A Regression Analysis of the probability of a recession and student loan debt utilizing data between 1993-2019

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Abstract

Over 44.7 million Americans carry student loan debt, with the total amount valued at approximately \$1.31 trillion (*Quarterly Report*, 2019). Ergo, consumer spending, a factor of GDP, is stifled and negatively impacts the economy (Frizell, 2014, p. 22). This study examined the relationship between student loan debt and the probability of a recession in the near future, as well as the effects of proposed student loan forgiveness policies through the use of a created model. The Federal Reserve Bank of St. Louis's website (FRED) was used to extract data regarding total GDP per quarter and student loan debt per quarter ("Federal Reserve Economic Data," 2019). Through the combination of the student loan debt per quarter and total GDP per quarter datasets, the percentage of total GDP composed of student loan debt per quarter was calculated and fitted to a logistic curve. Future quarterly values for total GDP and the percentage of total GDP composed by student loan debt per quarter were found through Long Short Term Models and Euler's Method, respectively. Through the creation of a probability of recession index, the probability of recession per quarter was compared to the percentage of total GDP composed by student loan debt per quarter to construct an exponential regression model. Utilizing a primarily quantitative method of analysis, the percentage of total GDP composed by student loan debt per quarter was found to be strongly associated [$p < 1.26696 * 10^{-8}$] with the probability of recession per quarter ($p(R)$), with the $p(R)$ tending to peak as the percentage of total GDP composed of student loan debt per quarter strayed away from the carrying capacity of the logistic curve. Inputting the student loan debt forgiveness policies of potential congressional bills proposed by lawmakers found that eliminating 49.7 % and 36.7% of student loan debt

would reduce the recession probabilities to be $1.73545 * 10^{-29} \%$ and $9.74474 * 10^{-25} \%$, respectively.

Introduction

In recent years, American society has seen a massive socio-cultural shift where pursuing some means of higher education, with the most common choice being a college education, is no longer just optional, but an expected and necessary investment for the futures of many young adults. While on the surface level, a college diploma appears to open the door to numerous opportunities for graduates, there comes a high price for the aforementioned result: student loans.

Student loans, also known as student debt, are a means of financial assistance that is primarily designed to support students in paying for college tuition/board and daily expenses (in college). These means of financial assistance do, in turn, assist many students in attending college, but the cost of taking out these loans can be financially devastating. All loans, like student loans, have some form of collateral in the case that the borrower does not recompense their loans. Specifically, in the case of student loans, the collateral is future earnings of the borrower, and when these loans aren't repaid, the lender can garnish the borrower's: credit, wages, social security, and even offset and take the defaulter's perceived tax refund ("Student Loan system presents repayment challenges," 2019).

As discussed earlier, student loans can have calamitous effects on borrowers/defaulters, but what public perception fails to cover are the possible consequences that student loans can have on the overall economy of the country (United States). In total, American families carry about 1.6 trillion dollars in student loan debt, approximately 8% of the national income ("Federal Reserve Economic Data," 2019). This tremendous amount of debt has a number of effects on the

American people ranging from delaying marriage and family formation (later marriages have also been attributed to greater poverty rates) to hampering the growth of small businesses (a decrease of over 70 small businesses per county) who are responsible for approximately 60% of all employment in the United States (Addo, Houle, & Sassler, 2018, p. 92). Possible ramifications, such as those aforementioned, carry a negative impact on the United States' economy as a whole and are partially responsible for increasing the debt of the United States (Greenstone & Looney, n.d., p. 3).

Given the numerous effects of student loan debt on the national economy, many researchers have proposed the idea of student loan forgiveness programs. These programs release borrowers from the obligation to repay part or all of their federal loan debt. The debate on this issue concerns who the student loan debt forgiveness programs should be implemented by, who they should benefit, and to what extent should it be implemented. Sunday Fakunmoju, an associate professor in the department of social work at Westfield State University, argues in his paper, "Perceived Effects of Student Loan Forgiveness on Turnover Intention among Social Workers in Massachusetts" that student loan debt forgiveness programs should be implemented by employers for the reason that it would provide incentives for workers to stay at their current jobs and reduce the need for additional tax hikes throughout the country, as would happen if the government implemented mass student forgiveness programs (Fakunmoju, 2016, p. 332). This same argument was made by members of Congress as they reintroduced the Employer Participation in Repayment Act in February 2019. This bill would seek to relieve employees' financial burdens through employer-based student loan forgiveness programs ("S.460 - Employer Participation in Repayment Act of 2019," 2019). The main difference between this

proposed program and Fakunmoju's claim is that the bill would have a cap of \$5,250 per year and would also allow the contribution to be tax-free. Solutions such as the one proposed above are ideal, as they result in increased consumer spending and continued federal funding, since the government does not have to directly forgive these loans, simultaneously providing benefits for the economy. According to Senator Lamar Alexander of Tennessee, the main issue with this solution is the lack of a guarantee that all employers will assist their employees in reducing student loan debt ("Prominent Republican wants to take student-loan payments out of your paycheck," 2019). For that reason, there have been many arguments in favor of government implemented student loan forgiveness programs. Two of the most popular programs have been proposed by South Bend, Indiana Mayor Pete Buttigieg and Massachusetts Senator Elizabeth Warren. Both of their plans revolve around student loan forgiveness programs funded by the government. Buttigieg's plan would include making public college truly debt-free for lower-income families, while Senator Warren's plan would offer \$50,000 in loan forgiveness for anyone making less than \$100,000 per year, offer tiered loan forgiveness to those making more than \$100,000 per year, and offer no forgiveness to those making more than \$250,000 per year (Myong, 2019). On the other hand, Holger M. Mueller, the Nomura Professor of Finance at New York University's Leonard N. Stern School of Business, states that having the government implement immediate student loan forgiveness programs would decrease the amount of federal funding available to public schools and further incentivize colleges to raise prices (Mueller & Yannelis, 2019, p. 12). This claim is further substantiated by Kenya McCullum, a freelance writer with extensive experience covering topics such as education, the workplace, health, and legal issues, in her paper, "For-Profit Frenzy", published in the Journal of College Admissions.

In this paper, McCullum states that student loan forgiveness programs established during the Obama administration were ineffective, caused decreases in federal funding, and negatively impacted the economy to make her final claim that government implemented student loan debt programs decrease federal funding and could even do more damage to the already fragile condition of the economy (McCullum, 2019, p. 6).

This dialogue between many researchers and law-makers revolves around the main aspects of student debt forgiveness programs which are: who should implement these programs, and, most importantly, what impact will these programs have on the economy. This, in turn, leads to the purpose of this study: to create a model that can be used to analyze the effects of student loan debt forgiveness programs on the economy. This would allow for law-makers and researchers to come to a consensus on the best approach to curb the negative effects of student loan debt on the economy as such a tool does not currently exist.

Method

The purpose of this study was to create a model to determine the effects of student loan debt on the United States economy, whether or not a recession would occur due to this debt, and the effects of student loan debt forgiveness programs on the U.S economy. This was accomplished through a detailed analysis and creation of a model that would predict the student loan debt and GDP for the next two quarters and the probability of a recession given the implementation of student loan debt forgiveness programs. This would be done through an evaluation of past student loan debt data, total GDP data, consumer spending data, and federal funding data, which were all provided by the Federal Reserve Bank of St. Louis Economic Research Department ("Federal Reserve Economic Data," 2019). A correlational research

methodology was adopted to evaluate a multitude of sources in order to find the association between student loan debt, total GDP, student loan forgiveness programs, and the probability of a recession.

The Federal Reserve Bank of St. Louis (FRED) served as the primary source of data for this study. This service was selected because no other academic databases contain similar information required by the study. The FRED database offers comprehensive data regarding the GDP and Student Loan Debt for every quarter between 1993 and 2019.

Of all the information offered, the researcher only focused on the student loan debt data and total GDP data as it is the most relevant to this study. To aid the data extraction process, the researcher utilized a Python library, pandas, to interact with the FRED dataset and download the required files.

The researcher trained a Long Short Term Memory (LSTM) model, an artificial recurrent neural network (a series of algorithms that connects underlying relationships in the data and can predict future outputs), with the already available data points provided by FRED (total GDP dataset) and predicted the future total GDP Values for Q4 of 2019 through Q2 of 2021. The reason the researcher did not use a convolutional neural network (CNN) in this scenario was because CNN's consist of multiple layers of filters requiring larger amounts of data which were not available at the time of the study. This combined with the previous FRED total GDP values constitutes [DATASET2]. To train this LSTM model, the researcher included the following architecture: an Input layer (inputs the features with time steps into the model), an LSTM layer with 512 neurons (a recurrent layer that derives features of the time series data), a dropout layer with 0.2 dropout (a layer that randomly turns on and off neurons to optimize generalization of

the model), and an output dense layer with 2 neurons (a data layer that outputs the results of the model). The reason for employing a neural network to predict the total GDP values was due to the elevated level of accuracy neural networks possess compared to regression lines and tangential line estimation (Ornes, 2020, p. 2). Additionally, the neural networks allowed for the creation of datasets that would be used later to create the final exponential regression model. All referenced datasets and graphs are included in the results and supplementary materials sections.

Next, the percent GDP growth [DATASET3] for each quarter was calculated using the function $[GDP \text{ growth} = ((c/p)^4 - 1) * 100]$ where c represents the specific quarter's GDP, and p represents the previous quarter's GDP. The previous and current quarter's GDP values were obtained using [DATASET2].

Then, the researcher calculated the probability of a recession using the method described in Chauvet and Hamilton (2005). The method consists of obtaining the probability distributions of both recession and expansion periods between 1967 Q4 to 2019 Q3. The probability distribution of both recession and expansion periods is represented by $r(x)$ and $e(x)$, respectively. Since approximately 80 percent of post-war quarters are defined as expansion, and about 20 percent of post-war quarters are defined as recessions, the recession probability distribution is multiplied by 0.2 , and the expansion probability distribution is multiplied by 0.8 (Chauvet & Hamilton, 2005). By adding both recession and expansion probability distributions together, the researcher obtained the mixture probability distribution. Additionally, by taking the ratio between the recession probability distribution and the mixture probability distribution, the researcher arrived at a function showing the conditional probability of a recession given an observed value of GDP growth. Therefore, the final equation for calculating the probability of a

recession occurring based on a quarter's GDP growth can be modeled by the function

[Probability of Recession for quarter = $\frac{0.2 * r(x)}{0.2 * r(x) + 0.8 * e(x)}$], where x represents GDP for a specific quarter. The researcher then graphed the probability of a recession occurring for each quarter (calculated using the percent change in GDP from quarter to quarter), with the probability of recession on the y-axis and each quarter placed on the x-axis [GRAPH1].

After downloading the total GDP and total student loan debt data sheets in the form of CSV files, the researchers created a program in Python that would take the following datasets and find the percentage of total GDP composed by student loan debt (labeled as DATASET1). Next, the researcher took DATASET1 (percentage of total GDP composed by student loan debt) for the time period 1993-2008, and used a curve-fitting function of another Python library, Scipy, to fit the data to a logistic curve represented by $[y = 0.78670777 / (1.0 + (14.7347e^{-0.136590x}))]$ [labeled as GRAPH2]. In order to clearly view the carrying capacity, and if the predicted values went above the carrying capacity, the equation $[y = 0.78670777 / (1.0 + (14.7347e^{-0.136590x}))]$ was subtracted from the carrying capacity, resulting in a new equation of $[y = 0.78670777 - (0.78670777 / (1.0 + (14.7347e^{-0.136590x})))]$. This new graph [GRAPH7] was used to create the exponential regression mentioned below for the years 1993-2008. Next, the researcher took [DATASET1] (percentage of total GDP composed by student loan debt) for the time period 2008-2019 and used the curve-fitting function again to fit the data to a logistic curve modeled by $[y = 6.063679 / (1.0 + (3.92249750e^{-0.1229486739x}))]$ [GRAPH3]. To estimate the percentage of total GDP composed of student loan debt for Q4 of 2019-Q4 of 2020, Euler's method—a form of numerical integration that approximates the solution of a first-order differential equation where an initial point on the solution curve is known—was utilized. The differential equation

used for Euler's method was $[(2.92428558296e^{-0.1229486739x})/(1 + 3.92249750e^{-0.1229486739x})^2]$.

Neural Networks were not used to estimate the percentage of total GDP composed of student loan debt for Q4 of 2019-Q4 of 2020 due to a lack of space in the computer's RAM. In order to easily view the carrying capacity, and if the predicted values went above the carrying capacity, the equation $[y = 6.063679/(1.0 + (3.92249750e^{-0.1229486739x}))]$ was subtracted from the carrying capacity. Therefore, the new equation would be $[y = 6.063679 - (6.063679/(1.0 + (3.92249750e^{-0.1229486739x})))]$. This new graph [GRAPH6] was used to create the exponential regression mentioned below for the years 2008-2021.

To examine if student loan debt had any correlation to the probability of a recession, the quarters with the highest probabilities of a recession were identified using [GRAPH1], and the percentages of total GDP composed by student loan debt at those specific quarters [GRAPH6 & GRAPH7] were also pinpointed. This was conducted for both the 1993-2008 and 2008-2020 datasets. Since the highest probabilities of recession occurred at approximately the same time that the points of the logistic curves started straying from the carrying capacity, it can be shown that there is an association between the probability of a recession occurring for each quarter [GRAPH1] and the aforementioned logistic curve models [GRAPH6 & GRAPH7]. To accompany these qualitative observations, two exponential regressions shown in [GRAPH4 & GRAPH5] were performed with, the probability of a recession occurring for each quarter [GRAPH1], and the aforementioned logistic curve models [GRAPH6 & GRAPH7] for both time periods. The equation for the final 2008 exponential regression model [GRAPH4] was $[\text{Probability of Recession} = 24.708971185569812 * e^{-10.492962541789721x}]$, while the equation for

the 2020 exponential regression model [GRAPH5] was [Probability of Recession = $13.09755589976239 * e^{-23.286083003397874x}$].

In order to accomplish the original objective of the study, which was to analyze the impact of student loan debt forgiveness policies on the probability of a recession, the student loan forgiveness plans of 2020 presidential candidates Elizabeth Warren and Pete Buttigieg were inputted into an equation (listed below) to find the GDP after their plans were implemented, and then, consequently, to find the probabilities of recession for each of their plans in 2020 Q1 by entering the amount of student loan debt being eliminated into exponential regression model equation for 2008-2020. As found by the Levy Bard Economic Institute, if all of student loan debt was eliminated (1.6 trillion dollars) then the GDP would increase by 108 billion dollars (Fullwiler, Kelton, Ruetschlin, & Steinbaum, 2018). To calculate the effect of the student loan forgiveness policies on the probability of recession, an equation was utilized: $\{[(\text{the amount of student loan debt being eliminated}/\text{the total student loan debt}) * 108 \text{ billion dollars}] + (\text{2020 Q1 predicted GDP})\}$.

Results

[GRAPH1] below shows the probability of a recession occurring for each quarter (calculated using the percent change in GDP from quarter to quarter). The results of GRAPH1 until 2021 Q2 display that the highest probabilities of recession before 2020 existed at the quarters where the National Bureau of Economic Research (NBER) declared that the most recession occurred. The most recent highest probabilities of recession occurred from 2008 Q1 to 2009 Q2, while the NBER declared that the most recent recession also occurred from 2008 Q1 to

2009 Q2. An upcoming recession is predicted to occur between the beginning of 2020 Q1 and end in 2020 Q4.

[GRAPH 1]

[GRAPH2] presents the percentage of total GDP composed of student loan debt for the time period 1993-2008 by plotting the presented points on a logistic curve with the equation of [$y = 0.78670777 / (1.0 + (14.7347e^{-0.136590x}))$].

[GRAPH2]

However, to normalize the data, the individual data points are subtracted from the carrying capacity of the logistic function to represent the distance from the carrying capacity as the distance from the x-axis. Thus, the final equation for the logistic curve is

$[y = 0.78670777 - (0.78670777 / (1.0 + (14.7347e^{-0.136590x})))]$, and the final graph [GRAPH7] is shown below.

[GRAPH7]

[GRAPH3] presents the percentage of total GDP composed of student loan debt for the time period 2008-2021 by plotting the presented points on a logistic curve with the equation of $[y = 6.063679 / (1.0 + (3.92249750e^{-0.1229486739x}))]$. This graph includes the predicted percentage of total GDP composed of student loan debt values until Q4 2020, since that is when the recession is predicted to end.

[GRAPH3]

However, to normalize the data, the individual data points are subtracted from the carrying capacity of the logistic function to represent the distance from the carrying capacity as the distance from the x-axis. Thus, the final equation for the logistic curve is $[y = 6.063679 - (6.063679 / (1.0 + (3.92249750e^{-0.1229486739x})))]$, and the final graph [GRAPH6] is shown below.

[GRAPH6]

An examination of the quarters with the highest probabilities of a recession using [GRAPH1] and the percentages of total GDP composed by student loan debt at those specific quarters using [GRAPH2 & GRAPH3] was conducted. It was found that at the highest

probabilities of recession, the percentages of total GDP composed by student loan debt at those specific quarters tended to be greater than the carrying capacity values. for both 1993-2008 and 2008-2021.

To further substantiate these qualitative observations, the equations of the two exponential regression models that were created for the time periods 1993-2008 and 2008-2021 between the highest probabilities of a recession and the percentages of total GDP composed by student loan debt at those specific quarters are [Probability of Recession = $24.708971185569812 * e^{-10.492962541789721x}$] for the 2008 model, and [Probability of Recession = $13.09755589976239 * e^{-23.286083003397874x}$] for the 2020 model. The accuracy of the above-mentioned exponential regression models is shown by the summary statistics below, where it can be seen that the p-value, derived from the chi-square goodness-of-fit value, is significant for both models $p < .05$.

[2008 MODEL - GRAPH4]

[2020 MODEL - GRAPH5]

[2008 MODEL STATISTICS]

Fitting Method	Least Squares
Chi-Square	1092.50472
Reduced Chi-Square	182.084119
Akaike Info. Criterion	43.3342936
Bayesian Info. Criterion	43.4931767
P-value	0.0 (indifferentiable from 0)

[2020 MODEL STATISTICS]

Fitting Method	Least Squares
Chi-Square	47.8483959
Reduced Chi-Square	7.97473264
Akaike Info. Criterion	18.3087684
Bayesian Info. Criterion	18.4676515
P-value	1.26696E-08

Using the aforementioned exponential regression model for 2008-2021, the student loan debt forgiveness plans of 2020 presidential candidates Elizabeth Warren (eliminating 640 billion) and Pete Buttigieg (eliminating 540 billion) were inputted into the equation $[(\text{total student loan debt} - \text{amount of student loan debt being eliminated}) / \{[(\text{the amount of student loan debt being eliminated} / \text{the total student loan debt}) * 108 \text{ billion dollars}] + (2020 \text{ Q1 predicted GDP})\}]$ and then consecutively inputted into the exponential regression model (Myong, 2019). It was found that with Elizabeth Warren's plan of eliminating \$640,000,000,000 from total student loan debt, the probability of a recession occurring for the 2020 Q1 drops to $1.73545 * 10^{-29}$ percent. However, with Pete Buttigieg's plan of eliminating \$540,000,000,000 from total student loan debt, the probability of a recession occurring for the 2020 Q1 drops to $9.74474 * 10^{-25}$ percent.

Discussion

The devised model and equation found a larger percentage of eliminated student loan debt is associated with lower probabilities of recessions. The model specifically found that between Pete Buttigieg and Elizabeth Warren's student loan debt forgiveness policies, Warren's policy reduced the probability of a recession by the greatest amount — the probability of recession being $1.73545\text{E-}29$ percent. This can be attributed to the fact that Elizabeth Warren's plan was to eliminate approximately 49.7% of student loan debt, or \$640,000,000,000, and as the percentage of GDP made up by student loans decreased, the probability of recession decreased as

well (Myong, 2019). The accuracy of this model is supported by the $p < .05$, derived from the chi-square value.

Limitations

It is necessary to keep in mind, however, that the created model does not take specific factors of GDP into account; furthermore, the model does not attempt to predict the values of the individual factors of GDP. This can have a detrimental effect on the accuracy of the model as there are possibilities that specific factors of GDP could change at different rates, potentially altering the rate at which total GDP strays away from a logistic curve.

Another limitation of this model concerns an assumption made at the beginning of the study — that the impacts of economic policies other than those concerning student loan debt forgiveness were not considered. This implies that if another economic policy was implemented within the time frame of reference, it would not have been factored into the model to predict the GDP.

Furthermore, to calculate the probability of an upcoming recession, the most recent quarterly data (2019 Q4) was not released within the time-frame that the study was conducted. This could lead to inaccuracies within the model, as the more recent the data, the higher the accuracy of the model.

Future Research

Due to the increase in the probability of recession associated with the increased student loan debt, further studies concerning student loan debt forgiveness programs are very important. For future research in this topic, all the factors of GDP (consumer spending, government spending, investment, and net exports) should be considered in order to find a student loan debt

forgiveness plan that both maximizes GDP by increasing consumer and government spending and minimizes the decrease in business investment caused by student loan debt forgiveness (Frizell, 2014, p. 22). Additionally, instead of using Euler's method of creating a multitude of tangent lines to estimate the percentage of total GDP composed of student loan debt in the next quarters, an additional LSTM neural network should be used to generate greater accuracy with the prediction and reduce mathematical error. If LSTM neural networks were to be used for the entirety of the study, then instead of an exponential regression as the final model to predict the effect of student loan debt forgiveness plans on the economy, the multiple LSTM neural networks could be integrated for the creation of a convolutional neural network (CNN) which would predict the effects without having to create a general regression line, minimizing the error exponentially. A CNN is able to be used at this point since through the integration of multiple LSTM's the amount of data available to filter would increase making this a plausible method. In future studies that revolve around this gap, multiple sources of data should be used compared to just the Federal Reserve of St. Louis data as was in this study. This would provide a more accurate model, reducing the risk of the data being skewed and inadvertently increasing the normality of the datasets. Finally, to potentially provide such a study with increased versatility, adding an additional element of how the average income of those who possess a higher amount of student loan debt compared to those with lower amounts of student loan debt would help outline the possible multiplier effect of student loan debt on the GDP. This was not included in this study due to the fact that to obtain this data, a census like survey would have to be sent out across the entire United States. The model created in this project has the capability to be applied in numerous other prediction instances. Such a system has the potential to be completely

automated in the future. This could be accomplished by using an API for the Federal Reserve Bank of St. Louis and retrieving the Student Loan Debt Data and Gross Domestic Product Data.

Appendix A

The aforementioned datasets [DATASET 1, DATASET2 & DATASET3] are provided below.

[DATASET1]

DATE	VALUES	DATE	VALUES	DATE	VALUES	DATE	VALUES
1993-10-01	0.00503298	2000-04-01	0.527973212	2006-10-01	0.774112952	2013-04-01	4.090473777
1994-01-01	0.004918734	2000-07-01	0.567277061	2007-01-01	0.789502447	2013-07-01	4.273753753
1994-04-01	0.004884826	2000-10-01	0.571528471	2007-04-01	0.777716429	2013-10-01	4.305514848
1994-07-01	0.007611435	2001-01-01	0.614787968	2007-07-01	0.791193507	2014-01-01	4.540018726
1994-10-01	0.092082291	2001-04-01	0.629214191	2007-10-01	0.787773675	2014-04-01	4.541972886
1995-01-01	0.091381759	2001-07-01	0.667827827	2008-01-01	0.826562539	2014-07-01	4.70057625
1995-04-01	0.081928538	2001-10-01	0.679812395	2008-04-01	0.826409663	2014-10-01	4.740908527
1995-07-01	0.09326934	2002-01-01	0.705277028	2008-07-01	0.883035718	2015-01-01	4.93368115
1995-10-01	0.118133141	2002-04-01	0.701317803	2008-10-01	0.928270894	2015-04-01	4.947269134
1996-01-01	0.146610496	2002-07-01	0.731883431	2009-01-01	1.020441977	2015-07-01	5.105269295
1996-04-01	0.162321172	2002-10-01	0.727004191	2009-04-01	1.074769123	2015-10-01	5.175053438
1996-07-01	0.190975536	2003-01-01	0.743317816	2009-07-01	1.27052036	2016-01-01	5.371981097
1996-10-01	0.213940556	2003-04-01	0.726287526	2009-10-01	1.590440703	2016-04-01	5.371692921
1997-01-01	0.245280954	2003-07-01	0.720226957	2010-01-01	1.682984237	2016-07-01	5.512134664
1997-04-01	0.268640335	2003-10-01	0.6998392	2010-04-01	1.774040342	2016-10-01	5.524955056
1997-07-01	0.295677287	2004-01-01	0.716457963	2010-07-01	2.148426944	2017-01-01	5.664463711
1997-10-01	0.315255455	2004-04-01	0.69971171	2010-10-01	2.386902089	2017-04-01	5.673921142
1998-01-01	0.354108959	2004-07-01	0.708262959	2011-01-01	2.707887332	2017-07-01	5.780104574
1998-04-01	0.374438429	2004-10-01	0.687358878	2011-04-01	2.778560587	2017-10-01	5.751213294
1998-07-01	0.405565252	2005-01-01	0.700749459	2011-07-01	3.032295719	2018-01-01	5.860356505
1998-10-01	0.392899025	2005-04-01	0.688891158	2011-10-01	3.132087822	2018-04-01	5.809954736
1999-01-01	0.431505371	2005-07-01	0.69783068	2012-01-01	3.317110034	2018-07-01	5.900653656
1999-04-01	0.449247345	2005-10-01	0.673716405	2012-04-01	3.457671581	2018-10-01	5.915798617
1999-07-01	0.479835684	2006-01-01	0.80928802	2012-07-01	3.704259129	2019-01-01	6.017258685
1999-10-01	0.484757729	2006-04-01	0.797145792	2012-10-01	3.803736238	2019-04-01	5.99030462
2000-01-01	0.522490724	2006-07-01	0.796533239	2013-01-01	4.014800365	2019-07-01	6.09436757

[DATASET2]

DATE	GDP	DATE	GDP	DATE	GDP	DATE	GDP	DATE	GDP	DATE	GDP	DATE	GDP	DATE	GDP
1947-04-01	245.968	1955-07-01	430.221	1963-10-01	653.94	1972-01-01	1230.6	1980-04-01	2797.35	1988-07-01	5282.84	1996-10-01	8259.771	2005-01-01	12761.337
1947-07-01	249.585	1955-10-01	437.092	1964-01-01	669.82	1972-04-01	1266.4	1980-07-01	2856.48	1988-10-01	5399.51	1997-01-01	8362.855	2005-04-01	12910.022
1947-10-01	259.745	1956-01-01	439.746	1964-04-01	678.67	1972-07-01	1290.6	1980-10-01	2985.56	1989-01-01	5511.25	1997-04-01	8518.825	2005-07-01	13142.873
1948-01-01	265.742	1956-04-01	446.01	1964-07-01	692.03	1972-10-01	1328.9	1981-01-01	3124.21	1989-04-01	5612.46	1997-07-01	8662.823	2005-10-01	13332.316
1948-04-01	272.567	1956-07-01	451.191	1964-10-01	697.32	1973-01-01	1377.5	1981-04-01	3162.53	1989-07-01	5695.36	1997-10-01	8765.907	2006-01-01	13603.333
1948-07-01	279.196	1956-10-01	460.463	1965-01-01	717.79	1973-04-01	1413.9	1981-07-01	3260.61	1989-10-01	5747.24	1998-01-01	8866.48	2006-04-01	13749.806
1948-10-01	280.366	1957-01-01	469.779	1965-04-01	730.19	1973-07-01	1433.8	1981-10-01	3280.82	1990-01-01	5872.7	1998-04-01	8969.699	2006-07-01	13867.469
1949-01-01	275.034	1957-04-01	472.025	1965-07-01	749.32	1973-10-01	1476.3	1982-01-01	3274.3	1990-04-01	5960.03	1998-07-01	9121.097	2006-10-01	14037.228
1949-04-01	271.351	1957-07-01	479.49	1965-10-01	771.86	1974-01-01	1491.2	1982-04-01	3331.97	1990-07-01	6075.12	1998-10-01	9293.991	2007-01-01	14208.569
1949-07-01	272.889	1957-10-01	474.864	1966-01-01	795.73	1974-04-01	1530.1	1982-07-01	3366.32	1990-10-01	6004.73	1999-01-01	9417.264	2007-04-01	14382.363
1949-10-01	270.627	1958-01-01	467.54	1966-04-01	804.98	1974-07-01	1560	1982-10-01	3402.56	1991-01-01	6035.18	1999-04-01	9524.152	2007-07-01	14535.003
1950-01-01	280.828	1958-04-01	471.978	1966-07-01	819.64	1974-10-01	1599.7	1983-01-01	3473.41	1991-04-01	6126.86	1999-07-01	9681.856	2007-10-01	14681.501
1950-04-01	290.383	1958-07-01	485.841	1966-10-01	833.3	1975-01-01	1616.1	1983-04-01	3578.85	1991-07-01	6205.94	1999-10-01	9899.378	2008-01-01	14851.039
1950-07-01	308.153	1958-10-01	499.555	1967-01-01	844.17	1975-04-01	1651.9	1983-07-01	3689.18	1991-10-01	6264.54	2000-01-01	10002.86	2008-04-01	14905.611
1950-10-01	319.945	1959-01-01	510.33	1967-04-01	848.98	1975-07-01	1709.8	1983-10-01	3794.71	1992-01-01	6363.1	2000-04-01	10247.68	2008-07-01	14835.187
1951-01-01	336	1959-04-01	522.653	1967-07-01	865.23	1975-10-01	1761.8	1984-01-01	3908.05	1992-04-01	6470.76	2000-07-01	10319.83	2008-10-01	14559.543
1951-04-01	344.09	1959-07-01	525.094	1967-10-01	881.44	1976-01-01	1820.5	1984-04-01	4009.6	1992-07-01	6566.64	2000-10-01	10439.03	2009-01-01	14394.547
1951-07-01	351.385	1959-10-01	528.6	1968-01-01	909.39	1976-04-01	1852.3	1984-07-01	4084.25	1992-10-01	6680.8	2001-01-01	10472.88	2009-04-01	14352.85
1951-10-01	356.178	1960-01-01	542.648	1968-04-01	934.34	1976-07-01	1886.6	1984-10-01	4148.55	1993-01-01	6729.46	2001-04-01	10597.82	2009-07-01	14420.312
1952-01-01	359.82	1960-04-01	541.08	1968-07-01	950.83	1976-10-01	1934.3	1985-01-01	4230.17	1993-04-01	6808.94	2001-07-01	10596.29	2009-10-01	14628.021
1952-04-01	361.03	1960-07-01	545.604	1968-10-01	968.03	1977-01-01	1988.6	1985-04-01	4294.89	1993-07-01	6882.1	2001-10-01	10660.29	2010-01-01	14721.35
1952-07-01	367.701	1960-10-01	540.197	1969-01-01	993.34	1977-04-01	2055.9	1985-07-01	4386.77	1993-10-01	7013.74	2002-01-01	10788.95	2010-04-01	14926.098
1952-10-01	380.812	1961-01-01	545.018	1969-04-01	1009	1977-07-01	2188.5	1985-10-01	4444.09	1994-01-01	7115.65	2002-04-01	10893.21	2010-07-01	15079.917
1953-01-01	387.98	1961-04-01	555.545	1969-07-01	1030	1977-10-01	2164.3	1986-01-01	4507.89	1994-04-01	7246.93	2002-07-01	10992.05	2010-10-01	15240.843
1953-04-01	391.749	1961-07-01	567.664	1969-10-01	1038.1	1978-01-01	2202.8	1986-04-01	4545.34	1994-07-01	7331.08	2002-10-01	11071.46	2011-01-01	15285.828
1953-07-01	391.171	1961-10-01	580.612	1970-01-01	1051.2	1978-04-01	2331.6	1986-07-01	4607.67	1994-10-01	7455.29	2003-01-01	11183.51	2011-04-01	15496.189
1953-10-01	385.97	1962-01-01	594.019	1970-04-01	1067.4	1978-07-01	2395.1	1986-10-01	4657.63	1995-01-01	7522.29	2003-04-01	11312.88	2011-07-01	15591.85
1954-01-01	385.345	1962-04-01	600.366	1970-07-01	1086.1	1978-10-01	2478.9	1987-01-01	4722.16	1995-04-01	7581	2003-07-01	11567.33	2011-10-01	15796.46
1954-04-01	386.121	1962-07-01	609.027	1970-10-01	1088.6	1979-01-01	2526.6	1987-04-01	4806.16	1995-07-01	7683.13	2003-10-01	11769.28	2012-01-01	16019.758
1954-07-01	390.996	1962-10-01	612.28	1971-01-01	1135.2	1979-04-01	2591.2	1987-07-01	4884.56	1995-10-01	7772.59	2004-01-01	11820.17	2012-04-01	16152.257
1954-10-01	399.734	1963-01-01	621.672	1971-04-01	1156.3	1979-07-01	2667.6	1987-10-01	5007.99	1996-01-01	7868.47	2004-04-01	12108.99	2012-07-01	16257.151
1955-01-01	413.073	1963-04-01	629.752	1971-07-01	1177.7	1979-10-01	2723.9	1988-01-01	5073.37	1996-04-01	8032.84	2004-07-01	12303.34	2012-10-01	16358.863
1955-04-01	421.532	1963-07-01	644.444	1971-10-01	1190.3	1980-01-01	2789.8	1988-04-01	5190.04	1996-07-01	8131.41	2004-10-01	12522.43	2013-01-01	16569.591
														2013-04-01	16637.99
														2013-07-01	16848.75
														2013-10-01	17083.14
														2014-01-01	17104.56
														2014-04-01	17432.91
														2014-07-01	17721.68
														2014-10-01	17849.91
														2015-01-01	17984.18
														2015-04-01	18219.41
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														2015-10-01	18350.83
														2016-01-01	18424.28
														2016-04-01	18637.25
														2016-07-01	18806.74
														2016-10-01	18991.88
														2017-01-01	19190.43
														2017-04-01	19356.65
														2017-07-01	19611.7
														2017-10-01	19918.91
														2018-01-01	20163.16
														2018-04-01	20510.18
														2018-07-01	20749.75
														2018-10-01	20897.8
														2019-01-01	21098.83
														2019-04-01	21340.27
														2019-07-01	21542.1
														2019-10-01	20468.82
														2020-01-01	21903.55
														2020-04-01	20791.64
														2020-07-01	21625.2
														2020-10-01	21095.32
														2021-01-01	21195.73
														2021-04-01	21285.58

[DATASET3]

DATE	GDP	DATE	GDP	DATE	GDP	DATE	GDP	DATE	GDP	DATE	GDP	DATE	GDP	DATE	GDP
1947-04-01	4.7	1955-07-01	8.5	1963-10-01	6	1972-01-01	14.3	1980-04-01	1.1	1988-07-01	7.3	1996-10-01	6.5	2005-01-01	7.9
1947-07-01	6	1955-10-01	6.5	1964-01-01	10.1	1972-04-01	12.1	1980-07-01	8.7	1988-10-01	9.1	1997-01-01	5.1	2005-04-01	4.7
1947-10-01	17.3	1956-01-01	2.5	1964-04-01	5.4	1972-07-01	7.9	1980-10-01	19.3	1989-01-01	8.5	1997-04-01	7.7	2005-07-01	7.4
1948-01-01	9.6	1956-04-01	5.8	1964-07-01	8.1	1972-10-01	12.4	1981-01-01	19.9	1989-04-01	7.6	1997-07-01	6.9	2005-10-01	5.9
1948-04-01	10.7	1956-07-01	4.7	1964-10-01	3.1	1973-01-01	15.4	1981-04-01	5	1989-07-01	6	1997-10-01	4.8	2006-01-01	8.4
1948-07-01	10.1	1956-10-01	8.5	1965-01-01	12.3	1973-04-01	11	1981-07-01	13	1989-10-01	3.7	1998-01-01	4.7	2006-04-01	4.4
1948-10-01	1.7	1957-01-01	8.3	1965-04-01	7.1	1973-07-01	5.8	1981-10-01	2.5	1990-01-01	9	1998-04-01	4.7	2006-07-01	3.5
1949-01-01	-7.4	1957-04-01	1.9	1965-07-01	10.9	1973-10-01	12.4	1982-01-01	-0.8	1990-04-01	6.1	1998-07-01	6.9	2006-10-01	5
1949-04-01	-5.2	1957-07-01	6.5	1965-10-01	12.6	1974-01-01	4.1	1982-04-01	7.2	1990-07-01	3.7	1998-10-01	7.8	2007-01-01	5
1949-07-01	2.3	1957-10-01	-3.8	1966-01-01	13	1974-04-01	10.8	1982-07-01	4.2	1990-10-01	-0.7	1999-01-01	5.4	2007-04-01	5
1949-10-01	-3.3	1958-01-01	-6	1966-04-01	4.7	1974-07-01	8.1	1982-10-01	4.4	1991-01-01	2	1999-04-01	4.6	2007-07-01	4.3
1950-01-01	16	1958-04-01	3.9	1966-07-01	7.5	1974-10-01	10.6	1983-01-01	8.6	1991-04-01	6.2	1999-07-01	6.8	2007-10-01	4.1
1950-04-01	14.3	1958-07-01	12.3	1966-10-01	6.8	1975-01-01	4.2	1983-04-01	12.7	1991-07-01	5.3	1999-10-01	9.3	2008-01-01	-0.8
1950-07-01	26.8	1958-10-01	11.8	1967-01-01	5.3	1975-04-01	9.1	1983-07-01	12.9	1991-10-01	3.8	2000-01-01	4.2	2008-04-01	4.3
1950-10-01	16.2	1959-01-01	8.9	1967-04-01	2.3	1975-07-01	14.8	1983-10-01	11.9	1992-01-01	6.4	2000-04-01	10.2	2008-07-01	0.8
1951-01-01	21.6	1959-04-01	10	1967-07-01	7.9	1975-10-01	12.7	1984-01-01	12.5	1992-04-01	6.9	2000-07-01	2.8	2008-10-01	-7.2
1951-04-01	10	1959-07-01	1.8	1967-10-01	7.7	1976-01-01	14	1984-04-01	10.8	1992-07-01	6.1	2000-10-01	4.7	2009-01-01	-4.5
1951-07-01	8.8	1959-10-01	2.7	1968-01-01	13.3	1976-04-01	7.2	1984-07-01	7.7	1992-10-01	7.1	2001-01-01	1.3	2009-04-01	-1.2
1951-10-01	5.6	1960-01-01	11.1	1968-04-01	11.4	1976-07-01	7.6	1984-10-01	6.4	1993-01-01	2.9	2001-04-01	4.9	2009-07-01	1.9
1952-01-01	4.2	1960-04-01	-1.2	1968-07-01	7.2	1976-10-01	10.5	1985-01-01	8.1	1993-04-01	4.8	2001-07-01	-0.1	2009-10-01	5.9
1952-04-01	14	1960-07-01	3.4	1968-10-01	7.4	1977-01-01	11.7	1985-04-01	6.3	1993-07-01	4.4	2001-10-01	2.4	2010-01-01	2.6
1952-07-01	7.6	1960-10-01	-3.9	1969-01-01	10.9	1977-04-01	14.2	1985-07-01	8.8	1993-10-01	7.9	2002-01-01	4.9	2010-04-01	5.7
1952-10-01	15	1961-01-01	3.6	1969-04-01	6.5	1977-07-01	12.7	1985-10-01	5.3	1994-01-01	5.9	2002-04-01	3.9	2010-07-01	4.2
1953-01-01	7.7	1961-04-01	8	1969-07-01	8.6	1977-10-01	8.9	1986-01-01	5.9	1994-04-01	7.6	2002-07-01	3.7	2010-10-01	4.3
1953-04-01	3.9	1961-07-01	9	1969-10-01	3.2	1978-01-01	7.3	1986-04-01	3.4	1994-07-01	4.7	2002-10-01	2.9	2011-01-01	1.2
1953-07-01	-0.6	1961-10-01	9.4	1970-01-01	5.1	1978-04-01	25.5	1986-07-01	5.6	1994-10-01	7	2003-01-01	4.1	2011-04-01	5.6
1953-10-01	-5.2	1962-01-01	9.6	1970-04-01	6.3	1978-07-01	11.3	1986-10-01	4.4	1995-01-01	3.6	2003-04-01	4.7	2011-07-01	2.5
1954-01-01	-0.6	1962-04-01	4.3	1970-07-01	7.2	1978-10-01	14.4	1987-01-01	5.7	1995-04-01	3.2	2003-07-01	9.3	2011-10-01	5.4
1954-04-01	0.8	1962-07-01	5.9	1970-10-01	0.9	1979-01-01	8.3	1987-04-01	7.3	1995-07-01	5.5	2003-10-01	7.2	2012-01-01	5.8
1954-07-01	5.1	1962-10-01	2.2	1971-01-01	18.2	1979-04-01	10.6	1987-07-01	6.7	1995-10-01	4.7	2004-01-01	5.2	2012-04-01	3.3
1954-10-01	9.2	1963-01-01	6.3	1971-04-01	7.7	1979-07-01	12.3	1987-10-01	10.5	1996-01-01	5	2004-04-01	6.5	2012-07-01	2.6
1955-01-01	14	1963-04-01	5.3	1971-07-01	7.6	1979-10-01	8.7	1988-01-01	5.3	1996-04-01	8.6	2004-07-01	6.6	2012-10-01	2.5
1955-04-01	8.4	1963-07-01	9.7	1971-10-01	4.4	1980-01-01	10	1988-04-01	9.5	1996-07-01	5	2004-10-01	7.3	2013-01-01	5.3

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