Page One Economics® is an informative accessible essay on timely economic issues. The Teacher Edition provides the essay; student questions with answers; and additional lesson ideas for classroom, extra credit, or make-up assignments.

The Student Edition includes the essay and student questions; https://research.stlouisfed.org/publications/page1-econ/2017-03-03/the-productivity-puzzle_SE.pdf.

National Common Core State Standards (see pages 10-11)
Have you ever walked through a store and looked closely at where the products are made? If so, you might find yourself wondering if anything is manufactured in the United States anymore. As it turns out, manufacturing output in the United States is near its highest levels ever. In fact, the United States produces twice as much as it did in 1982, with one-third fewer workers (Figure 1).

Figure 1
Manufacturing Output and Employment

NOTE: The red line shows manufacturing output; the blue line shows employment in manufacturing. Starting in the 1980s, manufacturing employment started to fall, while output continued to rise.


Where Does Productivity Come From?
Here’s our riddle: How does an economy manufacture more goods with fewer workers? The answer lies in the economic concept of productivity. Productivity is the ratio of output per worker per unit of time. Increasing
productivity enables an economy to produce the same amount of output (or more) with fewer workers. In fact, productivity is key to raising the **standard of living**. Basically, a country can consume (buy) more goods and services per person if they produce more goods and services per person. But how does this happen? Economists say that changes in productivity are usually due to some combination of these factors:

1. **Increases in physical capital (both quantity and quality) per worker.** Physical capital (also known as capital resources and capital goods) are goods that have been produced and are used to produce other goods and services. They are used over and over again in the production process. For example, imagine an accountant keeping track of a corporation’s finances with an old-fashioned adding machine. Now, imagine the same accountant equipped with a computer and sophisticated software. In each case, one accountant is doing the work, but the output (and therefore productivity) will likely be higher with the computer and software.

2. **Increases in human capital per worker.** Human capital is the knowledge and skills that people obtain through education, experience, and training. Consider the accountant with her computer and software, but imagine she gets new software. Chances are she would benefit from training on the software, and her skills will grow further with experience. In a similar way, the education that students receive in school and college (and further training and work experience) is an important part of the productivity growth story.

3. **Technological change.** Technological change (also known as technological advancement) is an advance in overall knowledge in a specific area. For example, it could be the introduction of new production techniques or methods that allow firms to produce more output with the same amount of labor and physical capital. Technological change is the largest contributor to productivity.² Think about farming. One hundred years ago, a large portion of the American labor force worked on farms because food production was very labor intensive. But, due to large increases in productivity (because of new farming technology), more food is produced, while less than 2 percent of the labor force is now working in the agriculture sector of the economy.³

### Changing Productivity Over Time

Because productivity determines output, productivity is a major influence on a country’s rate of economic growth and standard of living. As such, it is very important economic data. From 1995 to 2010, U.S. productivity growth averaged 2.5 percent (Figure 2). Recently, however, productivity has declined—it averaged only 0.4 percent from 2011 to 2015.⁴ Lower productivity growth constrains a country’s economic growth and results in a slower increase in the standard of living.

Economists have suggested several theories for the productivity slowdown,⁵ and most of the analysis centers on changes in the three factors discussed above.

First, economists point to weak investment in capital stock. The capital stock is the total available physical capital in a nation. A nation can increase its capital stock through **investment.** The capital stock decreases due to capital depreciation, which is the amount of capital worn out or used up in producing a nation’s economic output. Currently, the capital stock has been growing at a slower rate. This means that the increase in capital per worker has been smaller than in previous periods and
that productivity will improve more slowly. Economists disagree about how much this piece explains the larger puzzle, with estimates ranging from 25 to 70 percent of the current slowdown in productivity.

Second, economists suggest that changes in human capital in the workforce are contributing to the change in productivity. Research suggests that rising levels of human capital explain about 20 percent of U.S. productivity growth from 1950 to 2007. Average educational attainment, which is the highest level of education that an individual has completed, has been growing at about one year per decade and has contributed about 0.6 percentage points to productivity growth per year. Most recently, educational attainment has slowed, which will (other things equal) likely contribute to slower productivity growth in the future.

Finally, some of the slowdown in productivity growth is likely due to a slowdown in technological change. Some economists speculate that even with advances in technology, some of the newer advances might impact productivity only slightly. For example, Twitter and Snapchat have great social value (and the companies themselves have a high market value), but they likely have little impact on labor productivity. In fact, some speculate that they might even reduce labor productivity because they distract workers from their jobs. A reality of technological change is that there is very often a long lag before it impacts productivity. For example, consider the series of inventions between 1860 and 1900, which included the electric light, electric motor, and internal combustion engine; telegraph and telephone; and indoor plumbing and sanitation. This burst of technological change has been called the Second Industrial Revolution. These inventions had an immediate effect, but they continued to dramatically increase productivity for six decades—from 1913 to 1972—as people found new ways to apply them. It has been proposed that the invention of the computer and internet might embody a Third Industrial Revolution in that the impact of these technologies will take years to play out as people find new ways to use them.

What’s Next?
If productivity stays at its current pace, slow growth in the standard of living and wages for workers is likely. Innovations are, however, by their very nature unpredictable. Some suggest that we could be one innovation away from a burst in productivity growth similar to the one from 1995 to 2004. Possible sources are the fields of robotics and artificial intelligence. Or the case could be, as proposed by some, that the age of large innovations (e.g., electrification and computers) is behind us and that productivity growth (and living standards) will likely increase little for the foreseeable future.

Can the Government Boost Productivity?
Economists concerned about the decrease in productivity suggest that government policy can play a role. Government spending on infrastructure (e.g., airports, highways, and bridges) could increase productivity because it reduces the cost (in time and money) of transporting goods and people from one place to another. Government could also increase productivity by increasing education spending, which increases the human capital of the workforce. In addition, tax reform that creates incentives for capital investment by private firms and more effective regulations could also increase productivity. Spending on R&D (research and development) could promote technological change, but more R&D does not always result in new technologies. And, because government intervention has costs, paying for these policies will result in higher taxes, larger budget deficits, or the loss of services currently enjoyed. The key piece of the productivity puzzle—technological change—is the most difficult to achieve because it is unpredictable.

Conclusion
U.S. productivity experienced rapid growth from 1995 to 2010, but it has slowed recently. Because productivity growth directly affects living standards and workers’ wages, economists have discussed many potential reasons for the slowdown. They have identified weak capital investment and a slowdown in educational attainment as causes but also a slowdown in technological change. Historically, the largest contributor to productivity growth has been technological change. Capital investment and educational attainment are easier to improve through investment and spending on education; however, technological change is more difficult to fix because it is inherently unpredictable.
Notes

5 Some economists suggest that productivity is not being properly measured in that traditional measurement strategies do not capture gains from newer technologies, while others suggest that if mismeasurement is a factor, it is tiny (See Fischer, Stanley. “Remarks on the U.S. Economy.” Federal Reserve Board of Governors. August 21, 2016; https://www.federalreserve.gov/newsevents/speech/fischer20160821a.pdf). Other economists suggest that the recent decrease in productivity is a return to normal productivity growth. Specifically, they say the acceleration of productivity from the mid-1990s to the early 2000s was an anomaly that should not be expected to continue.
6 Fischer (2016; see footnote 5).
9 See, for example, Blinder (2015; see footnote 7).
14 Powell (2016; see footnote 13).
16 Fischer (2016; see footnote 5).
17 Fischer (2016; see footnote 5).
After reading the article, complete the following:

1. Define productivity:

2. The *Page One Economics* essay identifies three factors that contribute to productivity. Describe the key aspects of each by completing the table below.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Definition</th>
<th>How does it contribute to the productivity slowdown?</th>
<th>How could government play a role?</th>
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<tbody>
<tr>
<td>Physical capital</td>
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<td>Human capital</td>
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<td>Technological change</td>
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</tbody>
</table>
3. How is productivity related to a country's standard of living?

4. What are the potential risks of using government policy to try to increase productivity?
Teacher’s Guide

Federal Reserve Bank of St. Louis Page One Economics®:
“The Productivity Puzzle”

After reading the article, complete the following:

1. Define productivity:
   Productivity is the ratio of output per worker per unit of time.

2. The Page One Economics essay identifies three factors that contribute to productivity. Describe the key aspects of each by completing the table below.

<table>
<thead>
<tr>
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<th>How does it contribute to the productivity slowdown?</th>
<th>How could government play a role?</th>
</tr>
</thead>
</table>
| **Physical capital**      | Goods that have been produced and are used to produce other goods and services | The capital stock has been growing at a slower rate, so productivity will improve more slowly. | Increase spending on infrastructure  
Enact policies to create incentives for capital investment |
| **Human capital**         | The knowledge and skills that people obtain through education, experience and training | Human capital (educational attainment) is growing at a slower rate. As educational attainment slows, productivity growth will slow also. | Spend more on education |
| **Technological change**  | An advance in overall knowledge in a specific area                          | It could be that technology is having a smaller impact on labor than previous technological changes or that there is a lag between new technology and productivity growth. | Increase funding for research and development |
3. How is productivity related to a country’s standard of living?
   A country can consume (buy) more goods and services per person if they produce more goods and services per person.

4. What are the potential risks of using government policy to try to increase productivity?
   Spending on research and development does not always result in technological change. Because government intervention has costs, paying for these policies will result in higher taxes, larger budget deficits, or the loss of services currently enjoyed.
Additional Resources

Econ Lowdown® of the Federal Reserve Bank of St. Louis provides numerous economic education resources for teachers to use with their students. These include lesson plans, online modules, interactive whiteboard lessons, podcasts, and videos. These free resources are available at [https://www.stlouisfed.org/education](https://www.stlouisfed.org/education).

Use the Econ Lowdown classroom resources listed below to help teach about topics related to this issue of *Page One Economics*. To register your students for one or more of our online courses, on the Econ Lowdown website (linked above), click the “TEACHERS” button to create or access your account and visit the Instructor Management Panel.

**What Are the “Ingredients” for Economic Growth? (Page One Economics Classroom Edition)**

Is there a recipe for economic growth? Perhaps some Miracle-Gro for the economy? If only it were that easy. While the exact recipe is a mystery, economists have identified some of the key ingredients. This issue discusses the role that economic institutions play in fostering long-term economic growth.


**Economic Growth—The Economic Lowdown Podcast Series, Episode 15**

Have you encountered mobile payment systems like mobile credit card readers? Pretty cool—and this kind of innovation can be good for the economy. From micro to macro, this episode takes a look at economic growth—how innovation and technological progress can make things happen for the economy over time by organizing the factors of production to be, well, more productive.


**Economic Growth, Online Course for Teachers and Students**

Our standard of living depends on the pace of economic growth. That pace can be enhanced through increased productivity brought about by investment in physical and human capital and advances in technology. In this course, students learn about these tools, which increase productivity and advance our standard of living.

[https://www.stlouisfed.org/education/economic-growth-online-course-for-teachers-and-students](https://www.stlouisfed.org/education/economic-growth-online-course-for-teachers-and-students)

**The Production Possibilities Frontier—The Economic Lowdown Video Series, Episode 8**

Have you been to a frontier lately? Whether you realize it or not, the economy has a frontier—it has an outer limit of economic production. This video explains how the production possibilities frontier (PPF) illustrates some very important economic concepts.

National Standards

Common Core State Standards

Grades 6-12 Literacy in History/Social Studies, Science, and Technical Subjects

- **Key Ideas and Details**
  
  RH.11-12.1: Cite specific textual evidence to support analysis of primary and secondary sources, connecting insights gained from specific details to an understanding of the text as a whole.
  
  RH.11-12.2: Determine the central ideas or information of a primary or secondary source; provide an accurate summary that makes clear the relationships among the key details and ideas.

- **Integration of Knowledge and Ideas**
  
  RH.11-12.7: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, as well as in words) in order to address a question or solve a problem.

- **Research to Build and Present Knowledge**
  
  WHST.11-12.7: Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

Grades 6-12 Reading Standards for Informational Text

- **Key Ideas and Details**
  
  RI.9-10.2: Determine a central idea of a text and analyze its development over the course of the text, including how it emerges and is shaped and refined by specific details; provide an objective summary of the text.
  
  RI.11-12.1: Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.

Voluntary National Content Standards

**Standard 6: Specialization**

When individuals, regions, and nations specialize in what they can produce at the lowest cost and then trade with others, both production and consumption increase.

- **Benchmarks: Grade 8**
  
  1. Labor productivity is output per worker.

**Standard 15: Economic Growth**

Investment in factories, machinery, new technology, and in the health, education, and training of people stimulates economic growth and can raise future standards of living.

- **Benchmarks: Grade 8**
  
  1. Standards of living increase as the productivity of labor improves.
  
  2. Productivity is measured by dividing output (goods and services) by the number of inputs used to produce the output. A change in productivity is a change in output relative to input.
3. Technological change results from an advance in knowledge leading to new and improved goods and services and better ways of producing them.

4. Increases in productivity can result from advances in technology or increases in physical or human capital.

- **Benchmarks: Grade 12**

1. Economic growth is a sustained rise in a nation’s production of goods and services. Long term growth in output results from improvements in labor productivity and increases in employment. It varies across countries because of differences in investments in human and physical capital, research and development, technological change, and from alternative institutional arrangements and incentives.

2. Historically, economic growth that raises per capita output has been a vehicle for alleviating poverty and raising standards of living.

3. Investing in new physical or human capital can increase future productivity and consumption, but such investments require the sacrifice of current consumption and entail economic risks.

5. The rate of productivity increase in an economy is strongly affected by the incentives that reward successful innovation and investments (in research and development, and in physical and human capital).