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Original Paper

US Real GDP Growth and Impact of Covid-19

Dhameeth, G.S.[1*] & Diasz, L.[2]

[1] Department of Economics and Management, Wells College, Aurora, New York, USA

[2] Cambridge College of Business Management, Colombo, Sri Lanka (DBA Candidate-2021)

[*] Dhameeth, G.S., Associate Professor of Business, Department of Economics and Management, Wells College, Aurora, New York, USA

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Abstract

The global pandemic, COVID-19, has exacerbated the Gross Domestic Product (GDP) growth of the global economy since its outbreak in December 2019. One of the most affected economies, due to the global pandemic, is the US economy, currently crippled by an increased number of COVID-19 related deaths, layoffs, reduced work hours, and other related natural disasters, such as winter storms. Hence, it is imperative that the damage done to the GDP growth is evaluated meticulously to craft favorable monetary and fiscal policies to uplift economic performance. One of the key yet debated methods used by many economists is utilizing real GDP per capita as an economic performance measurement tool. Using two economic datasets and a multiple regression model, we compared real GDP per capita performance in the US economy between the second and third quarters of 2020. The study finds that the impact seems detrimental due to restrictions imposed on economic activities, such as business closures, disturbances in the supply chain, employee layoffs and reduced work hours. However, in the third quarter of 2020 COVID-19 after some of the COVID-19 imposed restrictions were lifted, the real GDP per capita significantly increased.

Keywords

US economy, gross domestic product, real GDP, COVID-19, economic impact

1. Introduction

The goal of an economy is to guarantee that wealth is created and distributed fairly among all constituents in that economy (Rosser & Rosser, 2018). Predominantly, there are two types of economies grounded by two well-known economists: capitalist and socialist economies. While Adam Smith theorized economic philosophy in line with capitalistic principles, Karl Marx established his economic thought to support socialist ideologies. Whatever the formation it takes, whether capitalist,

socialist or the blend of the two, it is imperative to measure the performance of the economy to evaluate the efficiency of the application of monitory and fiscal policies to manage the economy. Hence, one of the measurement tools an economy uses to measure performance is the real Gross Domestic Product (GDP) per capita (Chang, 2012). Economic performance varies in line with the influence of exogenous factors. These exogenous factors could be political, socio-cultural, technological, legal, or uncontrollable factors stem from mother nature. In the past, SARS withered many economies in terms of their real GDP per capita, the current global pandemic, COVID-19 is causing a similar impact. This paper attempts to evaluate the impact of events such as the COVID-19 induced recession of 2020 in the US economy using an Ordinary Least Squares (OLS) method to construct a linear regression model. This study used the US19602019 dataset including quarterly observations for T=239 quarters (second quarter of 1960 to fourth quarter of 2019). An open-source software package known as GRETL was used to run both base and revised models in analyzing data. The following sections provide a detailed discussion of the procedure and the findings based on the analysis.

1.1 GDP Per Capita

Studies have shown that the significance of GDP per capita in evaluating the economic performance of an economy is paramount. All the legitimate transactions in an economy will contribute to a positive impact on the GDP per capita. Some authors argue that government investment in education, innovation, technology, infrastructure, manufacturing, product and market competition, and other related economic activities positively contribute to an increase in GDP per capita (Chang et al., 2012; Pator et al., 2018; Próchniak, 2018). While many scholars support the use of GDP per capita as an effective measurement tool to measure economic performance, there is backlash rhetoric found in the body of literature. Jetter (2019) contends that GDP has not been a successful measurement tool to measure all economic activities, especially those that do not account for legitimate activities. However, based on the literature surveyed, it is evident that GDP per capita is the most frequently used economic activity measurement tool in most cases (Chang et al., 2012; Pator et al., 2018).

1.2 History: Impact of SARS (2003) on GDP Growth

The current global pandemic (COVID-19) has threatened all economies globally, impacting negatively on their Gross Domestic Product (GDP). In addition to the current pandemic, it is also vital to investigate similar events that hampered many economies in the past, especially to comprehend how it threatened GDP growth. SARS was another similar global pandemic that broke out in 2003. Hence, it is worth understanding the impact of SARS on GDP growth in various economies in the world. Out of all the economies that were negatively impacted, the Chinese economy suffered a significant loss due to the Severe Acute Respiratory Syndrome (SARS) in 2003. According to a survey conducted by Wen Hai et al. (2003), the authors found that during SARS, the most hampered industry in China was the tourist industry. The authors further emphasize that China’s tourism revenue from foreigners dropped by sixty percent (60%), amounting to a dollar value of US$ 10.8 billion compared to 2002. Based on the same study, the authors predicted China’s tourism industry revenue to encounter a loss of US$ 16.8 billion by

the end of the year 2003, and the growth rate of China's GDP in 2003 to be two percent (2%) points lower than before the SARS outbreak (Wen Hai et al., 2003). However, according to a separate study conducted by Hanna and Huang (2004), it becomes apparent that compared to the tourism industry, the Foreign Direct Investments (FDI) were further jeopardized due to the SARS outbreak in 2003—They extend their findings to illustrate how FDIs were negatively impacted in many neighboring countries such as Taiwan, Hong Kong, Thailand, and Singapore in the same year. Moreover, the authors determined that the losses suffered by the FDI directly impacted the overall GDP growth in the respective countries.

Cooper and Madigan (2003), argue that despite the heated housing market, rising inflation, increasing retail sales and consumer confidence levels, the Australian authorities decided to cut interest rates during the SARS pandemic outbreak in Asia in 2003. The Australian government expected to suffer a loss on their exports and tourism industries. Furthermore, the authors note that these two areas, exports and the tourism industry, will adversely affect the overall GDP growth by 3% in the same year. The expectations for GDP growth in 2003 had been revised down to 2.2% in the Canadian economy (Canada, 2003). This was due to two key reasons: the SARS outbreak in Asia and the ban on beef exports to the US. More specifically, SARS had devastated Canada's exports and tourism industry relatively severely.

Chen et al. (2009), based on an empirical study conducted in Taiwan, note that despite the negative impact of the SARS outbreak on the Taiwan economy and its GDP growth, it also presented some positive impacts. These positive impacts are related to the biotechnology sector in the economy. Moreover, the authors state that this is commonly seen in all the neighboring Asian countries, such as China, Hong Kong, and Singapore. These countries were able to maintain their GDP growth to some extent by producing biotechnology-related products, such as nanotechnology and photocatalysts, and healthcare products (Chen et al., 2009). Based on the above literature surveyed, it is evident that most of the countries suffered a decrease in GDP growth during the SARS outbreak in 2003. The key factors contributing to the decrease in overall GDP growth in countries were—tourism revenue, exports, FDI, and retail sales. However, some studies have reported positive impacts of the same outbreak in 2003. The positive impacts were reported in biotechnology and healthcare sectors that helped economies to minimize the magnitude of the damage caused by the SARS outbreak.

2. Model Estimate Results

2.1 Data

This study used the US19602019 dataset, including quarterly observations for T=239 quarters (second quarter 1960 to fourth quarter 2019). The dataset used for the base model has four variables and 239 observations. QTR—observation identifier in year: quarter format. The quarters are denoted as 00 for the first quarter, 25 for the second quarter, 50 for the third quarter, and 75 for the last or fourth quarter. DRGDP—quarterly change in real GDP per capita. RECESS—an indicator variable that equals 1 for

the first quarter of a recession and equals zero for all other quarters. RECOVER—an indicator variable that equals 1 for the first quarter after the end of a recession and equals zero for all other quarters. DRGDP (-1) represents the value of DRGDP from the previous quarter. The second dataset, US19602020, was used to measure the coefficients of the revised model. The dataset used for the revised model entailed six variables and 243 observations. The two additional explanatory variables included in the revised model were the second (Covid1) and third (Covid2) quarters of 2020.

2.2 Procedure Used

Predominantly, the results of the two models were compared; the base model and the revised model. Using the base model, summary statistics were observed. Ordinary Least Squares (OLS) was used to construct a linear regression model as the base model and the revised model to estimate the coefficients. Finally, the results were presented with a discussion on the findings in the subsequent section.

2.3 Base Model

Based on the descriptive statistics, it can be concluded that the average quarterly change in real GDP per capita was $176.07, the most significant increase in quarterly real GDP per capita from 1960 to 2019 was $1075.8, and finally, the largest decline in quarterly real GDP per capita from 1960 to 2019 was -$1286.1. The following table depicts the summary statistics yielded.

Table 1. Summary Statistics (observations 1960:1-2019:3)

Mean	176.07
Median	191.50
Min	-1286.1
Max	1075.8
Standard dev	278.17
Skewness	-0.94070
5% percentile	-329.80
95% percentile	588.50
IQR	311.80
Missing obs.	0

Source: *GRETL output*

The base model was developed using DRGDP (y-variable) and RECESS, RECOVER, and DRGDP (-1) as explanatory variables (see below regression base model).

$DRGDP = b_1 + b_2*RECESS + b_3*RECOVER + b_4*DRGDP(-1)$

Based on the base model developed and presented above, data was used to test the coefficients of the base model. The following table provides the regression output yielded.

Table 2. Base Model Regression Output

	Coefficient	Std.error	t-ratio	p-value
Const	115.750	20.3095	5.699	3.60e-08 ***
RECESS	-404.312	96.6452	-4.183	4.06e-05 ***
RECOVER	220.806	93.6672	2.357	0.0192 **
DRGDP_1	0.378245	0.0607606	6.225	2.20e-09 ***

Source: *GRETL output: R-squared 0.189532, adjusted R-squared 0.179141, P-value (F) 1.14e-10*

Based on the R-Squared statistic of 0.189532 yielded (see Figure 2), it can be concluded that it is only 19% of the variation in the real GDP per capita (DRGDP) is explained by the regressor variables (const,_RECESS,_RECOVER, and DRGDP_1) included in the model. In other words, the R-Squared value implies that there could be other factors that are not considered in the model that explain 81% of the variation of the real GDP per capita (DRGDP). Based on the F-Statistic (p-value) of 1.14e-10 (0.000000000114) yielded, which is < 0.1, it can be concluded that there is no significant evidence to accept the null hypothesis. In other words, there is statistical evidence to conclude that the model has explanatory power for real GDP per capita (DRGDP). B_1 (const) estimate yielded is 115.75. Technically, b_1 estimate is the value yields (y-intercept) when the regressor is at zero (x-axis). This can be interpreted as the dollar value of the real GDP per capita yielded is $115.75 when there is $0 increase from the regressor variables (recession, recover, and real GDP per capita last quarter). B3 estimate yielded is 220.81. This can be interpreted as a $1 increase in the economic recovery will increase $220.81 real GDP per capita. Based on the p-values in the GRETL output, none of the explanatory variables in the base model is significantly different from zero as they all have p-values < 0.1

2.4 Revised Model

The base model was developed, adding two more explanatory variables to the base model. The dataset used to analyze in this model was expanded to include the four quarterly observations for 2020. The revised model entails one response variable and five predictor variables. Compared to variables used in the base model, the additional predictor variables, indicate the second and third quarter of the COVID-19 impact of 2020. Following is the revised model developed to test the coefficients;

$DRGDP = b_1 + b_2*RECESS + b_3*RECOVER + b_4*COVID1 + b_5*COVID2 + b_6*DRGDP\ (-1)$

Based on the base model developed and presented above, data was used to test the coefficients and the level of significance based on the p-values of the revised model. The R-squared value interprets the variation of the real GDP per capita explained by the model. GRETL, an open-source statistical software, was used to analyze the data. The following table provides the regression output yielded.

Table 3. Revised Model Regression Output

	Coefficient	Std.error	t-ratio	p-value
Const	134.390	20.1075	6.684	1.67e-010 ***
RECESS	-386.495	101.741	-3.799	0.0002 ***
RECOVER	172.865	97.3178	1.776	0.0770 *
COVID1	-5033.27	287.957	-17.48	1.88e-044 ***
COVID2	5025.07	374.839	13.41	7.58e-031 ***
DRGDP_1	0.239263	0.0470188	5.089	7.36e-07 ***

Source: *GRETL output: R-squared 0.749649, adjusted R-squared 0.744345, P-value (F) 6.82e-69*

Based on the above table of the regression output of the revised model of real GDP per capita, the R-Squared statistic is 0.75, which explains the variation of real GDP per capita by the model. Based on the R-Squared statistic of 0.75, it can be interpreted that the explanatory variables of the revised model, such as recession, recovery, both quarters of COVID-19 (b4 and b5), and the value of DRGDP from the previous year (DRGDP [-1]), explain only 75% of the variation of real GDP per capita. Moreover, the balance 25% explanation depends on any other variable or variables that are not considered in this model. The f-statistic is used to test the hypothesis; H0: explanatory variables regression coefficients = 0. In other words, it hypothesizes that the model has no explanatory power. The f-statistics yielded (p-values) from the above regression output of the revised model are less than 0.1. Hence, all the coefficients are significantly different from zero. As such, it can be concluded that the model has significant explanatory power.

Table 4. Model Comparison

	Base Model	Revised Model
b1- Const	115.750	134.390
b2 - RECESS	-404.312	-386.495
b3 - RECOVER	220.806	172.865
DRGDP (-1)	0.378245	0.239263

Based on the above table, the intercept (b1) has increased in the revised model compared to the base model. However, an increase of $1 in recession (b2) has reduced real GDP per capita by $386.50 according to the revised model. As per the base model estimates, a $1 increase in recession has reduced real GDP per capita by $404.31, a relatively high magnitude of damage to the economy. Based on recovery (b3) estimates between the two models, it is apparent that both estimates are positive. Therefore, a $1 increase in recovery, according to the base model, will increase $220.81of real GDP per capita.

Similarly, according to the revised model, a $1 increase in recovery, will increase $172.87 of real GDP per capita. Comparing the base model with the revised model, it can be interpreted that the revised model, with regards to recovery (b3), has a relatively higher impact on real GDP per capita. The quarterly change (DRGDP [-1]) based on the previous quarter, is high according to the base model estimates compared to the revised model. Hence, it can be concluded that the quarterly change of real GDP per capita is low as per the revised model coefficients compared to the base model. Based on the GRETL regression results (see Figure 2), the impact estimate of COVID1 on real GDP per capita is -5033.27. This can be interpreted as one unit change in COVID1 will result in a loss of $5033.27 on real GDP per capita due to the economic restrictions caused by the pandemic. The impact estimate of COVID2 on real GDP per capita is 5025.07. This can be interpreted as one unit of change in COVID2 will result in the recovery of $5025.07 on real GDP per capita due to the lifting of pandemic restrictions on the US economy.

3. Conclusion

GDP per capita is an economic performance measurement tool used despite some resistance from a few scholars. Economic performance is subject to impacts from external and unavoidable forces. One of the unavoidable circumstances many economies, especially the East Asian economies, such as China, Singapore, Taiwan, Hong Kong, faced in the past was the SARS outbreak in late 2003. Currently, the most economic-damaging pandemic, COVID-19, has withered many economies globally. The US economy is one of the economies that is adversely affected by the current pandemic. Hence, this paper investigated the impact of the COVID-19 pandemic on the US economy using two models; base and revised. Based on the study conducted, data suggests that before COVID-19, the recession and recovery significantly impacted the US economy. After considering the impact of the COVID-19 pandemic during the second quarter of 2020, the impact seems detrimental due to restrictions imposed on economic activities, such business closure, disturbances in the supply chain, and employee layoffs and reduced work hours. However, the-third quarter of 2020, especially following the eradication of some of the restrictions imposed, the real GDP per capita significantly increased. Based on the above premise, it can be concluded that the ongoing pandemic, COVID-19, has severely impacted the US economy.

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