous power (military, monetary, productivity) internationally. The productivity increases and cost containment that was the basis for these pillars were dependent upon cheap oil while ignoring many environmental issues such as CO<sub>2</sub> release. As we can no longer do this, the inherent tendency toward stagnation that characterizes mature market economies is exacerbated by biophysical limits. As these pillars of prosperity have weakened, the prospects for a dream, instead of a nightmare, decline as well [27, 28]. While such a decline may seem far away for those in comfortable circumstances reading this, the reality for people in Egypt, Syria, Nigeria, Venezuela, and other once-wealthy oil-producing regions who have indeed reached and passed peak oil is that economic and social turmoil is now a daily fact of life. This is especially well documented in the book by Nafeez Ahmed *Failing States, Collapsing Systems: BioPhysical Triggers of Political Violence* [29]. We think it extremely important to understand this book and adjust our economic aspirations to what is likely to be a new biophysical reality.

What is the basis for our perspective? What does it mean to live within nature's limits? Ultimately it comes down to maintaining the per capita resource stocks and flows required for human existence (and at what level of material well-being?) and the degree to which the atmosphere and oceans can handle the wastes of the human economy. The number of people, in the United States and elsewhere, continues to increase greatly (■ Fig. 7.11). For example, when Hall was born (1943), there were about 137 million Americans and a little more than 2 billion people in the world. There are now more than 330 million people living in the United States and 7 billion people in the world. So the resources that form the basic inputs into our national and global economies have to be divided by roughly three times more people, and this is in only one person's (incomplete) lifespan. Global populations may well double or at least increase by another 50% in the reader's lifetime. Our most important mined resource is oil, and while it is not clear yet whether global oil production has peaked for all time, it is clear that per capita oil use (or oil use per person)



■ Fig. 7.11 US population (excluding many native Americans)

peaked in about 1978 (■ Fig. 7.12). In other words, a growing amount of oil (until recently) has been used by an even more rapidly increasing world population. The traditional economist argues that this is not crucially important as various technologies have allowed humans to generate more resources or more wealth from the resources that we do use. While we do not argue with the idea that technological innovation is important, we also will show in later chapters how this concept is extremely misleading and cannot form the only solution for our future and that of our children.

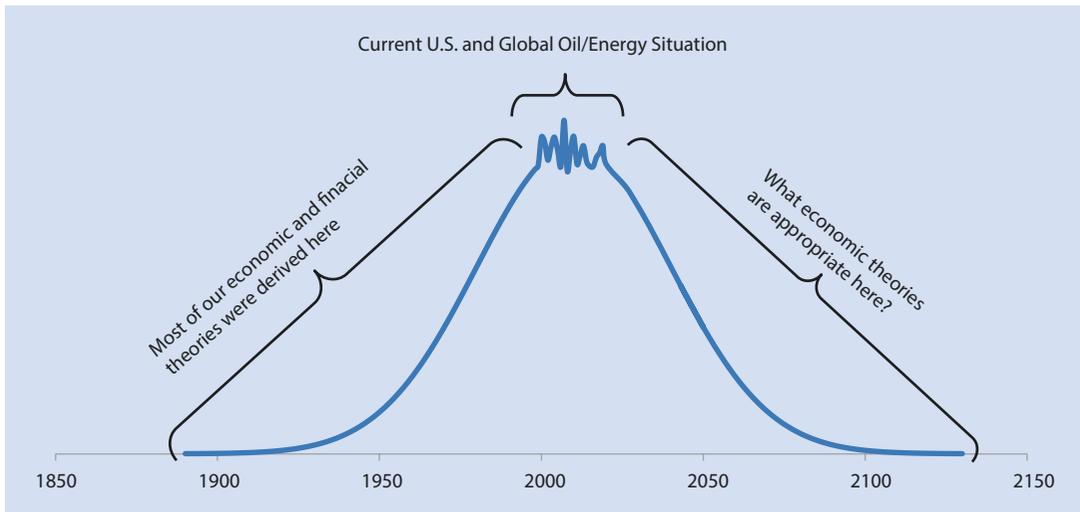
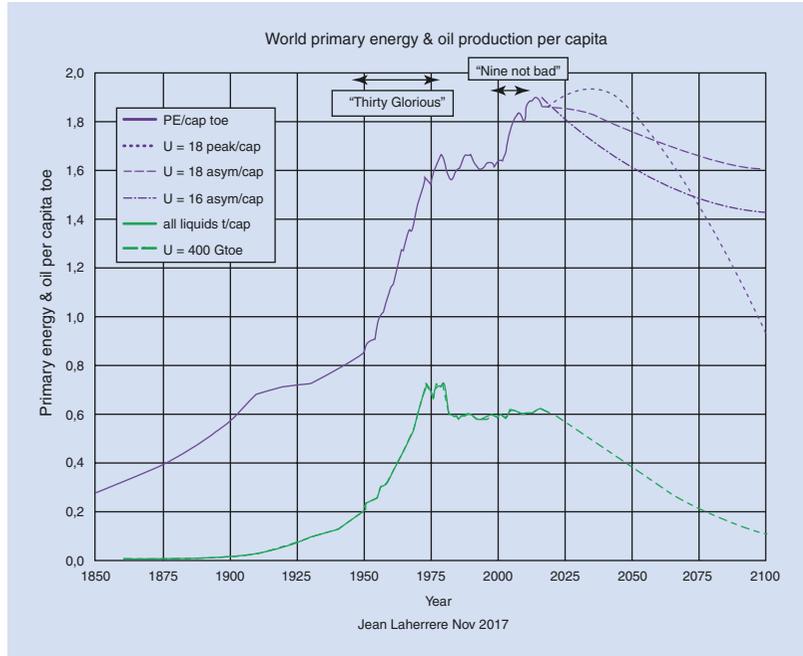
We can begin by considering petroleum, perhaps our most important resource beyond sunshine, clean water and soil. Most everything we do is based on cheap oil [19–21]. Where we live relative to where we work, what we do for our work, how much leisure time we have and how we spend it, the price of our food, most of our purchases and how much education we can afford, to name but a few, are largely dependent on adequate supplies of cheap oil. For example, it takes the energy of about a gallon of oil a day to feed each of us, about 80 barrels of oil to provide an undergraduate education at one of our colleges, and the energy equivalent of about 10 gallons per day to keep us supplied with all the goods and services that we demand through our economic activity. In earlier days this level of

affluence was available to only a tiny elite of society and was usually provided by slave labor or indentured servitude. The net effect is that each of us today has some 60 to 80 “energy slaves” doing our bidding, effectively “hewing our wood and hauling our water.”

The incredible thing about oil and gas is the almost complete absence of an understanding of its importance to the average American and their failure to understand how critical it is to our economy. At a meeting of ASPO-USA (the Association for the Study of Peak Oil) in 2006, Denver Mayor Hickenlooper, who understood the importance of oil and its restrictions, said “This land was originally settled by the Arapahoe and Cheyenne tribes. Everything that the natives depended upon, their food, clothing, shelter, implements and so on, came from the bison. They had many ceremonies giving thanks and appreciation to the Bison. We today are as dependent upon oil as the Sioux were on the bison, but not only do we not acknowledge that, but most people do not have a clue.” The second critical thing about oil is “peak oil” and that as of 2017, global conventional oil production is no longer clearly increasing and may indeed be decreasing (■ Fig. 7.13). Almost certainly it will decrease substantially in the near future as we enter, in the words of geologist Colin Campbell, “the second half of the age of oil.”

## 7.15 · Are We Seeing the End of the American Dream?

■ **Fig. 7.12** Total and per capita oil production for the world, with projections. TOE tons oil equivalent



■ **Fig. 7.13** Conceptual view of relation of our economic concepts and the Hubbert curve for global total oil use. Most of our economic concepts were derived during a period of

increasing energy use. They may be having trouble explaining economic events during the present period of peak oil. How will they do during the decline in energy availability?

We conclude by saying yes, the American dream was the product of industrious and clever people working hard within a relatively benign political system that encouraged business in various ways but that all of these things also required a large resource base relative to the number of people using it. A key issue was the abundance of oil and gas in the United States, which was the world's largest producer in 1970. But in 1970 (and

1973 for gas, although there may be a second peak), there was a clear peak in US oil production, and while the continued increase in oil production worldwide buffered the United States (and other countries) from the local peak, it seems clear by 2010 that global oil production has reached its own peak, while demand from around the world continues to grow. This mismatch between supply and demand resulted in a sharp

increase in the price of oil and many economic problems that we believe it caused, at least in part, including the stock market declines, the subprime real estate bust, the failure of many financial corporations, and the fact that some 40 odd of 50 states are officially broke and that there is a substantial decrease in discretionary income for many average Americans. As developed later in ▶ Chap. 19, we believe that all of these economic problems are a direct consequence of the beginning of real shortages of petroleum in a petroleum-dependent society.

## 7.16 The Future of the American Dream

“Macondo (The Gulf of Mexico oil spill site) eventually gripped the media and political eye. It is time for sober reflection on the global energy predicament and not for knee jerk reactions. How important is primary energy production and consumption for the OECD way of life? It links to economic growth, tax receipts and all that these pay for, pensions, manufacturing, food production, defense, leisure, comfort and security.” These words, presented by energy analyst Euan Mearns on *The Oil Drum* (Europe) June 16, 2010, sum up our dilemma. As the country wrestles with the terrible environmental and economic consequences of the oil spill, does the disaster signal the end of finding new oil to support the fishing and recreation industries that are bemoaning the impact? Will this single event be the turning point in our hope of maintaining our national affluence [27, 28]. Have we finally caught up with living beyond our means through debt while seeing the beginning of the end of the continual hope that technology, such as deep sea drilling, will extend the American dream forever? A decade later it turns out that this oil spill has made little difference. American economic activity continues unabated but with little growth and increasing disparity between rich and poor, so that the American dream seems increasingly beyond the grasp of more and more people. How much of this is related to the essential cessation of growth in oil production and availability?

It is not just the United States but Europe and Japan that are experiencing much lower economic growth than in the past. In Europe growth has essentially stopped for a decade, something called

“secular stagnation”. This is something that is quite unprecedented in the economics of the past century but which now seems to be quite established in many places. It has meant that it is very difficult to meet pension plans (because investments do not return as they once did) and that money in the bank does not earn interest. Those who still assume that growth should be taking place have ended up in very bad financial situations. This is correlated over time with a discontinuance of the growth of oil and fossil fuels more generally. It is behind the difficulties that many states have with meeting pension obligations, assisting students, and so on and perhaps the disaffection that many have with governments.

Franklin Roosevelt ran up huge debts to reconstruct the economy after the Depression and during the Second World War. Except for Bill Clinton, all presidents since (and including Ronald Reagan) increased debt (both corrected for inflation and the size of the economy) more than did Franklin Roosevelt during the new deal (■ Fig. 7.9). Will the economy continue to grow so that we can pay off those debts if there is no longer cheap energy? What kind of jobs will be available if Americans have less and less discretionary income? Do we still want more labor productivity, which has usually meant subsidizing each laborer with more and more energy? Or do we want less labor productivity, that is, more energy productivity, by subsidizing each increasingly valuable unit of energy with more and more labor, to keep our people employed? How will we maintain and enhance the value of pension funds if the stock market no longer grows in real terms? What about our inner cities? Can we find ways to employ those desperately in need of a job? Do population increases enhance our economic well-being or simply divide up our remaining untapped resources among more and more people? Do we need a completely new approach to economics during times when energy is declining? What indeed will the American dream mean in the future? Can we generate a new American dream with fewer material goods and more leisure? Will these issues limit our ability to support and educate our children? These are a new set of economic questions that require a new way of thinking about economics. Much of the rest of this book will try to provide some of the information to answer these questions.

## ? Questions

1. What does the word biophysical mean? How does it relate to economics? With what word(s) would you contrast it with?
2. What factors are likely to influence your own economic success in life?
3. Although energy is barely discussed in physiocratic, classical, or neoclassical economics, explain how each of these schools of economic thought focuses on the dominant energy flows of their time.
4. Why was Spindletop an event of great economic importance for the United States?

## References

1. Martin, P.S. 1973. The discovery of America. *Science* 179: 969–974.
2. Tainter, J. 1988. *The collapse of complex societies*. Cambridge: Cambridge University Press.
3. Diamond, J. 2004. *Collapse: How societies choose to fail or survive*. New York: Viking Press.
4. Crosby, Alfred. 1986. *Ecological imperialism: The biological expansion of Europe, 900–1900*. Cambridge, UK: Cambridge University Press.
5. Diamond, J. 1997. *Guns, germs and steel: The fates of human societies*. New York: Norton.
6. Zinn, Howard. 1980. *A people's history of the United States*. New York: Harper and Row.
7. The two greatest causes for war among the perhaps one third of the colonial population who supported independence was basically resource scarcity – the cutting off of the trans-Allegheny frontier, first in 1763 by means of the Proclamation Act, and then later in 1775, with greater enforcement, with the Quebec act. Open rebellion soon followed.
8. Perlin, J. 1989. *A forest journey: The role of wood and civilization*. New York: Norton.
9. Greene, A.N. 2008. *Horses at work: harnessing power in industrial America*. Cambridge: Harvard University Press.
10. Yergin, Daniel. 1991. *The prize: The epic quest for oil, money, and power*. New York: Simon & Schuster.
11. Bowles, S., D. Gordon, and T. Weiskopf. 1990. *After the wasteland*. Armonk: ME Sharpe.
12. Smil, V. 2001. *Enriching the earth. Fritz Haber, Carl Bosch and the transformation of western food production*. Cambridge: MIT Press.
13. Meadows, D., D. Meadows, and J. Randers. 2004. *Limits to growth: The 30-year update*. White River: Chelsea Green Publishers.
14. Ehrlich, P. 1968. *The population bomb*. New York: Ballantine Books.
15. Hubbert, M.K. 1969. Energy resources. In *The National Academy of Sciences–National Research Council, Committee on Resources and Man: A Study and Recommendations*. San Francisco: W. H. Freeman.
16. Hardesty, J., Norris C. Clement, and Clinton E. Jencks. 1971. The political economy of environmental destruction. *Review of Radical Political Economics* 3 (4): 82–102.
17. England, R., and B. Bluestone. 1971. Ecology and class conflict. *Review of Radical Political Economics* 3 (4): 31–55.
18. Bowles, S., D. Gordon, and T. Weiskopf. 1990. *After the wasteland*. Armonk, New York: M.E. Sharpe.
19. Odum, H.T. 1973. *Environment, power and society*. New York: Wiley Interscience.
20. Daly, Herman. 1973. *Towards a steady-state economy*. London: W.H. Freeman and Company, Ltd. Tables.
21. Cleveland, C., R. Costanza, C. Hall, and R. Kaufmann. 1984. Energy and the U.S. economy. A biophysical perspective. *Science* 225: 890–897; Hall, C.A.S., C.J. Cleveland and R. Kaufmann. 1986. *Energy and Resource Quality: The ecology of the economic process*. New York: Wiley Interscience. 577 pp.
22. Jorgenson, D.W., and Z. Grilliches. 1967. The explanation of productivity change. *Review of Economic Studies*: 249–283.
23. Maddala, G.S. 1965. Productivity and technical change in the bituminous coal industry. *Journal of Political Economy*: 352–265.
24. Reynolds, D. 2000. Soviet economic decline: Did an oil crisis cause the transition in the Soviet Union? *Journal of Energy and Development* 24: 65–82.
25. Campbell, C., and J. Laherrere. 1998. The end of cheap oil. *Scientific American* (March): 78–83.
26. Stern, N. 2007. *The economics of climate change. The stern review*. Cambridge: Cambridge University Press.
27. Luce, E. 2010 Goodbye, American Dream. The crisis of middle-class America. *The Financial Times*. 30 July 2010.
28. Brinkbaumer, K., M. Hujer, P. Muller, and T. Schulz. 2010. Is the American dream over? *Das Spiegel*: 2010.
29. Ahmed, N. 2017. *Failing states, collapsing systems: Bio-Physical triggers of political violence*. New York: Springer.