benefits of their actions, one solution is to use taxes or subsidies to correct this problem. An example of the use of taxes to address negative externalities can be seen in cases where some cities have implemented or are considering implementing congestion pricing. Under such a system, drivers in certain parts of cities must pay fees to drive. New York City became the first U.S. city to approve congestion pricing in April 2019. The city plans to hold public hearings on the topic of congestion pricing and will conduct environmental reviews before implementing the plan. For-hire vehicles, including taxis and app-based services like Uber and Lyft, already pay fees in some areas.[8]

Using taxes to remedy the effect of externalities is most effective when it is possible to estimate the value of the externality. In many cases, this information is not readily available. So it may be more effective to reduce a negative externality by establishing a quota limiting the activity that produces the externality. If such an approach were to be used to reduce traffic congestion, then a target number of vehicles would be set and only that many permits would be issued. Of course, a problem with this approach is that the drivers who get permits may not be those who value them most highly. But, this can be resolved by creating a market in which drivers can buy and sell permits.

The United States Environmental Protection Agency (EPA) has used this approach to deal with sulfur dioxide emissions. After establishing a maximum level of emissions, the EPA auctioned off the rights to emit sulfur dioxide to the highest bidders. A similar approach is used in California, which created an emissions trading system in 2013. The California system sets a cap on greenhouse gas emissions each year but allows companies to buy and sell pollution credits in auction markets, which allows them some flexibility in how they achieve the emissions reductions.

Property Rights

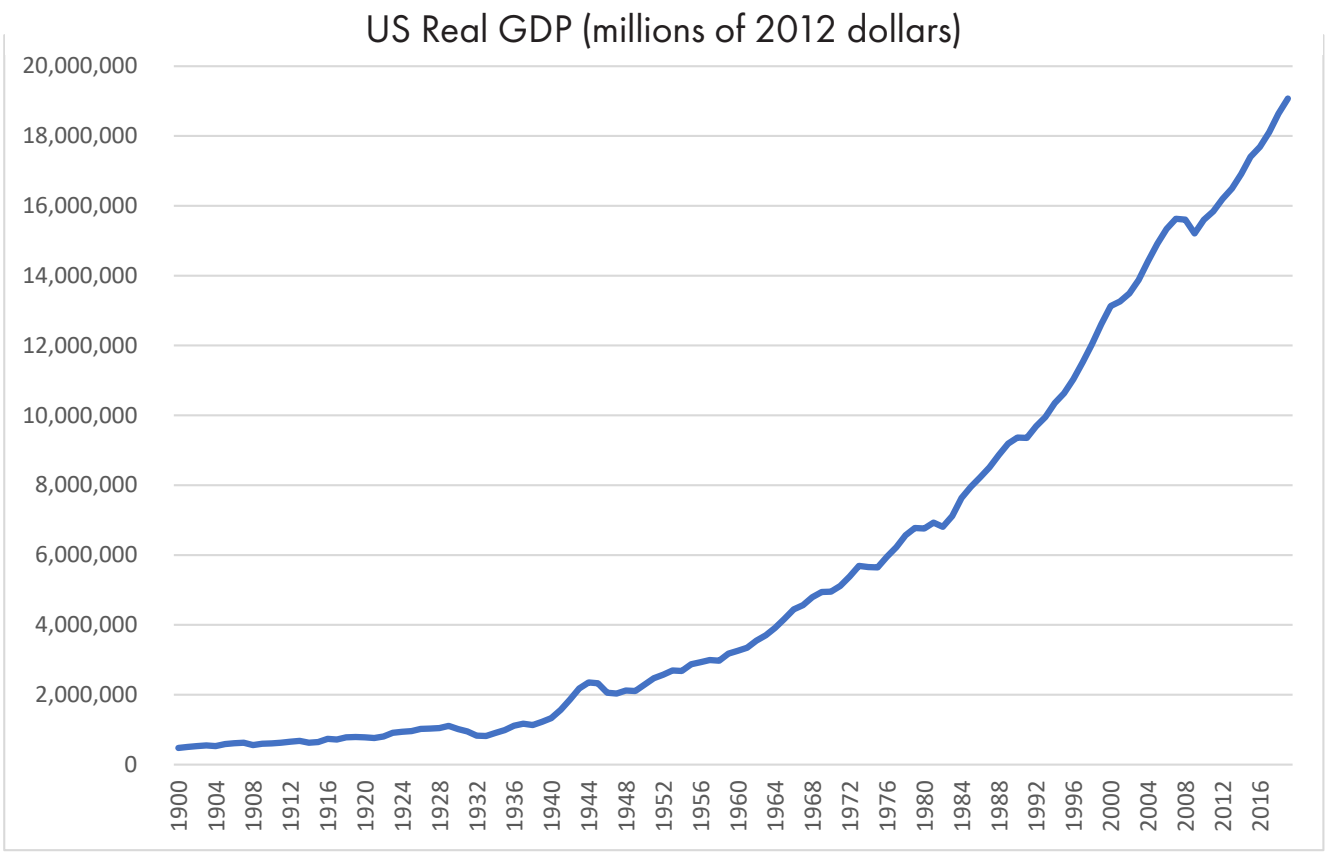
Having grown up in a market economy, the existence of private property seems quite natural to most of us. However, the institution of property rights is not a natural occurrence; it is a social innovation. The importance of this innovation becomes clear when we consider what happens when valuable economic resources have no owner.

To illustrate the importance of private property, let's consider what happens to property that no one owns in this simple example. A village located next to a lake has six residents, each of whom has $100 in savings they can use to either purchase a government bond that pays 15 percent interest, or to purchase a fishing boat necessary to catch fish in the lake. The number of fish each resident can catch depends on the number of residents who catch fish. This relationship is shown in the table in Figure 28. If only one villager purchases a boat, then he/she can catch $130 worth of fish, and his/her net income is $30 ($130 in income minus the $100 cost of the boat). If two villagers buy boats, then they catch $120 worth of fish each, and each earns a net income of $20. The average value of fish caught declines as additional villagers buy boats because they are all fishing in the same lake, and as each one depletes the fish population, it becomes increasingly difficult for others to find fish.

Imagine, first, that the villagers decide one at a time whether to purchase a boat or to invest in the government bond, and that the decisions are public. How many villagers will purchase boats? If a villager purchases the government bond, he/she will earn $15 interest income at the end of the year. He/she should only purchase a boat if his/her income from fishing is $15 or more. From the table, we can see that three villagers will purchase boats. After three boats are purchased, the fourth villager will see that his/her income from fishing will only be $10 and will choose to purchase a government bond. Total income in the village will be $90 per year. Three villagers will earn $15 each from fishing ($3 \times \$15 = \$45$), and three villagers will earn $15 each from bonds ($3 \times \$15 = \$45$).

Is this the socially optimal allocation of resources? Suppose that the villagers got together and decided collectively how to allocate their resources. To maximize village revenue, the villagers should invest in fishing boats only if the marginal contribution to village revenue exceeds the marginal cost. In this case, the cost of purchasing a boat is the opportunity cost of not purchasing the government bond, or $15. The table in Figure 28(b) calculates the marginal income from fishing for each additional fisherman. The marginal revenue generated by the first boat is $30. But the purchase of a second boat raises income from fishing only to $40, so the marginal contribution to village revenue is $10. The villagers should purchase just one boat. Total income will be $30 from fishing, plus $75 = $5 \cdot \$15$ from interest income, or $105.

FIGURE 30



SOURCE: Louis Johnston and Samuel H. Williamson, "What Was the U.S. GDP Then?" MeasuringWorth, 2020
URL: http://www.measuringworth.org/usgdp/. All values expressed in 2012 prices.

Real Output of the U.S. Economy, 1900–2019

impact of these events is dwarfed by the expansion of the size of the overall economy.

At the level of the overall economy, what we can consume is limited by what we produce. One reason for the rising level of production historically has been the growth in population. More people can produce more output. But output has grown much faster than population. Since 1900, the U.S. population has increased by a factor of more than four. Combining this information with the data in Figure 30 implies the average output per person has increased by a factor of nine. Figure 31 illustrates the growth of output per person. Economists refer to this quantity as output (GDP) **per capita**. The term "per capita" is a Latin phrase literally meaning "per head," which is commonly used to denote averages calculated for an entire population.

While average output per capita provides an indication of what the typical person can consume, economists are also interested in changes in what the average person can produce. The economy's total output divided by the total number of workers employed is called **average labor productivity**. This is a measure of how much the typical worker can produce. The second (higher) line in Figure 31 shows the history of average labor productivity since 1900.

The average output per person in the U.S. economy in 2019 was over $65,000. To put this figure in perspective, Figure 32 compares total output and output per person in the United States to a selection of other countries around the world. The range of variation in production per person is remarkably large. Despite having a population nearly five times as large as the United States, China's total production is only