Proceedings of the 2nd International Conference on Financial Technology and Business Analysis
DOI: 10.54254/2754-1169/101/20231694

Detrending U.S. GDP and Policy Responses to Economic Recessions

Shuai Huang[1,a,*], Zizhao Liang[2,b], Kun Chen[3,c]

[1]Qingdao Weiming School, Qingdao, 266555, China
[2]Guangdong overseas high school, Guangzhou, 510168, China
[3]Guangdong overseas high school, Guangzhou, 510168, China
a. 2096832478@qq.com, b. 1831397976@qq.com, c. 1577615498@qq.com
**corresponding author*

Abstract: The purpose of the article is to verify whether to stimulate investment or consumption when facing a recession in order to stabilize the economy. We use the detrend method and some specific data to analyze the situation. When faced with a financial crisis, some effective measures can help stabilize the economy. To diversify the sample, we include the United States' GDP in 1981–2022. We tried to predict some trend that might happen in the next few years, but when facing such a financial crisis, it shows a sharp downward trend. We also find that the standard deviation of investment is larger than the standard deviation of consumption, which means that in the short term, it's better to stimulate investment since it can be affected a lot. On the contrary, we had better stimulate consumption in the long term because of its stability.

Keyword: Business cycle, Detrending method, Standard Deviation and Correlation

1. Introduction

A recession is a term used by asset economists to describe an economic crisis. A recession is characterized by a general decline in economic activity and the consequent loss of jobs, investment, and corporate profits, along with falling prices (deflation). A severe recession is defined as a depression. A significant recession will result in many problems. Reeves, A. [1] claimed that during the 1999–2010 recession, the suicide rate in the United States increased significantly, and severe recessions could also cause depression. Government policy played a very important role in the decision to actively help career workers find jobs or to provide certain subsidies. The worst depression in the world was in the 1930s, when the unemployment rate was about 25 percent-that is, 1 in 4 people were unemployed. The difficulties brought by the Great Recession are not only limited to the loss of income, for some people, it also destroyed the normal life and healthy family relations. For example, in the second half of 2000, the American economy ended the high-speed growth period of 10 years since March 1991, and entered the period of slow growth. In 2001, economic growth declined quarter by quarter, and the sudden events of September 11, 2001, severely dented consumer and investor confidence and accelerated the decline of the U.S. economy. In the third quarter of 2001, the US economy contracted by 1.3 percent. However, when the Great Depression hit what people had to do was how to stimulate consumption to make the economy better, and how to stabilize the economy, and in terms of stabilizing the economy, people often made predictions, and some authors

DOI: 10.54254/2754-1169/101/20231694

think that predictions can be biased, because not everything is going to turn out the way we expect, Yves S. Schuler claimed that by using the trend of financial variables, Hodrick and Prescott might get an unreal economic trend because they would ignore short-term fluctuations. However, we directly use the trend method and some concrete data to predict these trends, so that we can effectively take economic measures. So what we find is that in the short run, we should be stimulating investment, and in the long run we should be stimulating consumption

2. Literature Review

When society faces a recession, there are many approaches to promoting real GDP. The real GDP is the market value of final goods and services produced within a country over a period of time without inflation. GDP's components are consumption, investment, government spending, and net exports, from which exports subtract imports. Using the straight line to estimate the tendency of movement is called the detrending method, which can clearly observe the fluctuation in raw data. The trend part of the time series is removed to make the time series more stable. Then, using the standard deviation can indicate the dispersion of a dataset relative to its mean; a higher standard deviation value also means higher fluctuation and higher dispersion. Correlation means a connection between two things in which one thing changes as the other does. It measures the strength and direction of a relationship between variables and normally has a range between -1 and 1. If two things have a correlation coefficient value of 1, it means two things have perfect positive correlation, meaning that when one variable changes, the other variables change in the same direction, and if the correlation coefficient value is 0, it means there is no relation between two things.

Canova, F. [2] discussed the different methods that could explain the relationship between Gross National Product (GNP), investment, consumption, hours, wages, productivity, and capital. The raw data was chosen from 1955–1986 GNP in the United States. The author reported the moments of the data, the short-term cross correlations, and the impulse response function of the seven variables when GNP is shocked. In our paper, we want to figure out whether investment or consumption will have the biggest stimulation when people need to improve the real GDP. We use the detrending method and co-movement figures between investment, consumption, and real GDP in the United States from 1981 to 2022. And our purpose is to find out whether the detrend method and co-movement graph still make sense by using the recent data.

During the COVID-19 period, the economy of the United States fell into recession, and the real GDP was significantly reduced. The United States economy showed the same downward trend during the epidemic period. It was due to the failure of some economic policies to ensure economic stability, which led to the decline of the US economy in many aspects. Examples include expansionary and contractionary policies, which seek to stabilize the economy by increasing or reducing taxes and government revenue. In the long run, we should pay more attention to financial variables and stabilize the economy from the perspective of economic composition. Let it enter a good cycle or change the stimulus for financial variables by forecasting some economic trends. Thorbecke, W. [3] indicated that during the pandemic, the United States economy suffered greatly. It affected agriculture and industry to a great extent. There's been a big drop in employment and in factory productivity because people aren't going out as much, leading to layoffs in companies, restaurants, and factories. Not only that, but American stocks have also been affected, and stock returns have fallen by a lot. After that, in order to maximize the recovery of the economic system, the U.S. government decided to cut the fund rate to stimulate people to invest and encourage people to take out loans. After that, the government increased unemployment benefits for the population, but the ultimate goal is to stimulate people's consumption and investment. To sum up, the epidemic has affected the US economy through a series of policies launched by the US government, such as CARES, S-I-P, and other policy actions.

DOI: 10.54254/2754-1169/101/20231694

Schüler, Y. S. [4] argued that using Hodrick and Prescott to calculate trendsetting in G7 countries (the United States, Britain, France, Germany, Japan, Italy, and Canada) could lead to a false conclusion that could only be applied to suitable countries, in particular by using these intermediate filters to increase the variance of a period of about 20 to 30 years by a factor of 204, which could lead to cancellation of short-term movements. In this way, it is impossible to accurately know whether the impact on GDP during this period is accurate. G7 countries are cited to prove mistakes, and some formulas are used to solve the problem. Similar to the main purpose of the research paper by Schüler, Y. S. Our methodology has a significant shortcoming, which is that a straight line cannot always represent all trends in each situation. Wu, Z. [5] contended that there isn't an exact common formula for trend lines or any logical algorithm for extracting it. Wu, Z. stated a methodology for nonlinear and nonstationary time series. This methodology can be our future research direction.

3. Methodology and Data

GDP formula: GDP = C + I + G + Nx, where GDP is equal to the sum of consumption, investment, government expenditure, and net exports (exports minus imports). We downloaded the raw material, which is the real GDP of the United States from 1981 to 2022, from the official website of the Bureau of Economic Analysis (BEA), and the unit of the data is billions of 2012 USD without inflation. We mainly focused on the relationship between real GDP, consumption, and investment. We should analyze the relationship between them from both qualitative and quantitative perspectives. So firstly, we used Excel to draw the image of the real GDP, consumption, investment, and its general trend line. A trend line means tendency, which is movement in a particular direction. Then, we find the cyclical component of each variable, from which we calculate the percentage deviation from the trend. The formula for calculating the cyclical component is equal to the formula for calculating the cyclical component is equal to the difference between the actual value and the trend value of the variable divided by the trend value, then multiplied by one hundred percent.

Using this formula, we drew the co-movement graphs of consumption and investment with the real GDP. The picture can help us qualitatively analyze the fluctuation of consumption or investment with the real GDP.

From the point of view of quantitative analysis, we had to use standard deviation and correlation to find to what extent consumption and investment were related to the real GDP. So, we used Excel to find the standard deviation value and its value over the real GDP, as well as the correlation between the real GDP and its components. We used Excel to calculate the standard deviation of each component.

Then, we calculated the ratio of the standard deviation over the real GDP.

The standard deviation showed the dispersion of a dataset, and its ratio over the real GDP showed how many times those other variable cyclical fluctuations were compared with the real GDP. The correlation showed how strongly those two things are related.

DOI: 10.54254/2754-1169/101/20231694

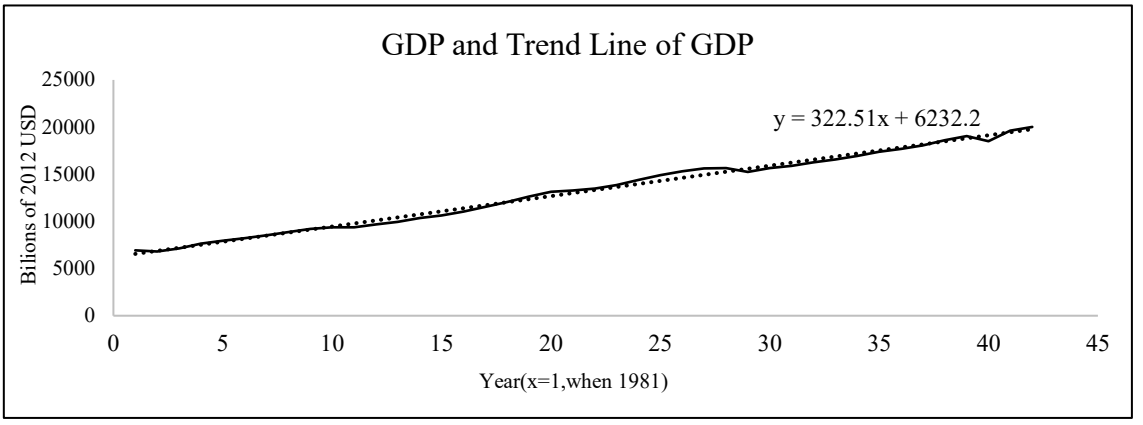

Figure 1: GDP and Trend Line of GDP

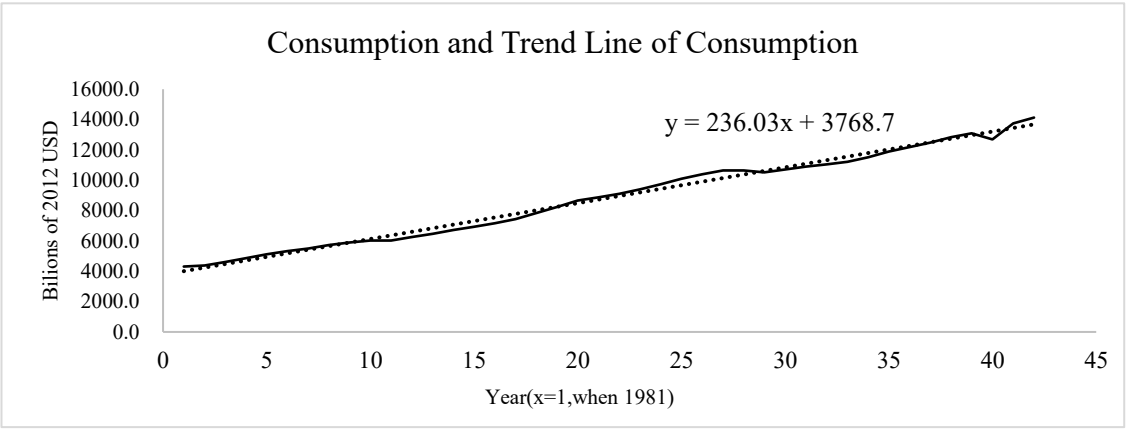

Figure 2: Consumption and Trend Line of Consumption

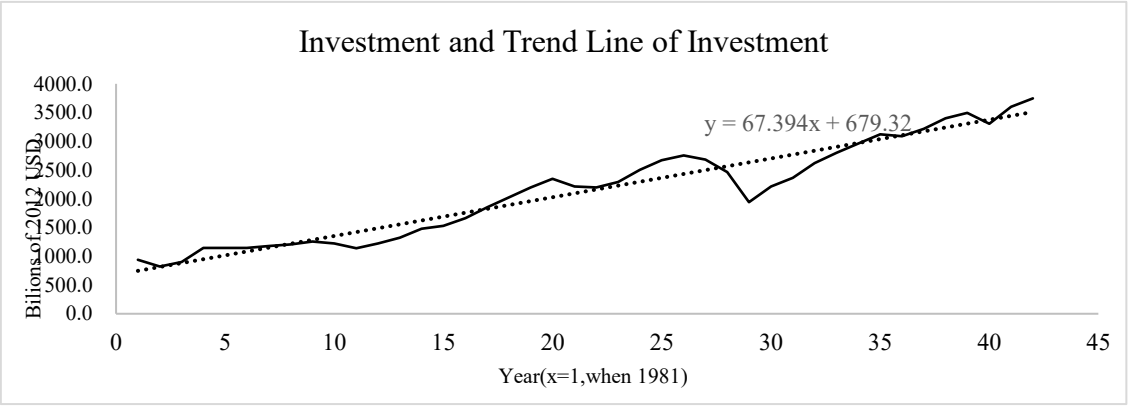

Figure 3: Investment and Trend Line of Investment

Figure 1, 2, and 3 showed trend line of each variable. We could use the linear equation to calculate the value of trend at a given year, thus we could calculate the the cyclical component.

DOI: 10.54254/2754-1169/101/20231694

4. Results and Discussions

Table 1: Values of Cyclical Components

Year	GDP cyclical (%)	Consumption Cyclical (%)	Investment cyclical (%)
1981	5.80	7.62	25.90
1982	-0.98	3.12	0.97
1983	-1.08	3.21	1.95
1984	1.53	3.20	20.56
1985	1.42	3.37	12.49
1986	0.79	2.74	5.66
1987	0.31	1.60	2.30
1988	0.68	1.43	-0.97
1989	0.69	0.20	-2.37
1990	-0.91	-1.71	-9.63
1991	-4.28	-5.19	-19.61
1992	-4.07	-5.21	-17.66
1993	-4.48	-5.30	-14.92
1994	-3.61	-4.91	-8.81
1995	-3.91	-5.27	-9.64
1996	-3.11	-5.05	-5.51
1997	-1.58	-4.46	1.38
1998	0.07	-2.35	7.07
1999	2.13	-0.04	12.19
2000	3.59	2.08	15.76
2001	1.99	1.78	5.73
2002	1.21	1.62	1.55
2003	1.58	2.14	2.74
2004	3.06	3.34	8.96
2005	4.24	4.39	12.96
2006	4.78	4.85	13.19
2007	4.58	4.90	7.41
2008	2.49	2.67	-4.03
2009	-2.24	-0.92	-26.26
2010	-1.63	-1.23	-17.94
2011	-2.09	-1.69	-14.68
2012	-1.80	-2.42	-7.55
2013	-1.91	-2.99	-3.51
2014	-1.54	-2.36	-0.39

DOI: 10.54254/2754-1169/101/20231694

Table 1: (continued).

2015	-0.74	-1.14	2.75
2016	-0.91	-0.64	-0.50
2017	-0.49	-0.19	1.36
2018	0.66	0.78	4.89
2019	1.20	0.91	5.59
2020	-3.26	-3.85	-2.03
2021	0.80	2.29	4.66
2022	1.20	3.28	6.75

Table 1 shown that the value of cyclical component, which is the deviation from trend in percentage.

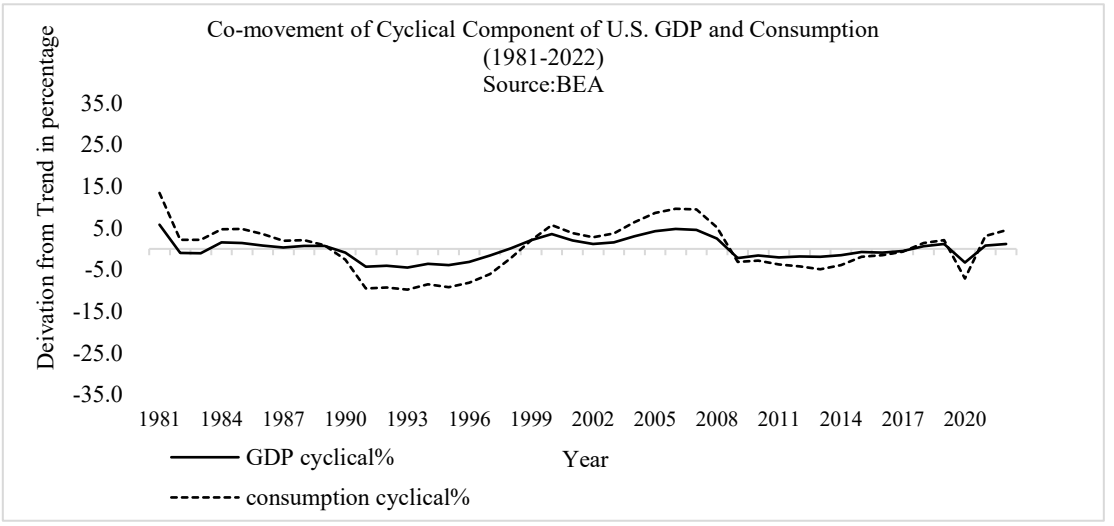

Figure 4: Co-movement of Cyclical Component of U.S. GDP and Consumption

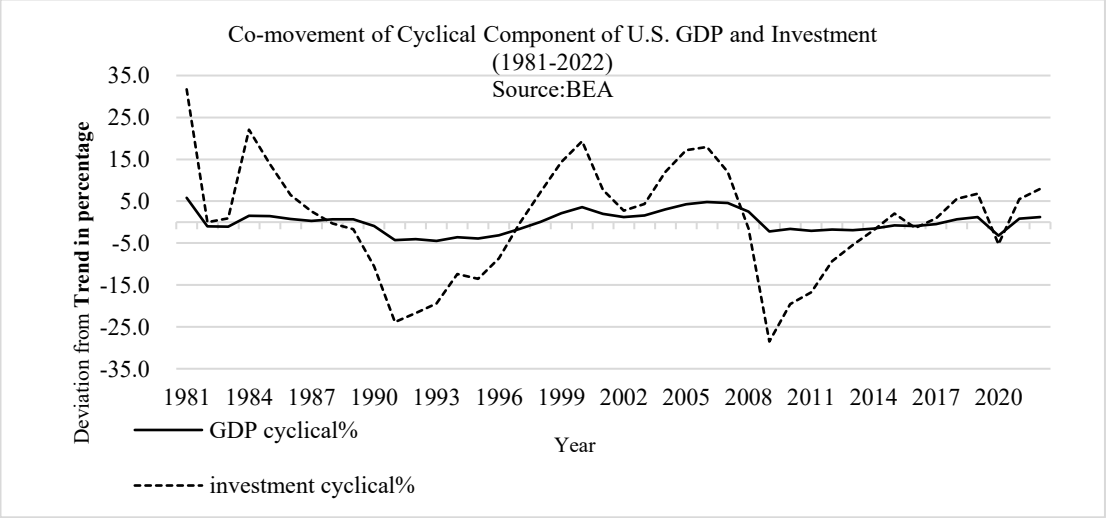

Figure 5: Co-movement of Cyclical Component of U.S. GDP and Investment

DOI: 10.54254/2754-1169/101/20231694

From the co-movement graph, we can know that the fluctuation range of consumption and the real GDP is generally the same, while the fluctuation range of investment is much larger than that of the real GDP. Both consumption and investment will move in the same direction as the real GDP. This is from the qualitative analysis aspect.

Table 2: results of calculation

	Standard Deviation	Standard Deviation Ratio (over GDP)	Correlation (with GDP)
GDP cyclical	2.6053	-	-
Consumption cyclical	3.3451	1.2839	0.90
Investment cyclical	10.9551	4.2049	0.81

The table showed all the results of our calculation. The standard deviation expresses that the fluctuation of the real GDP from its trend is 2.61%, the fluctuation of consumption from its trend is 3.35%, and the fluctuation of investment from its trend is 10.96%. The ratio of the standard deviation expresses that the cyclical fluctuation of consumption is 1.28 times the real GDP, and the fluctuation of investment is 4.2 times the real GDP. The value of the correlation between the real GDP and its components is higher than 0.8, which means consumption and investment are highly positively related to the real GDP. This is from the quantitative analysis aspect.

Combining our results, when society suffers a recession, Policymakers should first consider stimulating investment in the short-term, because investment can create more fluctuation. When there was a recession, investment was more sensitive, and it would immediately and significantly decrease in a short period of time, like during the COVID-19 pandemic (shown in figures 3 and 5 from 2019 to 2021). Also, it can recover quickly. So, if policymakers want to fast recover the real GDP, they should primarily focus on stimulating investment. For long-term development, policymakers should stimulate consumption because consumption is more stable than investment. When consumption reaches a higher level, it will probably remain at that level. So, stimulating consumption is a more suitable long-term strategy.

5. Conclusion

In our research paper, we wanted to find the best policy when the economy suffered a recession and which cyclical component we should stimulate. We used data from the United States from 1981 to 2022. We chose the detrending method and drew co-movement graphs using Excel to show that the standard deviation ratio of investment was about 4.2 times the real GDP, and consumption was about 1.3 times the real GDP. In the short term, investment will cause more fluctuations than consumption. So, in a short period of time, we should focus on investment to promote the real GDP. And in the long term, we should stimulate consumption. This was because consumption was much more stable than investment, and when we increase consumption, it will remain at that level. So, it was better for the long term. We also find a correlation between the real GDP, consumption, and investment. According to the equation and using Excel, we figured out that the correlation coefficient between consumption and the real GDP is +0.81, and the correlation coefficient between investment and the real GDP is +0.90, both higher than +0.8, thus consumption and investment are highly positively correlated with the real GDP.

Our biggest shortcoming in our methodology was using a straight line to represent the trend of each component. And this method does not work with all calculations. In many situations, our method cannot accurately calculate the results. There are many other ways to represent trend lines, such as

DOI: 10.54254/2754-1169/101/20231694

exponential trend lines, logarithmic trend lines, and so on. In future studies, we will try to use different methods to deal with different situations.

References

[1] *Reeves, A., Stuckler, D., McKee, M., Gunnell, D., Chang, S. S., & Basu, S. (2012, November). Increase in state suicide rates in the USA during economic recession. The Lancet, 380(9856), 1813–1814. https://doi.org/10.1016/s0140-6736(12)61910-2*

[2] *Canova, F. (1998). Detrending and Business Cycle Facts Journal of Monetary Economics, 41(3), 475–512. https://doi.org/10.1016/s0304-3932(98)00006-3*

[3] *Thorbecke, W. (2020). The Impact of the COVID-19 Pandemic on the U.S. Economy: Evidence from the Stock Market Journal of Risk and Financial Management, 13(10), 233 https://doi.org/10.3390/jrfm13100233*

[4] *Schüler, Y. S. (2018). Detrending and Financial Cycle Facts Across G7 Countries: Mind a Spurious Medium Term! SSRN Electronic Journal. https://doi.org/10.2139/ssrn.3152820*

[5] *Wu, Z., Huang, N. E., Long, S. R., & Peng, C. K. (2007, September 18). On the trend, detrending, and variability of nonlinear and nonstationary time series. Proceedings of the National Academy of Sciences, 104(38), 14889–14894. https://doi.org/10.1073/pnas.0701020104*