

Problem Set 1

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Table of Contents

Contents

Recessions	3
Inflation	8
Music Recommendations	10
<u>Figure 1 Graph of Real Aggregate Demand and Real GDP Inputs Since 1960 ...</u>	4
<u>Figure 2 Graph of Natural Log of Real Aggregate Demand Inputs and Real GDP Since 1960.....</u>	4
<u>Figure 3 Recessionary Periods Defined by the NBER.....</u>	7
<u>Table 1 Quarter-To-Quarter Percent Change of Aggregate Demand Real Inputs</u>	5
<u>Table 2 Natural log Quarter-To-Quarter Change of Aggregate Demand Real Inputs.....</u>	5
<u>Table 3 Standard Deviation of Quarter-To-Quarter Change of Aggregate Demand Real Inputs</u>	5
<u>Table 4 Recessionary Periods by Popular Definition.....</u>	6
<u>Table 5 GDP Growth During Dot-Com Recession.....</u>	7

Recessions

There has been a lot of recent buzz as to whether the United States is in recession or headed into one. Economic news outlets like [Business Insider](#) and [Nerd Wallet](#) have recent articles on the topic of currently being in a recession. But defining what a recession is can help identify whether we are in a recession and can lead our expectations for what is next if we are in one.

The popular definition of a recession is two or more consecutive quarters of negative real GDP growth. However, while popular, this is not the definition that the National Bureau of Economic Research (NBER), a non-profit dedicated to unbiased economic analysis, gives to a recession. The NBER's definition is "a significant decline in economic activity that is spread across the economy and that lasts more than a few months," which is graded on three issues "depth, diffusion, and duration." NBER doesn't give a discrete definition, rather it evaluates a vast number of economic factors.

That said, how does the simpler, less arcane wisdom of the popular definition match up with the NBER's? Are the measures of a recession so different?

To know, first I'll establish what real GDP is and why it is relevant to a recession. Then I'll evaluate the parts of real GDP and the trends within those parts. We'll use those trends to assess recessionary periods based on the popular definition and juxtapose that against the authoritative judgments of the NBER.

According to the International Monetary Fund, GDP, "measures the monetary value of final goods and services... produced in a country in a given period of time," (Callen). This information in the United States is reported quarterly and annualized. Real GDP is also adjusted for today's dollars, not nominal, so it accounts for inflation, and can be calculated by the following formula:

$$Y = C + I + G + EX - IM$$

Y is a measure of the sum of spending on final goods and services between consumers (C), private investment (I), government spending (G), and exports (EX) minus imports (IM).

What makes real GDP useful and valuable is it is an approximator of quality of life and performance of the economy. As real GDP declines, we'd also expect standard of living to do so, too.

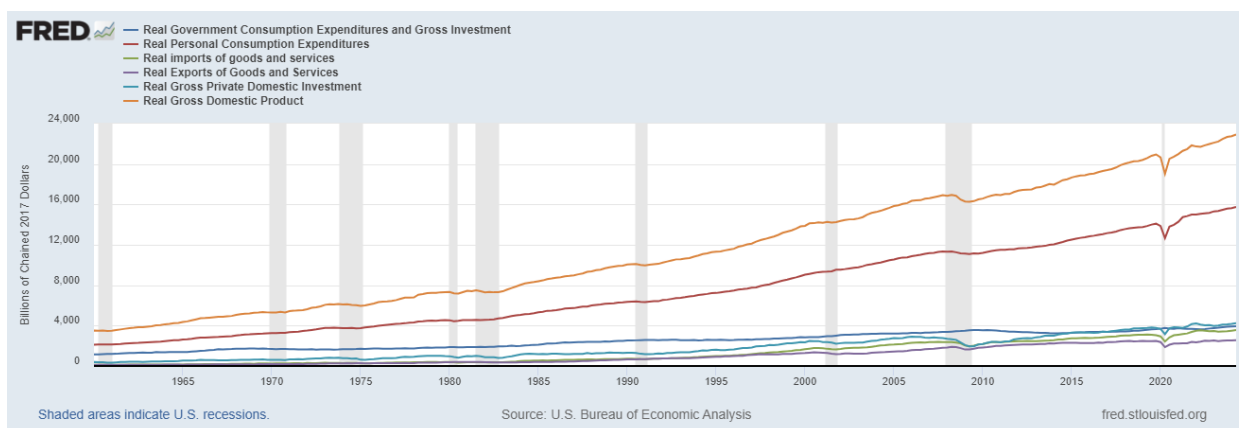


Figure 1 Graph of Real Aggregate Demand and Real GDP Inputs Since 1960

Though total numbers reported are convenient at a glance, we're more concerned with the change in real GDP as it pertains directly to our popular definition. The graph below shows the changes in real GDP by taking the natural log of each variable in our summation equation.

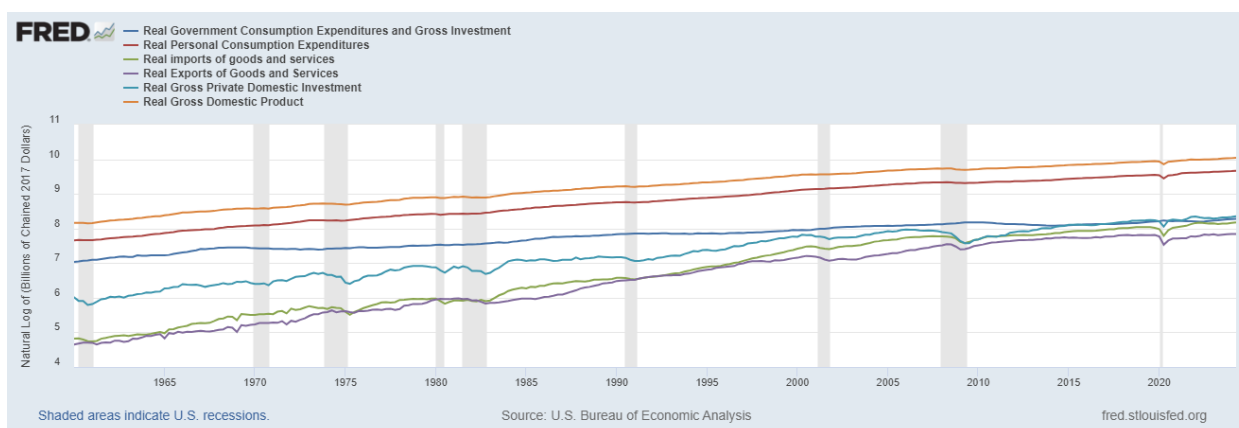


Figure 2 Graph of Natural Log of Real Aggregate Demand Inputs and Real GDP Since 1960

While over time, as a general trend, these variables of consumption increase, Consumption and government spending are steadier than imports, exports, and private investment.

Another estimator of this change over time is the quarter-to-quarter growth rate which shows the variance in growth. Inputs with a higher average change from quarter to quarter should align with the inputs that changed the most in logarithmic graph. The inputs with lower average change over the same period

should be our flatter, more static inputs like government spending and consumption.

We can see that these estimates follow what we see on the above graph, with consumption and government spending having the lowest percent change, matching with their flatter curve of their natural log lines. These aspects of GDP have very little change over time. Simultaneously we see Real Investment, Real Exports, and Real Imports all with higher average percent changes, which again follows the logarithmic trend from Figure 2.

Table 1 Quarter-To-Quarter Percent Change of Aggregate Demand Real Inputs

Aggregate Demand Input	Average Quarter-To-Quarter % Change From 1960-2024
Real Government Spending	0.488299021
Real Personal Consumption	0.789855329
Real Private Investment	0.999729182
Real Exports	1.315406284
Real Imports	1.379146969

This percent change in the raw data also follows the logarithmic change as seen below. These estimators of change not only coincide trend-wise, they also are exceptionally close in value, differing by thousandths of a percent at most.

Table 2 Natural log Quarter-To-Quarter Change of Aggregate Demand Real Inputs

Aggregate Demand Input	Average Quarter-To-Quarter % Change Ln From 1960-2024
Real Government Spending	0.482466926
Real Personal Consumption	0.781451362
Real Private Investment	0.926604743
Real Exports	1.242062257
Real Imports	1.307350195

While both the average percent change and the natural log both measure growth rate of each input of aggregate demand, mapping their standard deviation displays the steadiness or erraticism of an input. An input with a low standard deviation indicates that it has steadier change and doesn't deviate from its average growth much, whereas a higher standard deviation indicates volatility in its growth rate.

Table 3 Standard Deviation of Quarter-To-Quarter Change of Aggregate Demand Real Inputs

Aggregate Demand Input	Standard Deviation of Quarter-To-Quarter Change From 1960-2024
Real Government Spending	0.00971432
Real Personal Consumption	0.010343963
Real Private Investment	0.040851064

Real Exports	0.036267114
Real Imports	0.035802859

Above, we see that government spending and consumption are the most consistent, with smaller fluctuations in growth rate. This lack in change of consumer spending could be attributed to people's real incomes not changing much over the years, stickiness of lifestyle, and savings. This consistency in government may be due to the history of fiscal budgets, which not only are preset for relatively longer time horizons, but also can be based on the previous year's budget.

Private investment, exports, and imports are much more erratic however, compared to C and G. These volatilities may be explained by changes in interest rates (and by extension, exchange rates), whereas the two aforementioned are far more insulated, and business cycles.

These are but a few measures of the economy; all is to say that determining whether the United States is in a recession is exceptionally nuanced and more than just black-and-white.

Using data used to derive the graphs and tables above, partnered with the popular definition of a recession (two or more, consecutive quarters of negative GDP growth), the number of recessions in the US from 1960 to present would be eight:

Table 4 Recessionary Periods by Popular Definition

Period	Real GDP in Billions Chained 2017 Dollars	Change in GDP From Last Period
1969-07-01	5334.600	-0.004882091
1969-10-01	5308.556	-0.001488917
1974-04-01	6111.751	-0.009452774
1974-07-01	6053.978	-0.003884058
1974-10-01	6030.464	-0.012176343
1980-01-01	7341.557	-0.020604349
1980-04-01	7190.289	-0.001188547
1981-07-01	7492.405	-0.010895967
1981-10-01	7410.768	-0.015536446
1990-07-01	10090.569	-0.009104046
1990-10-01	9998.704	-0.004679406
2008-04-01	16943.291	-0.005252581
2008-07-01	16854.295	-0.021890266
2008-10-01	16485.350	-0.011348743
2009-01-01	16298.262	-0.00178651
2019-10-01	20951.088	-0.013628648

2020-01-01	20665.553	-0.078910204
2021-10-01	21847.602	-0.004976793
2022-01-01	21738.871	-0.001412723

However, the authoritative voice on recessions in the United States, the NBER, has concluded that in this same period there has been nine, which can be seen here in the shaded regions:

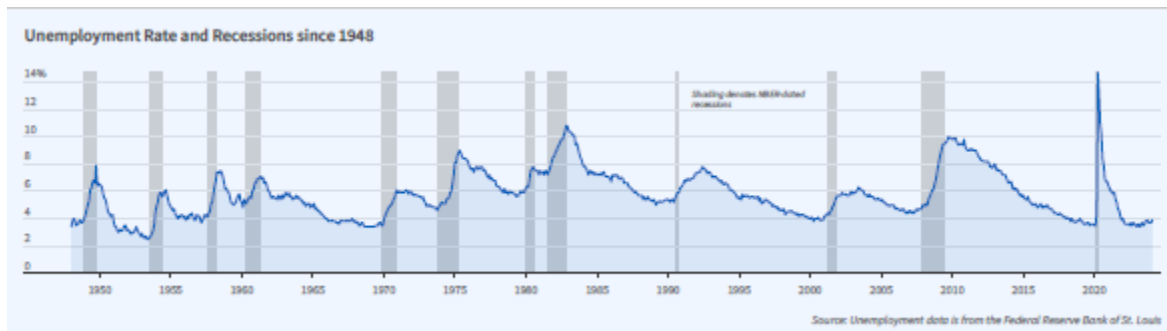


Figure 3 Recessionary Periods Defined by the NBER

The NBER counts March 2001-November 2001 as the additional recessionary period. A few reasons for these is the dot-com bubble burst and possibly even the 9/11 terror attacks which could contribute to fear and uncertainty. And they count this as a recession despite the US seeing mostly positive quarter-to-quarter growth in that timeframe, as seen in *Table 5*:

Table 5 GDP Growth Rate During Dot-Com Recession

Period	Real GDP in Billions Chained 2017 Dollars	Change in GDP From Last Period
2001-01-01	14183.120	0.006245029
2001-04-01	14271.694	-0.004006392
2001-07-01	14214.516	0.002747754
2001-10-01	14253.574	0.008363587

So, while the popular definition of a recession often coincides with the wisdom and authority of the NBER, it does not always, for GDP alone is not the sole metric for a recession.

Inflation

There are several different ways to measure inflation. The four I'll focus on is the Consumer Price Index (CPI), Personal Consumption Expenditure (PCE), and each indices' "core" variant which removes food and energy consumption due to their more volatile tendencies and non-trending behavior in price month-over-month. While distinct, these indices are very close in how they follow each other and map inflationary trends. Traditionally, the US Federal Reserve looked at CPI but has recently favored PCE which accounts for substitution of goods, is weighted for more commonly bought items, and includes goods or services consumers enjoy but may not pay for such as employer-provided medical care or national insurance programs like Medicare and Medicaid.

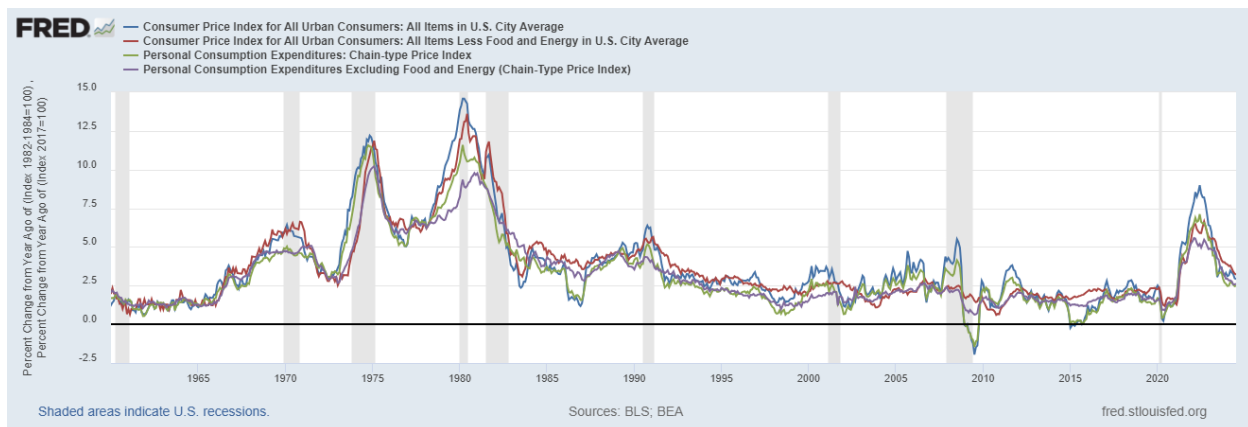


Figure 4 CPI, PCEI, and Core Variants

Above, we see these charts trend together. You'll notice that the CPI and PCEI are more jagged compared to their smoother, core counterparts, as a product of discounting food and energy. Focusing on PCEI and PCEI Core, these two have a mean difference of .059, variance of .547, and a standard deviation of .74; this shows the average difference between the core and non-core PCEI is extremely slim, with the core data on average being within 6% of the non-core data's percent estimation of inflation. While on average these are close, the variance and standard deviation are much greater by comparison, displaying the erraticism in food and energy.

While each of these indices follows each other closely, each of them is useful to different types of people and situations. For example, policy makers, specifically, tend to focus on overall trends over long periods of time to achieve their goals. For monetary policy, the United States Federal Reserve's goals for instance is to keep inflation at a predictable level and manage unemployment to a low rate. For these broad policy objectives, it is better to look at overall

trends less than their more volatile, non-trending components in order to make sound policy decisions, leading them to prefer “core” indices over the traditional counterparts.

Some alternative indices that account for volatile, non-trending prices is Weighted-Median CPI calculated by the Cleveland Fed and Trimmed-Mean PCE from the Dallas Federal Reserve, which take out volatile, non-trending prices, not necessarily food and energy. This causes, on average, a smoother curve than what we see with the aforementioned measures.

That said, taking out volatile or non-trending variables isn’t always as useful as keeping them in the index; energy and food prices are a considerable fraction of monthly budgets for families and individuals, so excluding their price fluctuations from an index may be misleading or less desirable for budgeting. Because households consume food and energy, they’re better off using traditional as opposed to core values of indices. Further, CPI tracks only out-of-pocket expenses to households, making it usually a more desirable option for budgeting and inflation tracking for the average household.

Music Recommendations

Must listen to, if you don't listen to anything else, please listen to this: "Get What's Mine For You," by Jack Swing. They're a small funk rock band from Pittsburgh and they're ridiculously talented.

Songs I'm obsessed with right now: "Stella Brown" by Jelani Aryeh and "Come Out, Ye Black and Tans," by The Maguire Brothers, and "Futon," by Ūla.

Genre's to look into: [Winter Synth](#) and [Bardcore](#), and hyperlink to two playlists for both. I'd just turn the Winter synth playlist on shuffle and enjoy, but Bardcore may be better if you find songs you recognize and give them a listen first.

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