# International Macroeconomics and Monetary Policy

## Term Paper

# Consumer spending and business cycles is the transmission of consumer spending to growth rates with special focus on Covid pandemic 2020-21. Country: USA



**Submitted to -**

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# Introduction

A financial crisis can have a huge and long-lasting impact on an economy. Its effect can be felt in all financial sectors, whether public or private. It disrupts the market, changes consumer behaviour, and affects personal expenditure. The business cycle declines, and so does the GDP of an economy. These crises challenge a country's economy and highlight its crisis management system, the government's proficiency in tackling them. The situation worsened as these crises sent shockwaves through the world, leading to the global devastation of the economy. So, to control the problem, it was a need of the hour to take steps to maintain financial accountability and stability. The global financial crisis and the COVID-19 pandemic are some of such crises. In this project, we discussed the world's significant crises from 2002 to 2022 and their effect on consumer spending and business cycles in the US economy.

The sub-prime crisis hit in 2007-08. It significantly increased unemployment and led to a recession. A decade later, in 2020-21, the COVID-19 pandemic again disrupted the global economy. The pandemic made the world's entire population stay at home. It led all the stores to shut down; many businesses collapsed, and GDP declined massively. It also exposed deep susceptibilities in the economy. It showed that top-line economic numbers that signalled a healthy economy, a booming stock market three months ago, low unemployment, and corporate profits hid the painful truth that our economy is built on far too many low-wage, low-quality jobs.

Studying past crises like that during 2007-08 and the economic slowdown due to COVID-19 is crucial to detect and avoid such crises in future. Personal consumption expenditure and GDP growth are commonly studied parameters for economic activity analysis. They are good indicators of a coming recession.

Personal consumption expenditure is a household's spending on goods and services in a given period. Common goods include food, clothing, and durable goods like cars and laptops. In contrast, services widely availed include healthcare, transportation and entertainment. Consumer spending is a good indicator of economic activity, accounting for a large share of a nation's total economic activity (generally about 70-80%). Consumer spending drives economic growth. So, higher levels of consumer spending generally indicate high economic activity. In contrast, low consumer spending shows an imminent recession. Thus, it is a crucial driver of understanding the business cycle in an economy.

# Research Objective

The primary aim of this research paper is to study the transmission of consumer spending to the economic growth of the USA during the year 2002-2023. Specifically, the report aims to investigate the impact of consumer spending on the country's gross domestic product (GDP) and to analyse the dependence of consumer spending on a country's GDP. The research also focuses on the effects of two significant crises, the Global Financial Crisis of 2008-09 and the Covid-19 pandemic of 2020-21, on the US economy. Consumer Spending (Personal Consumption Expenditure) and Gross Domestic Product (GDP) data of the USA have been analysed for the period mentioned earlier to study the dependence of consumer spending on a country's GDP.

The study of crisis years has helped to better understand the effect that such financial crises can have on the output of an economy and how that impacts consumer spending and business cycles. A quarter-wise analysis of GDP and PCE (Personal Consumption Expenditure) data has been performed here for

detailed data analysis. The percentage change in GDP and percentage change in PCE have also been used to find a correlation between various parameters and the impact of one on the other. The research paper further does a comparative and comprehensive analysis of crises and the non-crises period to study the differences and similarities between the two.

Further in the paper, we checked for stationarity of GDP and PCE using the Augmented Dicky Fuller test. Autocorrelation analysis on various parameters was performed to investigate the long-term relationships between the variables. To better estimate the dependence of GDP on Consumer Spending during the normal and crisis periods, regression analysis using Python was performed on the quarter-wise dataset.

In conclusion, this research aims to offer insights into the effects of economic downturns on the economy and the relationship between GDP and consumer spending. By utilizing various analytical methods, the research provides a comprehensive analysis that can be useful to policymakers, economists, and scholars interested in the economic dynamics of any country.

## Data Source

The datasets used for the project were collected from the Federal Reserve of Economic Data (FRED) database. We considered quarter-wise GDP and PCE data from 2002 to 2023. This period contains two periods where the global economy faced two of the most significant recessions the global economy has ever faced: the Global Sub-par Financial Crisis of 2007-08 and the economic slowdown in 2020-21 due to COVID-19. The following datasets were collected:

1. Real Gross Development (GDP) of the United States (Q1 2002 – Q1 2023): This dataset shows the GDP and its growth (or decline) of the United States from the first financial quarter of 2002 to the first financial quarter of 2023.
2. Real Personal Consumption Expenditure of the United States (Q1 2002 – Q1 2023): This dataset tracks the personal consumption expenditure of the United States and its change from the first financial quarter of 2002 to the first financial quarter of 2023. It is a good indicator of the spending of the consumer sector, which is the economy's primary driver.

## Stylized Facts

On plotting the data available, the following observations were made:

**A. GDP Data:**

1. The period from 2002 to 2007 saw a steady growth of the US economy with GDP increasing at an average annual rate of around 2.5%. This growth was primarily driven by the housing market boom, low interest rates, and increased consumer spending.

2. In 2008, the US economy was hit by a severe recession, which was



GDP through 2002 to 2023



GDP_Change through 2002 to 2023
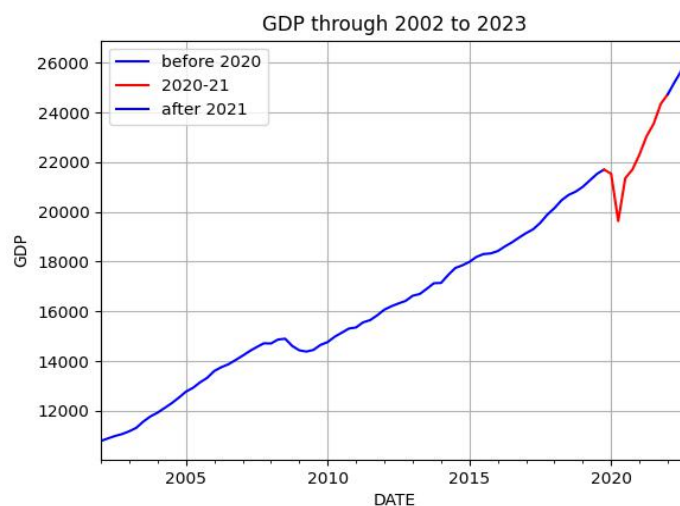
triggered by the collapse of the housing market and the mortgage crisis. As a result, the GDP contracted by 2.8% in 2008 and by 2.5% in 2009.

3. From 2010 to 2019, the US economy experienced moderate growth, with GDP increasing approximately at 2.3% annually.
4. The economy contracted sharply in Q2 of 2020, with GDP falling by 8.8%.due to shutdowns of businesses and schools, and other social distancing measures, significantly impacting consumer spending and investment. This contraction was sharper than that during the Global Financial Crisis.
5. By the next quarter, the GDP rebounded by 8.7% due to government dole outs during the pandemic that increased personal consumption, in turn raising the GDP.

### B. PCE Data:

1. A steady increase in personal consumption expenditures from 2002-2007 is observed. It is due to robust economic growth, increased employment, and high consumer confidence.



PCE through 2002 to 2023

2. During 2008-2009, the Global Financial Crisis hit. It was the most significant financial crisis since the Great Depression. Personal consumption expenditures as a result.
3. Personal consumption expenditures grew moderately from 2010-19 as the US slowly recovered from the crisis.
4. In Q2 2020, personal consumption expenditures declined sharply due to the COVID-19 pandemic, as a decrease in spending on business directly impacted by social distancing measures.



PCE_Change through 2002 to 2023

5. The expenditures increased in the next quarter as businesses reopened and government stimulus package reached the intended targets. Thus, the drop due to COVID-19 was ultimately short-lived with expenditure levels returning to around 2.5% by the end of 2021.
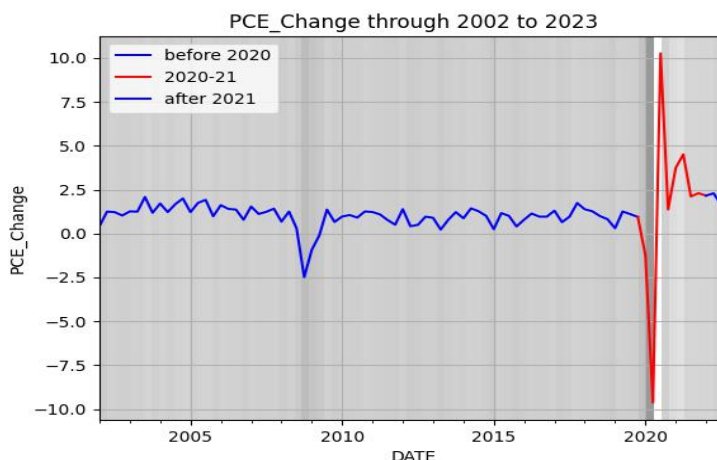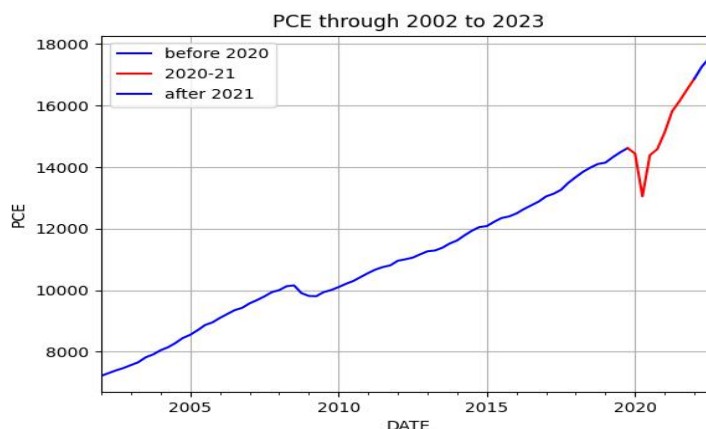
# Data Analysis

## Studying Correlation between GDP and PCE

A correlation matrix between GDP and PCE for crisis and non-crisis periods was plotted to estimate the correlation between GDP, PCE, and CRIS_PERIOD (indicating a crisis period). Figure alongside shows the heatmap (plotted in Python) depicting the correlation matrix. The intensity of colour in the heatmap shows how strongly or weakly two parameters correlate.

Using the label encoding technique with the help of a dummy variable, quarters of the crisis period and quarters of the non-crisis period were labelled as 0 and 1, respectively.

From the heatmap, we observed



Correlation between crises, GDP and PCE
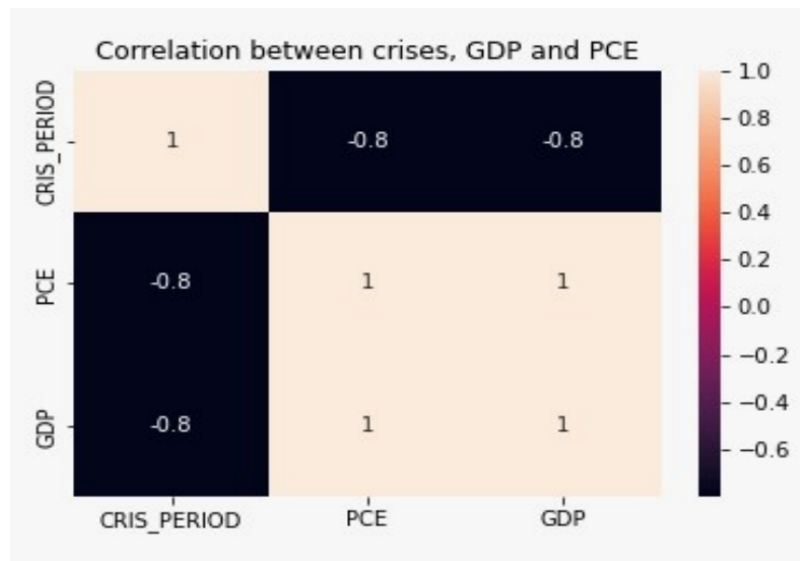
1. **A correlation of 1 between GDP and PCE:** This shows a strong and positive correlation between real GDP and real PCE, indicating that consumer spending is an essential driver of economic growth.
2. **A negative correlation of 0.8 between crises and PCE:** This indicates that during a crisis, there is a decrease in personal consumption, followed by a decline in the country's GDP.

## Correlation Matrix for GDP percentage change PCE percentage change

Furthermore, correlation matrices were plotted between GDP, PCE, GDP change, and PCE change. The heat maps were drawn for the entire period (from 2002 to 2022),
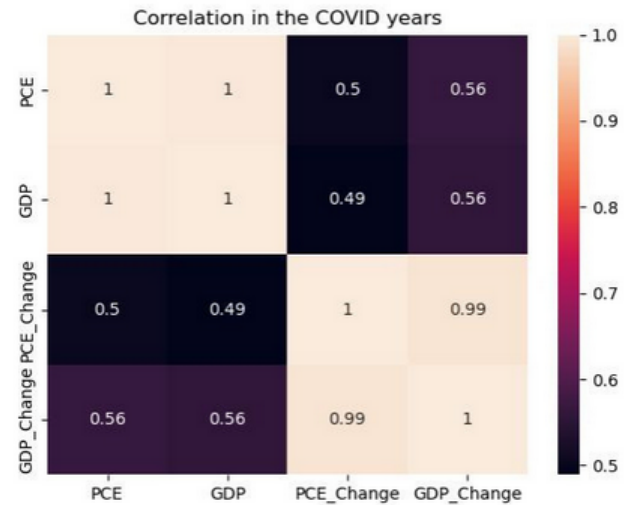
1) the crisis period: this includes:
   a. Global Financial Crisis (from 2008-2009)
   b. Covid Pandemic (from 2020-2021)
2) the non-crisis period (2002-07, 2010-2019, 2022- 2023).
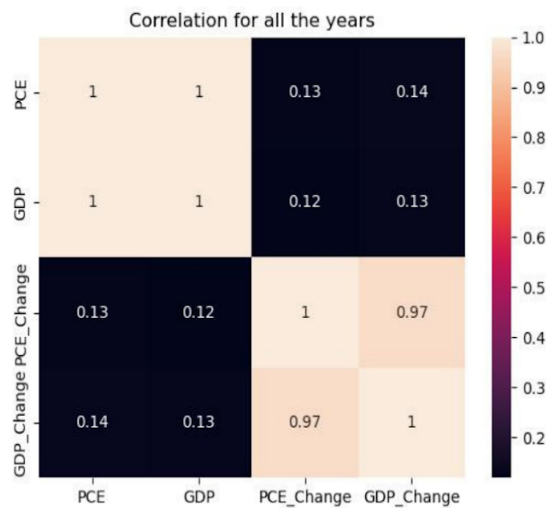
**Following heatmaps were plotted:**
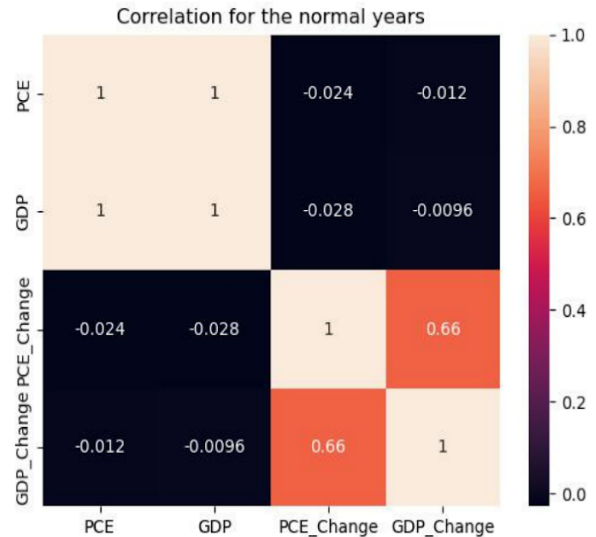
(a) Global Financial Crisis (from 2008-2009)
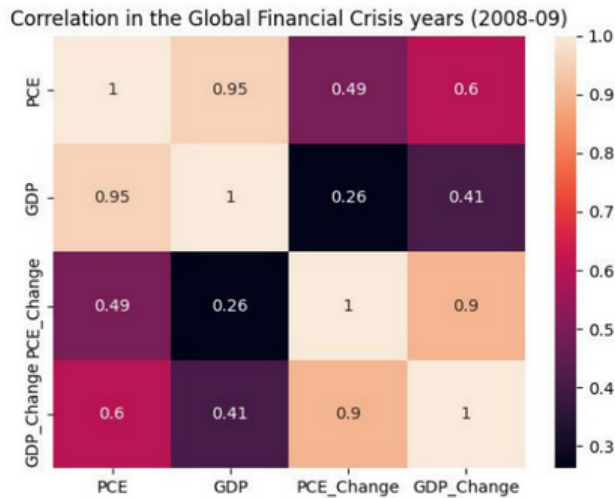
(b) Covid Pandemic (from 2020-2021)

(a) Overall (from 2002 to 2022)

(b) Non-Crises Years (2002-07, 2010-2019, 2022- 2023)

**Following observations from these heatmaps were drawn:**

1. A strong correlation factor of 0.97 between GDP change and PCE change was observed for the overall period.
2. A correlation factor of 0.66 between GDP change and PCE change was observed for the non-crisis period. In contrast, a high correlation was observed between GDP change and PCE changes for the crisis periods (0.9 for Global Financial Crisis and 0.99 for the covid period).

The weaker correlation between GDP and PCE in the non-crisis period compared with the crisis period may be attributed to the stable economic environment during regular times. Consumers may keep their spending habits the same, even if GDP fluctuations occur. Additionally, additional factors such as changes in the government's monetary and fiscal policy, may influence policy PCE changes, leading to a weaker correlation with GDP changes.

However, during the crisis periods, the relationship between GDP and PCE changes becomes more substantial due to significant changes in consumer spending habits. During a financial crisis or pandemic, consumers alter their spending habits. For instance, during the Covid-19 pandemic, people spent less on travel, dining, and other entertainment, impacting GDP and PCE changes. Additionally, government spending increased during the Covid period suggesting a further strong relation between GDP and PCE changes.

# Augmented Dickey Fuller Test

After finding correlation between the various indicators, Augmented Dickey-Fuller (ADF) test was performed to check stationarity in time series data.

**Stationarity:** In time series analysis, a stationary time series is one whose statistical properties, such as mean and variance, remain constant over time.

**Parameters of ADF Test**
There are many parameters in this test out of which we have considered the following:
1. **Test Statistic (ADF):** This is a negative number that measures how much the series deviates from stationarity. The more negative the test statistic, the stronger the evidence for stationarity.
2. **P-value**: If the p-value obtained is less than a prespecified significance level (here we take 0.05), we reject the null hypothesis to conclude that the series is stationary.

**Results:**

## P-Value

| | PCE | GDP | PCE_Change | GDP_Change |
|---|---|---|---|---|
| Global Financial Crisis (2008-09) | 0.998443 | 0.998765 | 1.361779e-18 | 1.125522e-17 |
| Covid (2020-21) | 0.000000 | 0.002236 | 8.494580e-02 | 2.089435e-01 |
| Overall | 0.653058 | 0.961525 | 3.347842e-02 | 2.911378e-01 |

## Test Statistic

| | PCE | GDP | PCE_Change | GDP_Change |
|---|---|---|---|---|
| Global Financial Crisis (2008-09) | 1.849924 | 2.076544 | -10.460663 | -10.090497 |
| Covid (2020-21) | -89.229254 | -3.873846 | -2.640326 | -2.192596 |
| Overall | -1.247000 | 0.037499 | -3.015429 | -1.989631 |

## Inferences from the ADF Test:

We can infer the following:

1. In the global financial crisis (2008-09), PCE and GDP have a p-value close to 1. Also, the test statistic comes out to be non-negative. Hence, we can accept the null hypothesis assumption that they are non-stationary. The PCE_Change and GDP_Change have p-values close to 0, indicating stationarity. The sudden sharp decline in GDP and PCE may have caused the time series to become non-stationary due to a structural break. However, taking their first difference might have cancelled the effect making them stationary.
2. In the COVID period (2020-21), PCE and the GDP have a p-value close to 0, while test statistics is negative. Thus, we can reject the null hypothesis assumption (non-stationary), indicating that they are stationary. However, the GDP_change and PCE_change passed the significance level, showing non-stationarity. These results do not match our expectations because, during a pandemic, a country's economy is volatile and unpredictable.
3. In the non-crisis period we observe a more or less stationary series in all the indicators.

**A plausible explanation of the above inference can be:** The global financial crisis of 2008-09 caused a sharp decline in economic activity and a significant drop in GDP, which may have made GDP and PCE non-stationary due to a trend or a structural break. But during COVID, due to sound fiscal and monetary policy, the fluctuations in GDP were balanced over time. This inference aligns with our observation from the graph that the economy bounced back after a sharp decline in Q2 2020 when restrictions were eased. These fluctuations may have cancelled each other out and resulted in
a relatively stable statistical pattern for the GDP and PCE time series, which could have made it stationary.

## Autocorrelation analysis

After performing the ADF test, we did an autocorrelation analysis to examine the correlation between the series values at different lags. Autocorrelation is the correlation between a variable and its lagged values, and it can indicate whether there is a pattern or structure in the time series. The graph's blue region signifies the confidence interval, while the lines show the correlation coefficient. When the correlation coefficient lies inside the blue region, it indicates no autocorrelation and vice-versa.
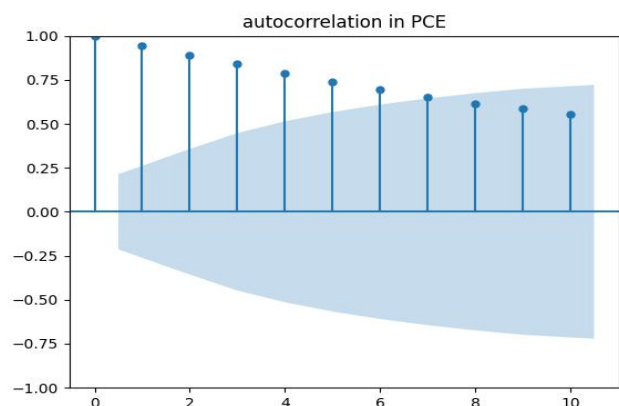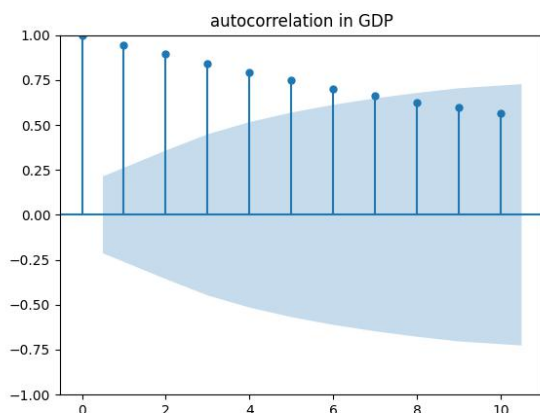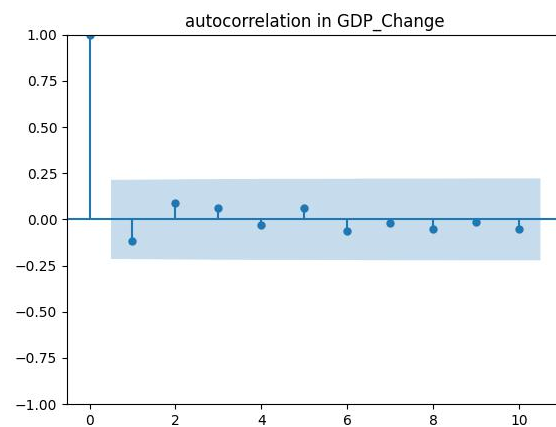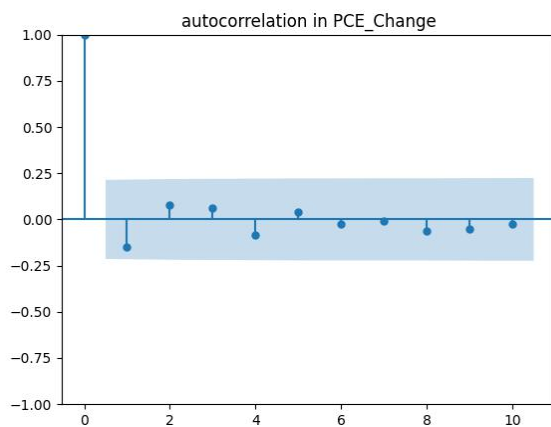
The above graph of PCE and GDP shows that a significant portion of the correlation coefficient lies outside the blue region, indicating that the series is autocorrelated. This signifies that there is some linear relationship between the current value of the series and its past values. Moreover, the autocorrelation graph also shows a clear and distinct pattern in the coefficients. So, here we can use a linear regression model for prediction.

## Regression Analysis

We performed regression analysis to understand the relationship between personal consumption expenditures percentage change and Gross domestic product percentage change. We also added one dummy variable *CRIS_PERIOD*, which indicates a crisis. Its value is one during a crisis and zero otherwise.

```
X = overall_data[['GDP_PCH', 'CRIS_PERIOD']]
y = overall_data['PCE_PCH']

reg_model_rev = LinearRegression().fit(X,y)
print("GDP_PCH coefficient : ", reg_model_rev.coef_)
print("Intercept : ", reg_model_rev.intercept_)
```

```
GDP_PCH coefficient :  [ 0.84757782 -0.0374257 ]
Intercept :  0.18984787165045713
```

$$PCE\_PCH = 0.84 GDP\_PCH - 0.037 CRIS\_PERIOD + 0.189$$

Observing the regression coefficients and intercept, a positive relationship exists between GDP and personal consumption expenditure. As GDP changes by 1%, personal consumption expenditure also tends to change by 0.84%, holding all other variables constant. However, it's important to note that the relationship between GDP and personal consumption expenditure is more complex. Other factors, such as consumer confidence, crises, and inflation, can impact consumer spending.

The coefficient of the dummy variable *CRIS_PERIOD* can help us observe the impact of the crisis period on consumer spending. The negative coefficient of the crisis period suggests that it decreases during the crisis. This finding aligns with the mentality of a consumer to decrease spending during periods of uncertainty, as income reduces and confidence in the economy wavers. They may be more cautious with their spending and prioritise essential items over discretionary purchases. They may also delay making

major purchases such as homes or cars until the economic situation stabilises. This behaviour can contribute to a downward spiral in economic activity as businesses face reduced demand for their products and services.

Lastly, a positive intercept value suggests that other factors beyond those included in the regression equation contribute to personal consumption expenditure. Additionally, the positive intercept value suggests that even in the absence of changes in GDP or economic crises, there is a baseline level of personal consumption expenditure beyond which personal consumption expenditure doesn't fall.

**On Non-Crises Data**

$PCE\_PCH = 0.63 GDP\_PCH + 0.4069$

**On COVID Data**

$PCE\_PCH = 1.122 GDP\_PCH - 0.06771$

This regression analysis suggests that changes in GDP significantly impacts personal consumption expenditure during economic crises compared to non-crisis times. And the minimum level of personal consumption expenditure can be predicted using the intercept value, which is more in non-crisis time than in crisis time, which may be because consumers may be more cautious with their spending.

## Conclusion

Our analysis of the relationship between consumer spending and economic growth in the US from 2002 to 2022 shows that personal consumption expenditure (PCE) strongly correlates with economic growth as measured by the GDP growth rate. The COVID-19 pandemic significantly impacted the US economy, with a sharp decline in GDP and PCE growth rates in Q2 2020. However, the economy rebounded, with GDP and PCE returning to pre-pandemic levels by Q4 2021. The report also indicates a stronger relationship between GDP and PCE during crises compared to non-crisis times. Also, consumer spending is found to decrease during crises. This observation aligns with the mentality of an average consumer to cut costs during economic hardships.

To conclude, our analysis highlights the importance of consumer spending in driving economic growth in the US. It underscores the contraction of the US economy in the face of external shocks such as the Global Financial Crisis and the economic slowdown due to COVID-19.

## References

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