

# Analyzing the Elements of Real GDP in FRED<sup>®</sup> Using Stacking

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## Introduction

This online activity shows how to use FRED<sup>®</sup>, 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<sup>®</sup>'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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## Concepts

### Boom

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

### Balance of trade

The difference between a country's total exports and total imports; also known as net exports

### Chained 2009 dollars

A dollar measure that is adjusted for price changes occurring since 2009; measuring expenditures in chained dollars allows comparison of dollar amounts from different years

### Exports

Goods and services bought by people in other countries

### Government expenditures

Purchases of goods and services by government

### Imports

Goods and services produced in other countries

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**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**

U.S. exports minus U.S. imports

**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 (PCE)**

Personal consumption expenditures measures goods and services purchased by U.S. residents

**Real gross domestic product (RGDP)**

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; significant decline in general economic activity extending over a period of time

**Seasonally adjusted**

Data adjusted mathematically to remove the dips and bumps caused by seasonal events, such as extra retail workers hired for the holidays

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## Getting Started

1. Begin by viewing the "Introduction to FRED®" video at <http://fredqa.stlouisfed.org/2014/02/27/video-introduction-to-fred/> and then continue as follows.
2. Navigate to the FRED® website: <http://research.stlouisfed.org/fred2/>. Or just search the Internet for FRED®. Select the link that says "Federal Reserve Economic Data—FRED—St. Louis Fed." It will probably be the first link on the list.
3. 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 due to 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

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is reported in chained 2009 dollars, a real measure that ignores changes caused by inflation. Pricing each year’s total dollar value of final goods and services in 2009 dollars guarantees that differences in output from year to year resulted from factors other than inflation.

## Getting the Data

1. On the FRED® website, click in the search bar at the top-right corner of the page. Type “real personal consumption expenditures” and hit “Enter.” Your search should return results similar to those shown in Figure 1.
2. Under “Real personal consumption expenditures,” click the box next to “Billions of Chained 2009 Dollars, Quarterly, Seasonally Adjusted Annual Rate.” Notice that this series, which measures goods and services purchased by U.S. residents, is reported in “Billions of chained 2009 dollars.” Further, it is reported “Quarterly” and at a “Seasonally Adjusted Annual Rate.” Using seasonally adjusted data smooths out the dips and bumps that occur during a typical calendar year.

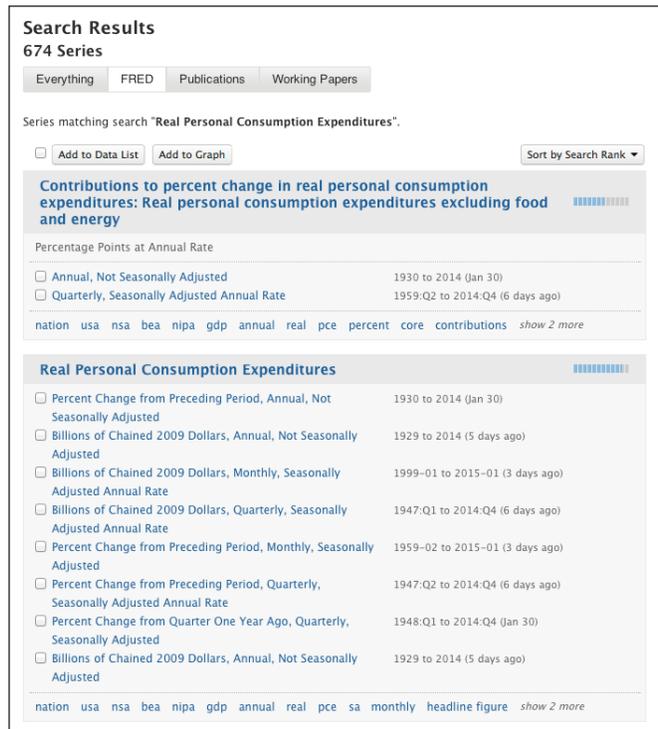


Figure 1

3. Click “Add to Graph” (the gray box above the data lists). FRED® automatically creates an up-to-date line graph with inflation-adjusted dollar values stretching back to 1947. The steady increase in U.S. consumer expenditures shown on the graph is not the result of inflation—these are the real increases in consumer spending from year to year.
4. Check out FRED®’s mouse-over data display. Hover your cursor over the far-left side of the graph until you see “1947 Q2: 1,219.3” displayed in a box. So, in the second quarter of 1947, domestic consumers spent about 1.2 trillion dollars on final goods and services (measured in 2009 dollars). Move your cursor to the right and you will see data displayed for each year along the line.

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- You are now going to add a second consumption expenditures data line for all levels of government—national, state, and local. This broad category includes government spending on its workforce and goods and services, such as fuel for military jets, rent for government buildings, and items such as new highways, schools, and computers. Government spending is second only to consumer spending.

Under the “Graph” tab, select “Add Data Series.” In the search bar, type “real government consumption expenditures and gross investment quarterly seasonally adjusted.” Two data series names will appear (Figure 2). Notice that when you move the cursor, the data series you hover over is highlighted.



Figure 2

- Also notice the codes at the end of the data descriptions—“GCEC96” and “GCEC1.” Every data series in FRED® has a unique code called a series ID. Make sure the “GCEC96” series is highlighted and then click it. Now click the blue “Add Series” box. Your graph updates automatically, adding the new line in red.

- Real GDP also includes a category for investment spending by private firms on physical capital—for example, buildings and machinery used to produce goods and services. This category also includes spending on new residences.

Click “Add Data Series” again. In the search bar, type “real gross private domestic investment quarterly seasonally adjusted.” Select the series with the series ID GPDIC1 and click the blue “Add Series” box. Your graph should now look like Figure 3. (If you want to know more about what is included in this category, see <http://www.bea.gov/national/pdf/nipaguid.pdf>.)

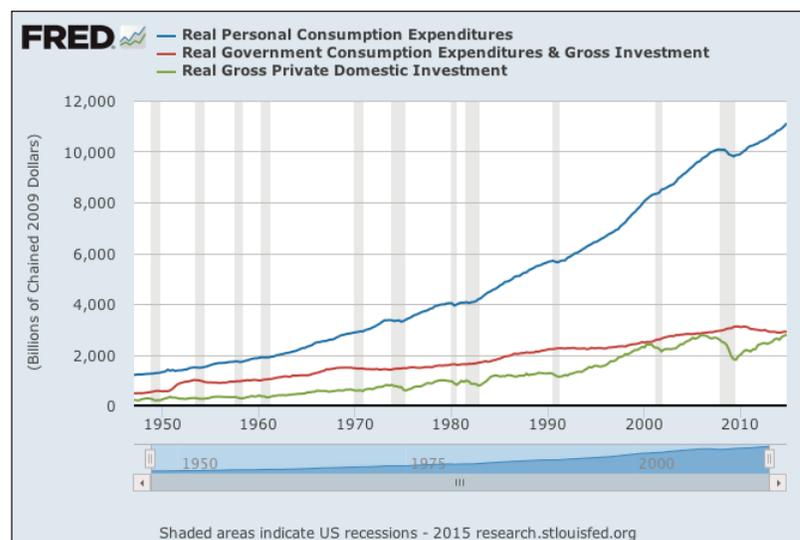


Figure 3

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8. A fourth real GDP category—net exports—accounts 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 U.S. 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. FRED® allows you to easily calculate net exports from imports and exports data series. Simply stated, you will take the dollars spent on U.S. exports and subtract the dollars Americans spent on imports. If the imports dollar value is larger, net exports will be negative.

Return to your FRED® graph and again click “Add Data Series.” In the search bar, type “real exports of goods and services seasonally adjusted.” Find “Real Exports of Goods and Services” (EXPGSC1)—and then click the blue “Add Series” box. Your graph should now look like Figure 4. To create net exports, you will now transform the data as described in the next section.

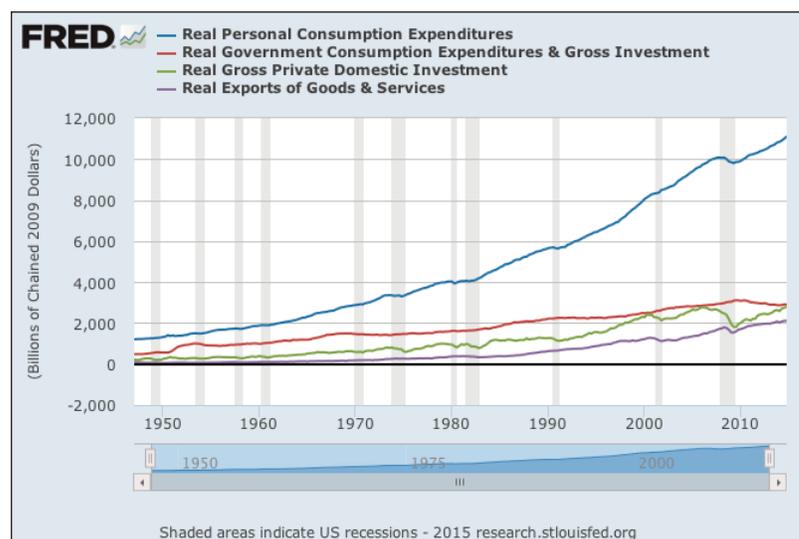


Figure 4

## Transforming the Data

1. FRED® allows you to use a formula to modify and combine two or more data series into a single line. Again, click “Add Data Series.” In the search bar, type “real imports of goods and services.” Scroll down and click on the series in the list with series ID IMPGSC1.

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2. Now—and this is really important—click the “Modify existing series” option (under the search bar). In the drop-down menu select “Data Series 4.” This selection tells FRED® that you want to use the series just selected (Real Imports, IMPGSC1) to modify Data Series 4, (Real Exports, EXPGSC1). Your screen should now look like Figure 5.

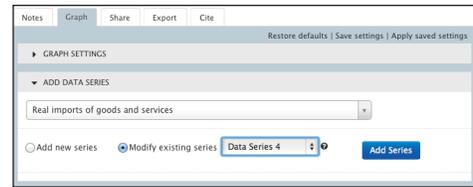


Figure 5

3. Now click “Add Series.” Your screen should now look like Figure 6.

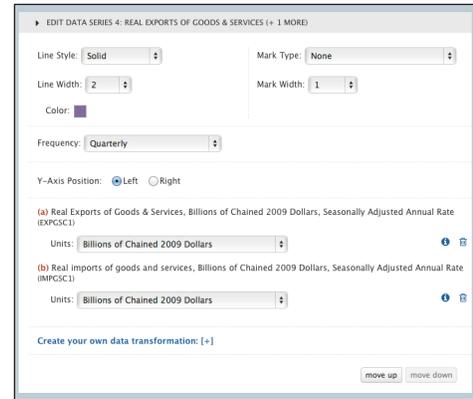


Figure 6

4. To calculate net exports, click “Create your own data transformation: [+].” In the “Formula” bar that appears, type “a-b.” This formula tells FRED® to subtract the “b” series (real imports, IMPGSC1) from the “a” series (real exports, EXPGSC1) to create a new data line (which will replace the current Data Series 4 line). Your screen should now look like Figure 7.

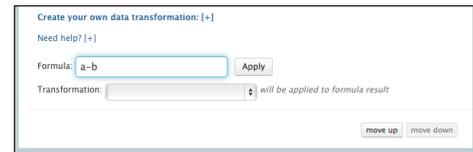


Figure 7

5. Click “Apply.” Your graph automatically updates and should now look like Figure 8.

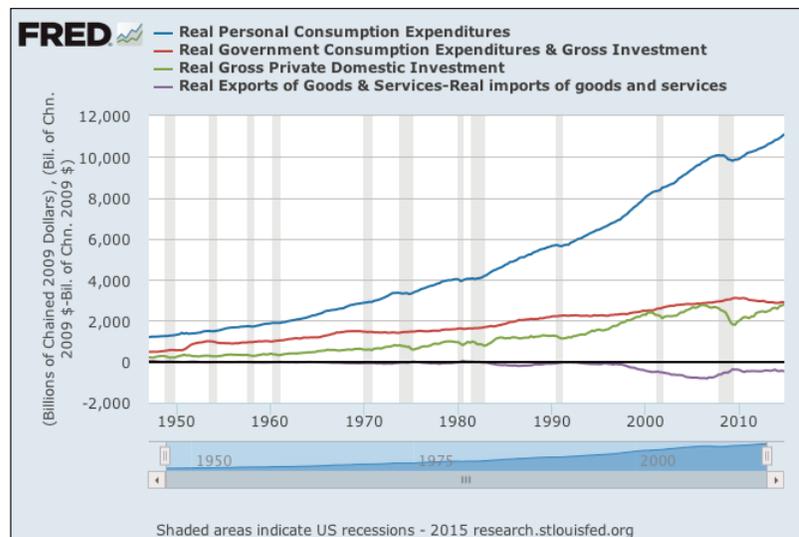


Figure 8

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## Stacking the Data

1. To change from a line graph to an area graph, under the “Graph” tab, click “GRAPH SETTINGS.” Go to the “Graph type” drop-down menu and select “Area.” Your graph changes to an area graph.
2. You have now graphed all of the individual components of U.S. real GDP, but they have not yet been combined into a total value. Does FRED® have the capability to perform this function? Of course! First, notice the values on the y-axis. With the next action, these values will change to accommodate the total value of all of the components.

Go to the “Stacking” drop-down menu (below “Graph type”) and select “Normal.” Your graph changes to create the total value. Notice the increase in the y-axis values. You have now created a graph showing total real GDP and the values of each of its subparts: consumer spending, government spending, private sector spending, and spending outside the United States on U.S. goods (exports). Your graph should now look like Figure 9.

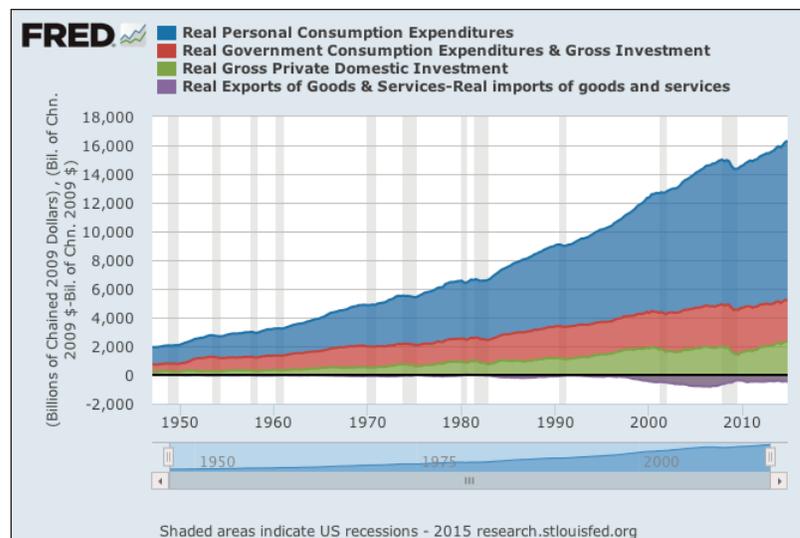


Figure 9

## Saving and Recalling Your Graph

1. With a (free) FRED® account, you can easily save any FRED® graph. (To create an account, follow the steps outlined in the “Introduction to FRED®” video link in the “Getting Started” section.) To save your graph, click “Save Graph” in the left-hand column menu and follow the prompts. You may give a graph any name you choose, and you can

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create categories for sorting your graphs. As shown in Figure 10, 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 logged in, you will see your “My Account” page. Click “Saved Graphs” from the gray menu bar near the top of the page. Alternatively, if you are already working in FRED®, click “MY ACCOUNT” in the top-right corner and select “MY GRAPHS” from the drop-down menu. From either option, titles of all the graphs you have created will appear along with other information about the graphs. You can create categories for new and existing graphs.

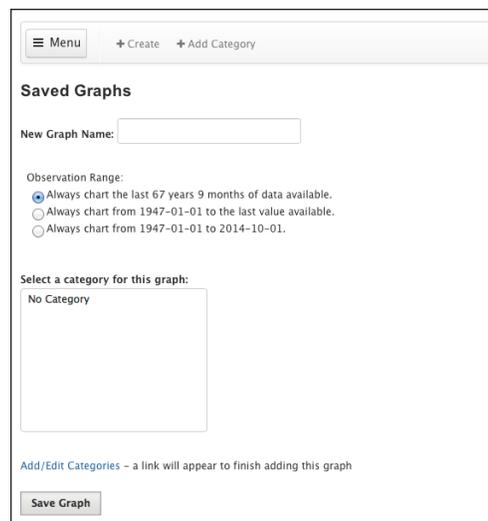


Figure 10

## Sharing Your Graph

- You can share FRED® graphs via permanent links. Click the “Share” tab under the graph to access the sharing options.
- The icons shown first allow you to share your graphs through Twitter, Facebook, Google Plus, and email. Select an option and follow the prompts.
- The next three options provide permanent links that can be copied and pasted:
  - “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.
  - “Link” provides a URL that links to FRED® and the specific graph you created.
  - “Image” provides a link to the image of the graph.

## Printing Your Graph and Downloading the Data

- Click the “Export” tab under the graph to access your exporting options.
- Under “Graph Data,” click “Download as XLS” to download the “raw” data in the form of a Microsoft Excel spreadsheet.

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3. Under “Graph Image” you will see these options: Print, Export as PDF, Export as PNG, Export as JPG, and Export as SVG. Choose the option that best meets your needs.

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## Developing Questions and Discussion

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® currently hosts well over 200,000 time series of data, 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, with their horizontal time axis, provide historical context, a crucial dimension for analysis, questions, and discussions. The following questions relate to the final area graph of real GDP and its components created above (Figure 9).

1. Study the graph and describe how any one component changed over time. (*Expenditures by consumers, governments, and firms have all increased; net exports—sometimes called “the balance of trade”—have trended from slightly positive in the late 1940s, to slightly negative, to significantly negative for the past two decades or so.*)
2. The graph shows that U.S. net exports have been negative since the mid-1970s. Ask students to suggest reasons why Americans spend more on foreign goods and services than foreigners spend on U.S. exports. (*Answers will vary, but may include the following: Tastes for U.S.-produced goods have declined; prices of foreign goods are lower; some countries restrict U.S. imports; and relatively faster-growing U.S. incomes make Americans better able to afford more goods—including imported ones.*)
3. 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). Since 1947 there have been 11 such periods in the United States. Ask students if they see 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.*)

An additional way to analyze the data shown in FRED® is to change the units to “Percent Change” from period to period. Looking at a variable through the percent change lens often exposes abrupt shifts in a trend.

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4. Return to FRED® and your real GDP components graph. Under the “Graph” tab, select “GRAPH SETTINGS.” Change the “Stacking” setting from “Normal” to “Percent.” Your graph now shows the percent share of each data series graphed. Ask students to 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.
5. Ask students what possible explanations there are for the changes in the share government spending contributes to real GDP. (*Accept all reasonable answers.*)
6. Government consumption and investment spending (for all levels of government) peaked as a percentage of real GDP during the early 1950s (at 36 percent) 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 (which is funded primarily by state and local governments) expenditures. 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 in times of high defense spending during wars in Korea and Vietnam. Moreover, the government spending share of U.S. real GDP has remained below 25 percent since the collapse of the Soviet Union, declining steadily to the present-day 17 percent.

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## Conclusion

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 also derived the correct quantity of net exports by subtracting real imports data from real exports data. You encountered additional concepts during this activity, including real versus nominal, chained 2009 dollars, and personal consumption expenditures. And you considered reasons that could explain fluctuations in components of GDP, including the U.S. negative balance of trade. Finally, you created a real GDP area graph showing the percent each of the main categories contributed to the total value or real GDP.