BOSTON UNIVERSITY
Global Development Policy Center
Economics in Context Initiative

# Chapter 2: Foundations of Economic Analysis

## Appendix

*Appendix to Chapter 2 of Essentials of Economics in Context, Second Edition*

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# APPENDIX: GRAPHING REVIEW

This review covers the two most common ways that economic data are presented in this book. The first way is in a table, such as Table 2A.1, which presents time-series data on the annual real growth rate of GDP and the annual average unemployment rate for the U.S. economy over the period 2011-2023. We can determine from the table, for example, that in 2016 the unemployment rate was 4.9 percent and real GDP grew at a rate of 1.8 percent.

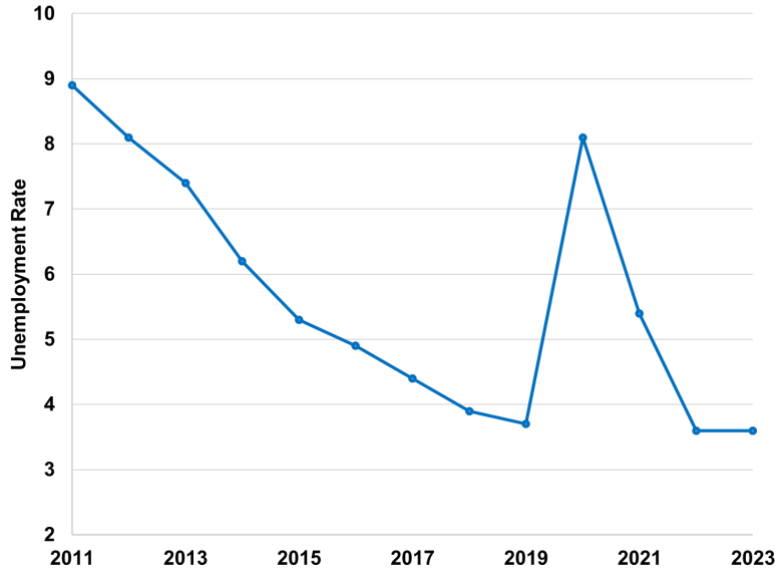
**Table 2A.1 Unemployment Rate and Real GDP Growth Rate, United States, 2011–2023 (in percent)**

| Year | Unemployment rate | Real GDP growth rate |
|---|---|---|
| 2011 | 8.9 | 1.6 |
| 2012 | 8.1 | 2.3 |
| 2013 | 7.4 | 2.1 |
| 2014 | 6.2 | 2.5 |
| 2015 | 5.3 | 2.9 |
| 2016 | 4.9 | 1.8 |
| 2017 | 4.4 | 2.5 |
| 2018 | 3.9 | 3.0 |
| 2019 | 3.7 | 2.5 |
| 2020 | 8.1 | -2.2 |
| 2021 | 5.4 | 5.8 |
| 2022 | 3.6 | 1.9 |
| 2023 | 3.6 | 2.5 |

*Sources*: U.S. Bureau of Economic Analysis and U.S. Bureau of Labor Statistics.

While tables can present detailed numerical data, it is not always easy to determine the overall trends over time using a table as unemployment is rising in some years and falling in others. Instead, it is often useful to present data in visual form, using graphs, to "see" what is happening in an economy more clearly. Figure 2A.1 presents a time-series graph of the unemployment rate. Graphs have a horizontal axis (also called the "*x*-axis") and a vertical axis (also called the "*y*-axis"). It is common practice to present time-series data with the time intervals on the *x*-axis. Presented this way, we can easily see that unemployment declined gradually from a high of 8.9 percent in 2011 to 3.7 percent in 2019. In 2020, it rose significantly to over 8 percent due to the economic impacts of the COVID-19 crisis, but since then it has declined to 3.6 percent in 2023. You can test yourself by using the data in Table 2A.1 to construct a time-series graph for the GDP growth rate.

**Figure 2A.1 Unemployment Rate, United States, 2011–2023**




*Source*: U.S. Bureau of Labor Statistics.

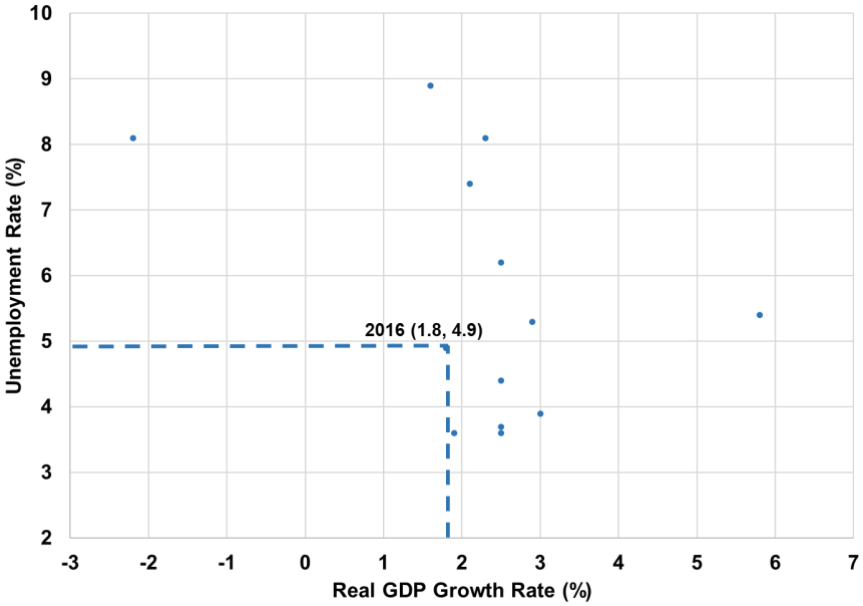
We can also use graphs to explore the relationship between two different variables—this provides a way to test specific economic hypotheses. Referring to Table 2A.1, we might form the hypothesis that unemployment rates tend to be higher when GDP growth rates are lower. We call this a **negative, or inverse, relationship**—when an increase in one variable is associated with a decrease in another variable (or, vice versa, when a decrease in one variable is associated with an increase in another variable).

**negative (or inverse) relationship:** the relationship between two variables if an increase in one variable is associated with a decrease in the other variable (or vice versa)

Figure 2A.2 plots the relationship between unemployment rates and GDP growth rates. Each "data point" on the graph tells us the values of *both* variables for a specific year. In the graph we have kept the unemployment rate on the *y*-axis and the GDP growth rate on the *x*-axis. So, the data point for 2016, for example, indicates that the GDP growth rate was 1.8 percent (across the *x*-axis) and the unemployment rate was 4.9 percent (up along the *y*-axis). You can test yourself by figuring out which data points match which years.

A visual inspection of Figure 2A.2 can help us determine whether our hypothesis of an inverse relationship between unemployment and GDP growth rates is correct. We can see that unemployment is low when GDP growth rates are higher in general, but there are some exceptions. For example, unemployment rate was 8.1 percent in 2012 as well as in 2020, but GDP growth was much lower in 2020 (-2.2 percent) than in 2012 (2.3 percent). To determine more accurately whether our hypothesis is supported by the data, we would need to undertake statistical analysis (called "econometrics.")

**Figure 2A.2 Relationship between Unemployment and GDP Growth Rate, United States, 2011–2023**




*Sources*: U.S. Bureau of Economic Analysis and U.S. Bureau of Labor Statistics.

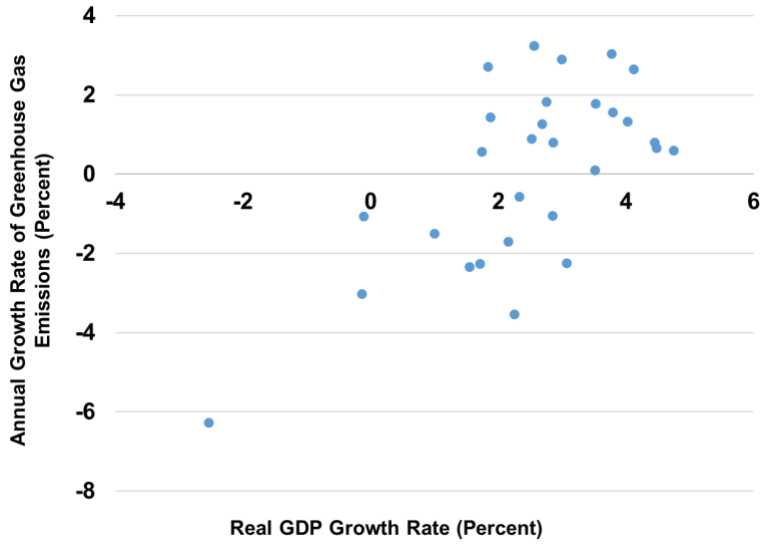
Figure 2A.2 can tell us whether our two variables are related, or "correlated," but we cannot determine whether there is a causal relationship between the two variables. While we suspect that low GDP growth causes high unemployment, we cannot prove it using a graph. The causality could be random, or it could potentially be in the opposite direction—that high unemployment causes low GDP growth.

The opposite of an inverse relationship is a **positive, or direct, relationship**. In this case, an increase in one variable is associated with an increase in another variable—or a decrease in one variable is associated with a decrease in another.

**positive (or direct) relationship:** the relationship between two variables if an increase in one variable is associated with an increase in the other variable

A good example of a positive relationship is between the growth rate of GDP and the growth rate of greenhouse gas emissions, such as carbon dioxide and methane. When the economy is growing, manufacturing industries tend to produce more goods, people tend to fly and drive more, and construction activity tends to increase. All these factors tend to increase greenhouse gas emissions. As shown in Figure 2A.3, the relationship between GDP growth and the growth of greenhouse gas emission is positive—when the economy is growing rapidly greenhouse gas emissions also tend to increase. Again, we cannot demonstrate causality just by looking at a graph, but the graph indicates that a positive relationship between the two variables is likely.

**Figure 2A.3 Relationship between GDP Growth Rate and Greenhouse Gas Emissions Growth Rate, United States, 1991–2020**




*Source*: Greenhouse Gas data from United States Environmental Protection Agency and Real GDP data from Bureau of Economic Analysis, Table 1.1.1.