

# Analyzing the Components of Real GDP in FRED® Using Stacking



TOOLS for TEACHING  
with FRED®

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## Standards and Benchmarks (see page 9)

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## Description

This online activity shows how to use FRED®, the Federal Reserve’s free online economic data website, to analyze changes in real gross domestic product (GDP) and its makeup over time. Following simple instructions, you will locate spending data for the individual components of real GDP—a measure of an economy’s total output of final goods and services for a given year. You will then combine these data into a highly informative area graph. You will also use FRED®’s ability to stack data and see how trade—imports and exports—contributes to GDP. The resulting customized graph will let you see how economic output varies from year to year.

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## Economic Concepts

**Balance of trade:** The difference between a country’s total exports and total imports; also known as net exports.

**Boom:** A period characterized by sustained increases in several economic indicators—for example, output, investment, and employment.

**Chained 2017 dollars:** A dollar measure that is adjusted for price changes occurring since 2017; measuring expenditures in chained dollars allows comparison of dollar amounts from different years.

**Exports:** Goods and services that are produced domestically but sold abroad.

**Government expenditures:** Purchases of goods and services by government.

**Imports:** Goods and services that are produced abroad but sold domestically.

**Inflation:** A general, sustained upward movement of prices for goods and services in an economy.

**Investment:** The purchase of physical capital goods (e.g., buildings, tools, and equipment) that are used to produce goods and services.

**Net exports:** The value of exports minus imports.

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**Nominal gross domestic product (GDP):** The total market value of all final goods and services produced in an economy in a given year, expressed using the current year's price for goods and services; also known as current-dollar GDP.

**Personal consumption expenditures:** A measurement of goods and services purchased by US residents.

**Real gross domestic product (real GDP):** The total market value of all final goods and services produced in an economy in a given year calculated by using a base year's price for goods and services; nominal gross domestic product (GDP) adjusted for inflation.

**Recession:** A period of declining real income and rising unemployment; a significant decline in general economic activity extending over a period of time.

**Seasonally adjusted:** Data adjusted mathematically to remove the repeating up-and-down patterns in economic activity that occur during a typical calendar year, such as extra retail workers hired for the holidays.

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## Objectives

Students will be able to

- distinguish between nominal and real dollar values,
- assess the relative magnitudes of aggregate expenditure categories, and
- observe the fluctuations in components of GDP over time.

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## Grade Level

Grades 8-12

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## Compelling Question

How does a stacked graph show the separate components of real gross domestic product?

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## Time Required

15-30 minutes

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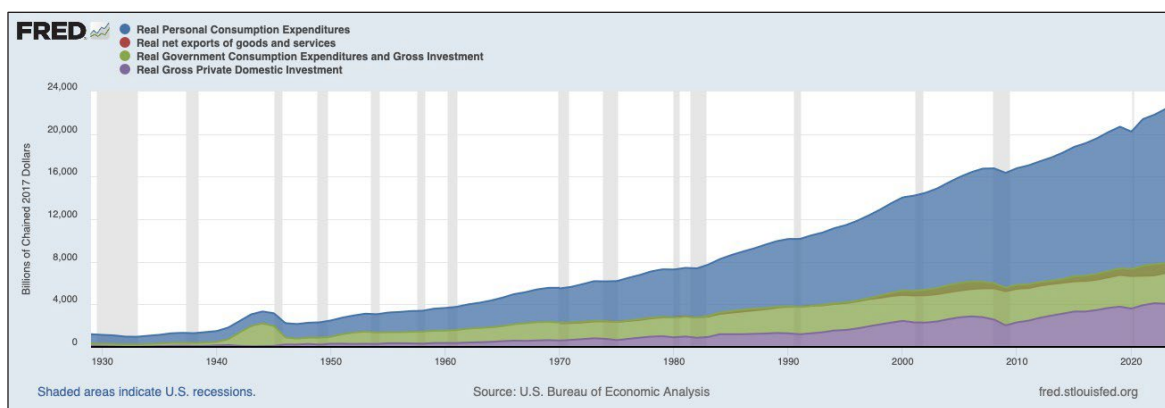
## Preparation

- Make sure you are comfortable navigating FRED®, finding values for data series used in this lesson, and identifying data sources. A demonstration is located here: <https://fredhelp.stlouisfed.org/>.
- Go to <https://federalreserveeducation.org/resources/economics/gdp/gross-domestic-product> to review the definition of gross domestic product.

## Procedure

1. **Open a web browser and navigate to the FRED® website:** <https://fred.stlouisfed.org/>. (Or just search the internet for FRED®.)
2. **Create a graph** on the website by following these steps:
  - In the “Browse Data By:” section, follow these links: Release > Gross Domestic Product > SECTION 1 - DOMESTIC PRODUCT AND INCOME > Table 1.1.6. Real Gross Domestic Product, Chained Dollars > Annual.
  - Select the following concepts by clicking on the box to the left of their names:
    - “Personal consumption expenditures”
    - “Gross private domestic investment”
    - “Net exports of goods and services”
    - “Government consumption expenditures and gross investment”
  - Plot the data series by clicking on the gray “Add to Graph” button.
  - Click on the orange “EDIT GRAPH” button and select the “FORMAT” tab.
  - Change “Graph type” to “Area.”
  - Change “Stacking” to “Normal.”
  - Your final graph will look like this one:

### Real Gross Domestic Product Components



SOURCE: US Bureau of Economic Analysis via FRED®, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/graph/?g=1cKSH>, accessed February 1, 2024.

3. **Explain the following:**
  - **Source:** Data on US gross domestic product is reported by the US Bureau of Economic Analysis (BEA). The BEA is an agency of the Department of Commerce that produces economic account statistics that enable government and business decisionmakers, researchers, and the American public to follow and understand the performance of the nation’s economy.

- **Units:** Data are reported in “Billions of Chained 2017 Dollars.” Further, they are reported with “Annual” frequency.
- **Series:** Each area in the graph shows the sum of goods and services purchased by four types of final users:
  - “Personal consumption expenditures” (also referred to as consumption or C) are the goods and services purchased by persons.
  - “Gross private domestic investment” (also referred to as investment or I) is the sum of private fixed investment and change in private inventories. It is measured without subtracting the value of capital depreciation.
  - “Net exports of goods and services” (also referred to as net exports or NX) are the exports of goods and services minus imports of goods and services.
  - “Government consumption expenditures and gross investment” (also referred to as government spending or G) are the value of services produced by government, measured as government purchases of labor inputs, intermediate goods and services, and investment expenditures.

4. **Interpret the data in the graph** by discussing the following:

- This activity uses real rather than nominal data. In this case, real means adjusted for inflation. As you may already have learned, prices tend to rise over time because of inflation. To compare GDP dollar values for different years and avoid measurement distortions from inflation, we use real GDP values. Each of the five data series used in this activity is reported in chained 2017 dollars, a real measure adjusted for changes caused by inflation. Pricing each year’s total dollar value of final goods and services in 2017 dollars guarantees that differences in output from year to year resulted from factors other than inflation.
- The inflation-adjusted dollar values stretch back to 1929, when the data are first available. The steady increase in consumer expenditures shown on the graph is not the result of inflation—these are the real increases in consumer spending from year to year.
- Hover your cursor over the far-left side of the graph until you see “1929 [dollar figure]” displayed in a box. In 1929, domestic consumers spent on final goods and services almost three times what firms and the government, combined, spent on goods and services. Move your cursor to the right and you will see data displayed for each year along the line.
- Net exports account for the ins and outs of international trade—that is, imports and exports. Some of the goods and services purchased by domestic consumers and firms (imports) are produced outside the United States. Similarly, some of the goods and services produced by US residents and firms (exports) are purchased outside the United States. Net exports (in dollars) are exports minus imports. It is important to calculate net exports so that real GDP is not overstated or understated.
- The value of inflation-adjusted net exports was first reported by the BEA in 1970. Data on non-inflation-adjusted net exports are available since 1929.

5. **Developing discussion prompts and questions:** Graphs, through a variety of visual configurations, can present large amounts of data in a compact area. When developing questions that depend on graphic depictions of data, consider how well the graph displays the relationship between two or more variables. FRED® hosts thousands of data time series, and each one can be displayed in multiple graphing formats (e.g., line, area, or bar). These datasets are called “time series” because each one reports a value on a linear time scale at a specific frequency (e.g., daily or annually). In other words, FRED® graphs show how one or more variables changed over time.

Graphs, of course, provide a visual prompt for discussions about data relationships. FRED® graphs, each with a horizontal time axis, provide historical context, which is a crucial dimension for analyses, questions, and discussions. Discuss the following related to the final area graph of real GDP and its components created above (<https://fred.stlouisfed.org/graph/?g=1cKSH>):

- According to the graph, how has any one component changed over time? (*Real expenditures by consumers, governments, and firms have all increased; real net exports—sometimes called “the balance of trade”—have generally been negative.*)
- The graph shows that inflation-adjusted US net exports have been negative since the mid-1970s. Why do you think Americans spend more on foreign goods and services than foreigners spend on US exports? (*Answers will vary but may include the following: Tastes for US-produced goods have declined; prices of foreign goods are lower; some countries restrict US imports; and relatively faster-growing US incomes make Americans better able to afford more goods—including imported ones.*)
- The gray bars on your graph show recessions (periods of declining real income and rising unemployment; a significant decline in general economic activity extending over a period of time). At the time of this writing and since 1929, there have been 15 such periods in the United States. Is there a pattern in private firms’ spending before and during a recession? (*Typically, businesses cut capital spending immediately before and during a recession as they become pessimistic about future prospects and real gross private domestic investment declines.*)

6. **Customizing the FRED® graph:** An additional way to analyze the data shown in FRED® is to observe the change in relative shares from period to period, which often reveals significant shifts in a trend. Instructions to change the “Stacking” setting from “Normal” to “Percent” are included below. The resulting graph is <https://fred.stlouisfed.org/graph/?g=1cLaa>. That graph shows the percent share of each data series graphed. Discuss the following:

- Focus on what appear to be the highest and lowest values for the government spending component and hover over those points, looking at the percentages shown.
- What possible explanations are there for the changes in the share that government spending contributes to real GDP? (*Accept all reasonable answers.*)

7. **Additional discussion prompts:**

- Government consumption and investment spending (for all levels of government) peaked as a percentage of real GDP in 1944 (at 64%) and has trended steadily downward to the present day. (Many students will likely be surprised by this finding.) This category includes

government spending on goods and services at all levels—both national defense (a responsibility of national government) and public education expenditures (funded primarily by state and local governments).

- Including government spending on goods and services is central to the determination of any calculation of GDP, real or nominal. While government payments such as Social Security and welfare make up a large part of our national government’s budget, these transfer payments are not made in return for goods and services, so they are not included in GDP expenditures. Close examination of the graph shows that the government portion of real GDP peaked at the time of high defense spending during World War II. Moreover, the government spending share of US real GDP has remained below 25% since the collapse of the Soviet Union, declining steadily to the present day, around the 16% range.

8. **Make the most out of the FRED® website** by noting the following:

- Each data series in FRED® has a series ID. For example, the series ID for “Real Personal Consumption Expenditures” is PCECCA. Each series in FRED® has a dedicated webpage, like this one: <https://fred.stlouisfed.org/series/PCECCA>.
- Changing the “Stacking” option to “Percent” shows the proportion of total GDP represented by each of its components. That graph looks like <https://fred.stlouisfed.org/graph/?g=1cLaa>. Note that data units are now percents and that their sum only equals 100 when net exports are zero or larger than zero. When net exports are negative the stacked areas don’t add up to 100.
- You can easily save any FRED® graph by creating a (free) FRED® account. (Just click “My Account” in the top-right corner of the website and fill in the fields in the “Create New Account” tab.) To save your graph, click “Account Tools” under the graph and follow the prompts. You may name a graph anything you choose, and you can create categories for sorting your graphs. You also can set the observation range to graph all new data as they become available, or you can limit the range to specific dates.
- To recall a saved graph, once you have signed into your FRED® account, you will see “My Account” at the top of the page. Click on this and select “Graphs” from the drop-down menu. Titles of all the graphs you have created and saved will appear along with other information about the graphs. You can create categories for new and existing graphs.
- You can share FRED® graphs via permanent links. Click “Share Links” under a graph to access the following sharing options:
  - “Page short URL” provides a URL that links to FRED® and the specific graph you created.
  - “Embed in website” inserts the graph you created and when clicked links back to FRED®, allowing the viewer to use FRED®’s interactivity. This option also provides a link to download the graphed data directly.
  - “Image short URL” provides a link to the image of the graph.
  - Click the clipboard icon to copy the link you created.
- The icons shown under the graph allow you to share your graphs through social media, such as X (formerly Twitter) and Facebook. Select an option and follow the prompts.

- Click the blue “DOWNLOAD” button above the graph to access your downloading options. The “Excel (data)” option downloads the “raw” data in the form of a Microsoft Excel spreadsheet. Other download options are a .csv file, a high-quality .png image, a hyperlinked PowerPoint slide, or a high-quality PDF. Choose the option that best meets your needs.

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## Closure

9. Review the purpose of the activity with the following:
  - The purpose of the activity was to provide an easy way for you to learn about FRED®’s ability to create custom graphs and view data in different forms.
  - To help you reach that goal, you created a stacked area graph of real GDP and its separate components.
  - You encountered additional concepts during this activity, including real versus nominal, chained 2017 dollars, and personal consumption expenditures. And you considered reasons that could explain fluctuations in components of GDP, including the US negative balance of trade.
  - Finally, you created a real GDP area graph showing what percent each of the main categories contributed to the total value of real GDP.



## Assessment

1. Open a web browser and navigate to the FRED® graph <https://fred.stlouisfed.org/graph/?g=1cWfz>.
2. Examine the graph and answer the following questions:
  - a. What country's GDP data are these?
  - b. What is the source of the data?
  - c. What are the units of the data?
  - d. Are the data series stacked normally or in percent?
  - e. Are the components of GDP measured in nominal or in real euros?
  - f. Which component of GDP is the largest?
  - g. In what years were net exports of goods and services minus imports of goods and services (i.e. net exports) negative?

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## Assessment—Answer Key

1. Open a web browser and navigate to the FRED® graph <https://fred.stlouisfed.org/graph/?g=1cWfz>.
2. Examine the graph and answer the following questions:
  - a. What country's GDP data are these? (*Germany*)
  - b. What is the source of the data? (*The Organization for Economic Co-operation and Development [OECD]. This is another data aggregator, similar to FRED®.*)
  - c. What are the units of the data? (*Chained 2010 Euros, Seasonally Adjusted*)
  - d. Are the data series stacked normally or in percent? (*In percent*)
  - e. Are the components of GDP measured in nominal or real euros? (*In real euros*)
  - f. Which component of GDP is the largest? (*Consumption*)
  - g. In what years were net exports of goods and services minus imports of goods and services (i.e., net exports) negative? (*In 1992 and 1994*)



## Standards and Benchmarks

### Voluntary National Content Standards in Economics

#### 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 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.

#### Standard 18: Economic Fluctuations

Fluctuations in a nation's overall levels of income, employment, and prices are determined by the interaction of spending and production decisions made by all households, firms, government agencies, and others in the economy. Recessions occur when overall levels of income and employment decline.

- **Benchmarks: Grade 8**

1. GDP is a basic measure of a nation's economic output and income. It is the total market value, measured in dollars, of all final goods and services produced in the economy in one year.
2. GDP can be computed by summing household consumption spending, investment expenditures, purchases by federal, state, and local governments, and net exports.
3. Net exports equal the value of exports (goods and services sold to other countries) minus the value of imports (goods and services bought from other countries). Net exports can be either positive (trade surplus) or negative (trade deficit).
7. A recession occurs when overall levels of income and employment decline.

- **Benchmarks: Grade 12**

3. A business cycle involves fluctuations of real GDP around its potential level.
4. Fluctuations of real GDP around its potential level occur when overall spending declines, as in a recession, or when overall spending increases rapidly, as in recovery from a recession or in an expansion.