Using the Almone model to measure the time regression of the interest rate in some macroeconomic variables: The United States of America as a model

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Abstract

Interest rate is one of the most important monetary policy instruments that is used both in times of crisis and in recovery cycles to influence macroeconomic variables, as well as the fact that the interest rate is one of the instruments that the real economy over a certain period, depending on the degree of economic dynamism.This research aimed to use time-distributed variables to measure and analyze the dynamic effects of interest rate changes and their reflection on certain macroeconomic variables in the United States during the period (2000.Q1 - 2020.Q4) using the Almone model. The study concluded that the interest rate is one of the most important tools used by monetary authorities to influence the components of aggregate demand (investment and consumption), as well as being the most readily transferable tool to the real economy. Furthermore, based on the estimation results, it became clear that investment increased at a decreasing rate with rising interest rates during the initial period of the first slowdown, i.e., after three months, due to the increased cost of using capital. To avoid surprises that may occur in a large-scale economy like the US economy, policy must be formulated systematically and in a way that is understandable to businesses and households to help them make economic decisions and plan for the future.

Keywords: *interest rate, Almone model, investment, consumption, Gross domestic production (GDP)*

استخدام نموذج ألمون لقياس الانحدار الزمني لسعر الفائدة في بعض متغيرات الاقتصاد الكلي: الولايات المتحدة الأمريكية كنموذج

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المستخلص

يُعدّ سعر الفائدة أحد أهم أدوات السياسة النقدية، ويُستخدم في أوقات الأزمات ودورات الانتعاش للتأثير على متغيرات الاقتصاد الكلي، فضلاً عن كونه أحد الأدوات التي يؤثر بها الاقتصاد الحقيقي على مدى فترة زمنية محددة، وذلك تبعاً لدرجة ديناميكيته. هدفت هذه الدراسة إلى استخدام متغيرات موزعة زمنياً لقياس وتحليل الآثار الديناميكية لتغيرات سعر الفائدة وانعكاسها على بعض متغيرات الاقتصاد الكلي في الولايات المتحدة خلال الفترة (الربع الأول من عام 2000 إلى الربع الرابع من عام 2020) باستخدام نموذج ألمون. وخلصت الدراسة إلى أن سعر الفائدة يُعدّ من أهم الأدوات التي تستخدمها السلطات النقدية للتأثير على مكونات الطلب الكلي (الاستثمار والاستهلاك)، فضلاً عن كونه الأداة الأسهل تطبيقاً على الاقتصاد الحقيقي. علاوة على ذلك، وبناءً على نتائج التقدير، اتضح أن الاستثمار ازداد بمعدل متناقص مع ارتفاع أسعار الفائدة خلال الفترة الأولى من التباطؤ الاقتصادي الأول، أي بعد ثلاثة أشهر، وذلك بسبب ارتفاع تكلفة استخدام رأس المال. لتجنب المفاجآت التي قد تحدث في اقتصاد واسع النطاق كالاقتصاد الأمريكي، يجب صياغة السياسات بشكل منهجي وبطريقة مفهومة للشركات والأسر لمساعدتهم على اتخاذ القرارات الاقتصادية والتخطيط للمستقبل.

الكلمات المفتاحية: *سعر الفائدة، نموذج ألمون، الاستثمار، الاستهلاك، الناتج المحلي الإجمالي*

1.   Introduction

The interest rate is the price at which money is paid for an investment, and is one of the most important instruments used by monetary policy to stabilize and drive economic growth.The interest rate is heavily dependent on economic volatility, as this tool can play a major role in avoiding the negative effects of such fluctuations by influencing consumption and investment through

expansionary policies in times of deflation or deflationary policies in times of recession.

The interest rate can also directly affect economic growth and raise rates by reducing interest rates, encouraging investors to increase their investments, thereby increasing income levels and raising investment rates, reflecting overall demand and economic activity. In advanced and dynamic breeding such as the United States of America, the interest rate has a major role to play in influencing economic activity by reducing or raising its rates, and the experiences and realities of the U.S. Economy have demonstrated the importance of this tool in the face of economic volatility and reducing the negative effects of cycles of deflation and stagnation and thus maintaining economic stability.

Research objective: The research seeks to demonstrate the importance of interest rate as a monetary policy tool in driving economic growth by influencing the components of aggregate demand (investment and consumption) and to show that decisions to lower and raise interest rates for earlier periods would affect aggregate demand during the current period.

problem statement: The problem with the search is the following question? Will decisions to raise or lower interest rates during earlier periods affect investment and consumer spending during the current period and thus on economic growth or not.

The research hypothesis: The research is based on the premise that decisions taken on interest rates, whether by raising or reducing them, will affect the components of aggregate demand (spending and investment), which will drive growth and economic stability.

2. interest rate and macroeconomics

Interest rate is one of the most important tools on which countries, particularly developed countries, rely on monetary policy management (especially in the face of crises and shocks) and the importance of this channel comes through its ability to directly affect the real economy and over a certain period, as lowering interest rates when pursuing an expansionary monetary policy to counter the money supply, in turn, reduces the cost of capital, resulting in an increase in consumer and investment spending and increased aggregate demand and output, on the other hand, the adoption of monetary authorities A policy of tightening it by raising interest rates results in individuals refraining from consumption and increasing their savings to take advantage of high-interest rates and postpone their consumption to the future, which is known as the substitution effect.(Al-Athly,2017,p18) Developed economies have a great ability to change official interest rates in the direct short-term impact on the prices of assets represented mainly in securities, but the nature of some financial markets and the structure of their economies may limit the rapid transmission of the impact of the use of these instruments on asset Prices.
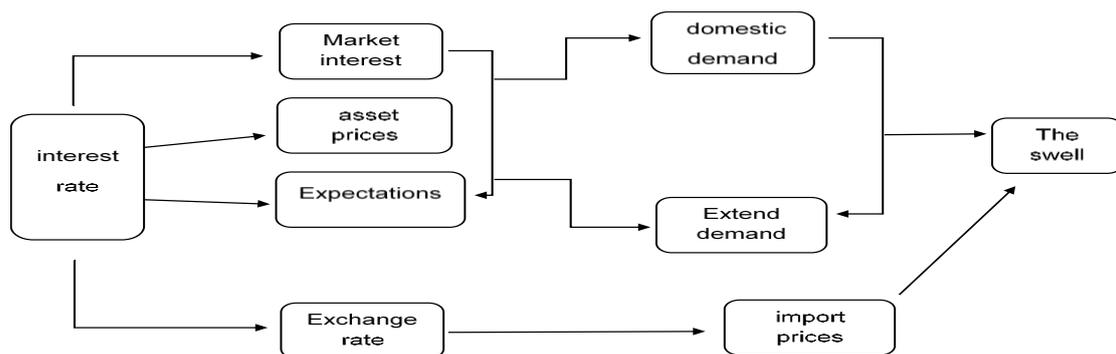

Figure 1. Transfer of interest rate impact on economic activity
Source: Mehmed Muric, The Transmission Mechanism of Monetary policy and Channels of Monetary transmission in Serbia ,Societe Generale Bank Serbia,2010,P:4

When central banks adopt an expansionary monetary policy that will increase the supply of cash and thus lower interest rates and the latter lower, the investment

will stimulate the volume of output and thus the volume of total demand, yet the low-interest rate does not have a significant impact on the volume of investment because investment projects appear in response to the change in the expected profit rate or the marginal adequacy of capital greater than their response to changes in interest rates, Therefore, when investment increases, the overall output also increases, and this increase is determined by the investment multiplier, and because the value of the multiplier depends on the value or amount of the marginal inclination of consumption, the higher the value of the slope, the higher the value of the multiplier and the greater the increase in total output, but this increase in the volume of output is relatively limited despite the increase in the volume of investment as an essential part of the components of aggregate demand through the lower interest rate resulting from the increase in the supply of cash and this The limited increase in output explains the view of the Kenzians, which states that private investment is less flexible in terms of changes in interest rates, as opposed to monetarists who assert that demand for investment is more responsive to changes in interest rates.

Based on the above, according to the view of the Treasure School, it can be concluded that there is a time bounce in the interest rate on the most important components of aggregate demand (consumer and investment spending) as long as the investment response is few to changes in interest rate.

The effectiveness of using the interest rate to influence macroeconomic indicators depends on the degree of economic dynamism, in the sense of the time range of the rate impact shifting to these indicators, that the changes in the interest rate reflect the results of monetary policy efforts but also market factors and prevailing economic conditions.(Al-Athly,2017,p8)

3. Measuring and analyzing the relationship between the interest rate and some macroeconomic indicators in the United States of America.

Before starting the measurement process, an examination and test of time chains must be conducted during the period studied and this test includes the diagnosis of structural changes and abnormal or extreme points to avoid false decline, and therefore extreme values and structural changes in regression specifications will be detected based on indicator saturation approach methodology.

The satisfaction index methodology is an extension of the (OLS) method of estimating regression to detect extreme values and structural changes in regression specifications, thereby identifying which variables should be retained and included in the final regression model in the system of interpretive variables and removing extreme values from appreciation. These extreme values, which are included in the model, reflect policies and decisions taken or economic events such as crises or accidental shocks that affect the morale of estimated functions and the value of statistical and standard tests. Generally speaking, the saturation index methodology consists of several types. (EViews 12 Manual)

3.1 Impulse indicator saturation (IIS) uses this mechanism to detect anomalies and include them as information within the form.

3.2 Trend indicators saturation (TIS) is used to detect structural changes in the overall direction of the time series.

3.3 Step indicator saturation is used to detect the structural change and includes it in the model after estimating the automatic model selection algorithm in EViews 12, as this algorithm is used (Dummy variables) to calculate changes to the structure, and the dates of structural changes are found using an algorithm known as Search path algorithms. (al-Jubouri,2015,P32-33)

To apply the distribution of the mone, it was assumed that a multi-border score was r=2 and that the number of variables slowed down or delayed (s=3). To begin the assessment process, it was assumed that.(Najm-al-Din,2012,p12)

The Weights of independent variables (b) based on second-class multi-border

$$\widehat{\beta_0} = \widehat{a_0}$$

$$\widehat{\beta_1} = \widehat{a_0} + \widehat{a_1} + \widehat{a_2}$$

$$\widehat{\beta_2} = \widehat{a_0} + 2\widehat{a_1} + 4\widehat{a_2}$$

$$\widehat{\beta_3} = \widehat{a_0} + 3\widehat{a_1} + 9\widehat{a_2}$$

Linear combinations of slow variables and their number (r+1=3) as follows:

$$W_0 = R_t + R_{t-1} + R_{t-2} + R_{t-3}$$

$$W_1 = R_{t-1} + 2R_{t-2} + 3R_{t-3}$$

$$W_2 = R_{t-1} + 4R_{t-2} + 9R_{t-3}$$

To obtain appropriate estimates of the next model that expresses the Almone lag:

$$Y_t = \alpha + \widehat{\beta_0}R_t + \widehat{\beta_1}R_{t-1} + \widehat{\beta_2}R_{t-2} + \widehat{\beta_3}R_{t-3} + Ut$$

Where: dependent variable $= Y_{1t}$, independent variable $= R_t$

The form of the estimated model using the ordinary least squares method was as follows:

$$Y_t = a + a_0 w_0 + a_1 w_1 + a_2 w_2 + U_t$$

4. Estimating the impact of the rate slowdown (R) on the total capital formation (investment) $(Y1)$

It should be noted that (W_0, W_1, W_2) was calculated in the Excel program and the following are the results of the estimate using the usual micro-box method of annual rent data for the time series (2000Q1- 2020Q4) taking into account structural changes and extreme points. After the test, the results of the estimate came as in table 1:

Table (1) Impact of the slowdown in interest rates on total investment in the United States (2000Q1-2020Q4)

Variable	Coefficie	Std.	t-Statistic	Prob.
C	0.961212	0.1932	4.973972	0.0000
W0	0.071150	0.0193	3.684654	0.0004
W1	-	0.0121	-1.045223	0.2995
W2	-	0.0119	-2.611574	0.0110
@AFTER("2008Q	-	0.7447	-6.272876	0.0000
@AFTER("2009Q	5.176364	0.7554	6.851894	0.0000
@AFTER("2015Q	-	0.7296	-3.329255	0.0014
@AFTER("2016Q	1.988997	0.7268	2.736512	0.0079
@AFTER("2020Q	-	1.1831	-5.533623	0.0000
@AFTER("2020Q	11.90012	1.3471	8.833343	0.0000
R-squared	**0.739622**	**Adjusted R-**		**0.706145**
F-statistic	**22.09333**	**Durbin-Waston**		**1.466632**

Source: Prepared by the researcher based on the outputs of the EViews 12

First stage: estimating the model for the weights of the variables (a_0, a_1, a_2). The results of the estimation, according to Table (1), are asfollows:

$$\widehat{Y_1} = 0.961212 + 0.71150W_{0t} - 0.012676W_{1t} - 0.031115W_{2t}$$

It is clear from table 1 that the model is highly moral according to the value $(R^2 = 0.74)$, and that the f value calculated is very high as it amounted to (22.09333) compared to its scheduling value (0.04), which means that the model as a whole is moral. The results of the estimate also showed that the value (DW-1.5) when compared to the high values and minimum values (dl-1.4 du=1.5) will be in the inconclusive decision area and we will accept that there is no problem with self-association.

Second stage: Estimates of the investment model with the interest rate by calculating parameter values (B) based on parameter values (a) and as follows:

$$\hat{\beta}_0 = \hat{a}_0 = 0.071150$$

$$\hat{\beta}_1 = \hat{a}_0 + \hat{a}_1 + \hat{a}_2 = 0.071150 - 0.12676 - 0.031115 = 0.03$$

$$\hat{\beta}_2 = \hat{a}_0 + 2\hat{a}_1 + 4\hat{a}_2 = 0.071150 + 2(-0.01268) + 4(-0.03112) = -0.08$$

$$\hat{\beta}_3 = \hat{a}_0 + 3\hat{a}_1 + 9\hat{a}_2 = 0.071150 + 3(-0.01268) + 9(-0.03112) = -0.25$$

This means that the estimated function and its parameters are:

The model for the Almone Lag is as follows:

$$Y_1 = 0.961212 + 0.07R_t + 0.03R_{t-1} + 0.08R_{t-2} - 0.25R_{t-3..} \quad (1)$$

Equation 1 shows that investment is increasing at a decreasing rate as interest rates rise during the first quarter, i.e. in the first three months as a result of the increased cost of using the first capital. Thereafter, a moral effect appears for previous periods and under the logic of the macroeconomic theory. In the second slow-down period, the investment grows at a rate of (0.08) when the interest rate falls by one unit and grows by (0.25) in the third interest slow-down period when the rate falls by one unit.

Indicators for the Almone model were also calculated as follows:

Average rebound period:

$$ML = \Sigma ibi$$

ML =(1)0.03 - (2)0.08 – (3)0.25= - 0.88

This is equivalent to (2) months and (6) days and represents the time required for half or 50 % of the change in investment resulting from a one-unit interest rate change.

Bounce period variation:

$$VL = \Sigma bi \cdot i^2 - ML^2$$

$$0.03(1)^2 - 0.08(2)^2 - 0.25(3)^2 - (-0.88)^2 = -1.7656$$

In other things, the difference between the actual period and the estimated investment period is equivalent to (5) months and (3) days.

5. Estimate the impact of the rate slowdown (R) on total consumer spending (Y_2).

The results of the estimate follow a slowdown in consumer spending for annual rent data for the time series (2000Q1-2020Q4)[i], taking into account structural changes and extreme points. After the test, the results of the estimate came as in the table 2.

Table (2) The effect of policy rate slowdown on aggregate consumer spending in the United States (Q4-2000Q12020))

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	14.56815	0.011996	1214.415	0.0000
W0	0.042921	0.014250	3.011925	0.0035
W1	-0.007310	0.008853	-0.825625	0.4116
W2	-0.024947	0.006701	-3.723117	0.0004
@TREMDBR("2001Q1")	0.013527	0.000197	68.71816	0.0000
@TRENDBR("2008Q1")	-0.006132	0.000255	-24.03562	0.0000
R-squared	**0.997359**	**Adjusted R-squared**		**0.997183**
F-statistic	**5665.181**	**Durbin-Waston stat**		**1.594059**

Source: Prepared by the researcher based on the outputs of E Views 12

First stage: Estimate the model for variable weights (a0, a1, a2) so the results of the estimate and by table (2) were as follows:

$\log Y_2 = 14.56815 + 0.042921 \log W_0 - 0.007310 \log W_1 - 0.024947 \log W_2$

Table 2 shows that the model is highly moral according to the value (R2 = 0.99) and that the F value calculated is very high as it was 5665.181, which is very large compared to the scheduling value of 0.04, which means that the model as a whole is moral. The results of the estimate also showed that the value (DW-

1.6) when compared to the higher values and minimum values (dl=1.4 du=1.5), which means that the model is free of the problem of self-association.

Second stage: Estimates of the model for total consumer spending with interest rate by calculating parameter values ($\hat{\beta}$) based on parameter values ($\hat{a}$) and as follows:

$$\hat{\beta}_0 = \hat{a}_0 = 0.042921$$

$$\hat{\beta}_1 = 0.042921 + (-0.007310) + (-0.024947) = 0.01$$

$$\hat{\beta}_2 = 0.042921 + 2(-0.007310) + 4(-0.024947) = -0.07$$

$$\hat{\beta}_3 = 0.042921 + 3(-0.007310) + 9(-0.024947) = -0.20$$

This means that the estimated function and its parameters are:

The model for the Almone Lag is as follows:

$$Y2 = 14.56815 + 0.04 LogR_t + 0.01 LogR_{t-1} - 0.07 R_{t-2} - 0.20 R_{t-3}. (2)$$

When observing the estimated model in equation (2), we find that the reference of the parameters of the duration of the second and third slowing downs is moral and consistent with the logic of macroeconomic theory in interpreting the behavior of the consumer spending function, besides, under the model of Almone and through the results of the estimate is clear Current consumer spending depends heavily on lower interest rates in the third quarter through the value of the R_{t-3}, six months after the interest rate fell, which is larger than R_{t-1} and R_{t-2} with absolute values (0.01), (0.07), (0.20) respectively. Thus, when the interest rate falls by one unit, total consumer spending rises by (0.20) after six months.

Indicators for the Almone model were also calculated as follows:

Average rebound period:

ML =Σibi

ML =(1)0.01 − (2)0.07 − (3)0.20= -0.73

This is equivalent to (2) months and (19) days, which represents the consumer time required for half or 50% of the change in spending resulting from a one-unit interest rate change.

Reverberation variance:

$$VL = \Sigma bi . i^2 - ML^2$$

$$0.01(1)^2 - 0.07(2)^2 - 0.2(3)^2 - (-0.73)^2 = -2.6029$$

In other things, the difference between the actual period and the estimated period of total consumer spending is equivalent to (7) months and (8) days.

6. Estimation of the effect of the slowdown on the velocity of gross domestic product (GDP) growth (Y_3).

The following are the results of the estimate using the usual micro- box method of annual rent data for the time series (2000Q1-2020Q4) (taking into account structural changes and extreme points, after the test the results of the estimate came as in the table 3.

Table 3 The Impact of the Interest Rate Slowdown on the Growth Rate of Growth in the US for the Period (2002Q1- 2020Q4)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.065434	0.077571	13.73494	0.0000
W0	0.032191	0.010834	2.971226	0.0040
W1	0.001685	0.006320	0.266593	0.7906
W2	-0.012575	0.006726	-1.869603	0.0657
@AFTER("2015Q4")	-1.709061	0.462477	-3.695451	0.0004
@AFTER("2016Q2")	1.367208	0.474997	2.878351	0.0053
@AFTER("2020Q2")	-9.107389	0.630179	-14.45207	0.0000
@AFTER("2020Q3")	18.04435	0.827829	21.79721	0.0000
@AFTER("2020Q4")	-6.728271	0.825273	-8.152787	0.0000
R-squared	**0.880992**	**R-squared**	**0.867583**	
F-statistic	**65.6977**	**Durbin-Waston stat**	**1.539881**	

Source: Prepared by the researcher based on the outputs of EViews 12

First stage: Estimate the model for variable weights (a_0, a_1, a_2), and the results of the estimate and by table (3) were as follows:

$$Y_3 = 1.065434 + 0.032191W_0 + 0.001685W_0 - 0.012575W_2$$

It is clear from table 3 that the model is highly moral according to the value (R^2 = 0.88), and that the value of (F) calculated is very high as it reached (65.69977), which means that the model as a whole is moral. The results of the estimate also indicate that the model is free of the problem of self-association by value (DW-1.5)

The second stage: Includes estimating the GDP model with the interest rate by calculating parameter values ($\hat{\beta}$) based on parameter values ($\hat{a}$)

and as follows:

$$\hat{\beta}_0 = \hat{a}_0 = 0.032191$$
$$\hat{\beta}_1 = 0.032191 + (0.001685) + (-0.012575) = 0.02$$
$$\hat{\beta}_2 = 0.032191 + 2(0.001685) + 4(-0.012575) = -0.02$$
$$\hat{\beta}_3 = 0.032191 + 3(0.001685) + 9(-0.012575) = -0.08$$

This means that the estimated function and its parameters according to the moon lag model are as follows:

$$Y3 = 32090.38 + 0.03R_t + 0.02R_{t-1} - 0.02R_{t-2} - 0.08R_{t-3} \dots . (3)$$

When observing the estimated model in equation (3) according to the Almone model, the reference of the parameters of the second and third slow period is moral and conforms to the logic of macroeconomic theory in interpreting the behavior of the GDP growth function. Moreover, through the results of the estimate, it is clear that the output depends heavily on the low-interest rate in the third quarter, i.e. the measures to reduce the interest rate have spent an impact on output six months after

the interest rate fell through the value of the R-3, which is larger than R_{t-2} and their absolute values (0.08), respectively. Thus, when the interest rate falls by one unit, output grows by (0.08) after six months.

The indicators for the Almone model were also calculated as follows:

Average rebound period:

ML $=\Sigma ibi$

ML $=(1)0.02 - (2)0.02 - (3)0.08 = -0.26$

This is equivalent to (2) months and (18) days and represents the time required for half or 50 percent of the change in GDP resulting from a one-unit interest rate change.

Variation of rebound period:

$VL = \Sigma bi \cdot i^2 - ML^2$

$0.02(1)^2 - 0.02(2)^2 - 0.08(3)^2 - (-0.26)^2 = -0.8476$

That is, the difference between the actual period and the estimated period of the GDP growth rate is equal to (2) months and (5) days.

7. Conclusions and Recommendations

First: Conclusions:

- The interest rate is one of the most important tools used by monetary authorities to influence the components of aggregate demand (investment and consumer) as well as the most transferable instrument to the real economy.

- Based on the results of the estimate, it is clear that the investment

was increasing at a decreasing rate with the rise of interest rates during

the first period of the first slow, i.e. after three months as a result of the increased cost of using capital.

-Both total consumption and GDP volume in the current period depend heavily on the time bounce of the interest rate nine months ago.

- Interpretive capacity was also high for the functions estimated   through the R^2 value, with a value of 0.74, 0.99 % of total consumption, and 0.88% of GDP.

Second: recommendations:

- The time factor must be taken into account in the study of the behavior of different functions, and further studies and research must be carried out that adopt time-shifting variables in interpreting the behavior of macroeconomic functions.

- To avoid surprises that may occur in a broad economy such as the U.S. economy, the policy must be formulated systematically and understandably for businesses and households to help them make economic decisions and plan for the future.

- To promote economic stability, the Fed should raise interest rates by more than one in response to a one-unit increase in inflation and vice versa.

- Time-slowing models should be used to formulate decisions and trade-offs when monetary authorities adjust the interest rate according to the requirements of the stage in which the economy is going through.

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8- Federal Reserve website, available at the link,

www.federalreserve.gov/datadownload/Choose.aspx?rel=H15)

https://www.bea.gov/data/consumer-spending/state

Appendices

Appendix (1) Interest rates in the United States of America for the period 2000-2020

2000.1	5.85	2005.2	3.04	2010.3	0.19	2015.4	0.24
2000.2	6.53	2005.3	3.62	2010.4	0.18	2016.1	0.36
2000.3	6.52	2005.4	4.16	2011.1	0.14	2016.2	0.38

2000.4	6.4	2006.1	4.59	2011.2	0.09	2016.3	0.4
2001.1	5.31	2006.2	4.99	2011.3	0.08	2016.4	0.54
2001.2	3.97	2006.3	5.25	2011.4	0.07	2017.1	0.79
2001.3	3.07	2006.4	5.24	2012.1	0.13	2017.2	1.04
2001.4	1.82	2007.1	5.26	2012.2	0.16	2017.3	1.15
2002.1	1.73	2007.2	5.25	2012.3	0.14	2017.4	1.3
2002.2	1.75	2007.3	4.94	2012.4	0.16	2018.1	1.51
2002.3	1.75	2007.4	4.24	2013.1	0.14	2018.2	1.82
2002.4	1.24	2008.1	2.61	2013.2	0.09	2018.3	1.95
2003.1	1.25	2008.2	2	2013.3	0.08	2018.4	2.27
2003.2	1.22	2008.3	1.81	2013.4	0.09	2019.1	2.41
2003.3	1.01	2008.4	0.16	2014.1	0.08	2019.2	2.38
2003.4	0.98	2009.1	0.18	2014.2	0.1	2019.3	2.04
2004.1	1	2009.2	0.21	2014.3	0.09	2019.4	1.55
2004.2	1.03	2009.3	0.15	2014.4	0.12	2020.1	0.65
2004.3	1.61	2009.4	0.12	2015.1	0.11	2020.2	0.08
2004.4	2.16	2010.1	0.16	2015.2	0.13	2020.3	0.09
2005.1	2.63	2010.2	0.18	2015.3	0.14	2020.4	0.09

Source: Available at the link

www.federalreserve.gov/datadownload/Choose.aspx?rel-H15)

Appendices (2) Aesthetic fixed capital formation in the United States for the period 2000-2020

2000.1	580912.000000	2005.2	739467.500000	2010.3	693253.500000	2015.4	934238.000000
2000.2	592789.750000	2005.3	759013.500000	2010.4	704633.500000	2016.1	939952.000000
2000.3	597235.250000	2005.4	770724.000000	2011.1	703308.750000	2016.2	946346.000000
2000.4	601776.500000	2006.1	792802.500000	2011.2	718146.000000	2016.3	954839.250000
2001.1	600710.250000	2006.2	796388.000000	2011.3	742496.250000	2016.4	967585.750000
2001.2	600877.750000	2006.3	795185.750000	2011.4	758967.500000	2017.1	986240.500000
2001.3	594626.750000	2006.4	798481.750000	2012.1	778578.750000	2017.2	1000283.500000
2001.4	588794.000000	2007.1	804301.750000	2012.2	793139.250000	2017.3	1005244.000000
2002.1	586771.000000	2007.2	811659.000000	2012.3	794779.250000	2017.4	1028497.250000
2002.2	587640.750000	2007.3	809255.250000	2012.4	805075.750000	2018.1	1049003.250000
2002.3	588707.500000	2007.4	805868.000000	2013.1	813661.500000	2018.2	1071137.250000
2002.4	590999.500000	2008.1	798004.750000	2013.2	821492.250000	2018.3	1077724.750000

2003.1	597812.750000	2008.2	797608.500000	2013.3	836747.750000	2018.4	1083814.250000
2003.2	609291.000000	2008.3	787952.000000	2013.4	849984.000000	2019.1	1102068.750000
2003.3	628234.250000	2008.4	752884.250000	2014.1	858925.000000	2019.2	1123156.000000
2003.4	641845.000000	2009.1	701480.500000	2014.2	884180.500000	2019.3	1133542.750000
2004.1	645587.000000	2009.2	676545.250000	2014.3	903671.750000	2019.4	1133858.000000
2004.2	667972.250000	2009.3	672591.500000	2014.4	916002.250000	2020.1	1136412.000000
2004.3	686050.000000	2009.4	672727.250000	2015.1	919349.750000	2020.2	1057902.750000
2004.4	703780.250000	2010.1	668144.250000	2015.2	930543.750000	2020.3	1119016.500000
2005.1	721288.000000	2010.2	690028.250000	2015.3	938847.250000	2020.4	1165611.000000

Source: Available at the link

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Appendices (3) Total consumer spending of the United States of America for the period 2001-2020

year	Total consumer spending	year	Total consumer spending	year	Total consumer spending	year	Total consumer spending
2000.1	2004739.2500	2005.2	2660790.0000	2010.3	3202409.5000	2015.4	3756626.2500
2000.2	2037154.5000	2005.3	2711299.0000	2010.4	3236805.5000	2016.1	3781344.2500
2000.3	2066464.5000	2005.4	2739926.2500	2011.1	3268651.7500	2016.2	3821891.5000
2000.4	2096409.2500	2006.1	2785138.5000	2011.2	3301249.0000	2016.3	3859441.7500
2001.1	2125168.5000	2006.2	2821600.5000	2011.3	3314209.7500	2016.4	3893696.0000
2001.2	2142765.7500	2006.3	2858493.7500	2011.4	3326057.0000	2017.1	3936711.2500
2001.3	2155066.0000	2006.4	2884956.0000	2012.1	3369125.5000	2017.2	3964458.7500
2001.4	2188951.7500	2007.1	2929086.2500	2012.2	3377102.2500	2017.3	4000538.5000
2002.1	2205751.7500	2007.2	2964756.7500	2012.3	3394769.0000	2017.4	4068092.5000

2002. 2	2235996.75 00	2007. 3	3002781.75 00	2012. 4	3421805.75 00	2018. 1	4120475.50 00
2002. 3	2262831.00 00	2007. 4	3048500.75 00	2013. 1	3448086.25 00	2018. 2	4180875.25 00
2002. 4	2290180.00 00	2008. 1	3075610.00 00	2013. 2	3456292.50 00	2018. 3	4223766.50 00
2003. 1	2320514.75 00	2008. 2	3118481.00 00	2013. 3	3477703.50 00	2018. 4	4257830.75 00
2003. 2	2350490.00 00	2008. 3	3137592.25 00	2013. 4	3514090.75 00	2019. 1	4270308.25 00
2003. 3	2393072.00 00	2008. 4	3071840.00 00	2014. 1	3541902.50 00	2019. 2	4335126.00 00
2003. 4	2423050.75 00	2009. 1	3049242.00 00	2014. 2	3584020.25 00	2019. 3	4379454.00 00
2004. 1	2465262.50 00	2009. 2	3057356.00 00	2014. 3	3629891.75 00	2019. 4	4417705.75 00
2004. 2	2496129.75 00	2009. 3	3096629.75 00	2014. 4	3658164.50 00	2020. 1	4374507.75 00
2004 3	2537403.00 0	2009 4	3121419.50 0	2015. 1	3666304.25 00	2020. 2	4018661.50 00
2004 4	2585085.00 0	2010 1	3150615.75 0	2015 2	3707582.50 0	2020 3	4343304.00 0
2005 1	2619078.00 0	2010 2	3181471.75 0	2015 3	3741946.50 0	2020 4	4389082.25 0

Total consumer spending was calculated by the researcher by collecting private consumption spending and public consumption spending

Source: Available at the link

https://alfred.stlouisfed.org/series?seid=USAGFCEQDSMEI&utm_source=seriespage&utm medium-relatedcontent&utm_term=related resources&utm_campaign=Alfred

- https://www.bea.gov/data/consumer-spending/state

Appendix (4) The Gross Domestic Product of the United States of America for the period 2000-2020

year	GDP	year	GDP	year	GDP	year	GDP
2000. 1	25005447500 00	**2005. 2**	32306640000 00	**2010. 3**	37854012500 00	**2015. 4**	45830197500 00
2000. 2	25619300000 00	**2005. 3**	32306640000 00	**2010. 4**	37854012500 00	**2016. 1**	46063265000 00
2000. 3	25795412500 00	**2005. 4**	32856650000 00	**2011. 1**	38893837500 00	**2016. 2**	46529402500 00
2000. 4	26089360000 00	**2006. 1**	33310510000 00	**2011. 2**	38378610000 00	**2016. 3**	46938647500 00
2001. 1	26157575000 00	**2006. 2**	33997900000 00	**2011. 3**	39119202500 00	**2016. 4**	47420102500 00

2001.2	2649750000000	**2006.3**	3467547000000	**2011.4**	3960566750000	**2017.1**	4788478000000
2001.3	2649505000000	**2006.4**	3498536000000	**2012.1**	4017206000000	**2017.2**	4830730000000
2001.4	2665116250000	**2007.1**	3553912750000	**2012.2**	4051782500000	**2017.3**	4889673250000
2002.1	2695875000000	**2007.2**	3605025000000	**2012.3**	4105965000000	**2017.4**	4970741250000
2002.2	2721865000000	**2007.3**	3641029250000	**2012.4**	4157262500000	**2018.1**	5035929000000
2002.3	2746010000000	**2007.4**	3678764500000	**2013.1**	4157262500000	**2018.2**	5123123000000
2002.4	2765382500000	**2008.1**	3767642500000	**2013.2**	4174887750000	**2018.3**	5164775500000
2003.1	2793532250000	**2008.2**	3716642500000	**2013.3**	4227767000000	**2018.4**	5203331250000
2003.2	2828191500000	**2008.3**	3761642500000	**2013.4**	4283278500000	**2019.1**	5250397750000
2003.3	2889162500000	**2008.4**	3675022500000	**2014.1**	4365675750000	**2019.2**	5322371000000
2003.4	2943065500000	**2009.1**	3607752250000	**2014.2**	4435806750000	**2019.3**	5376253000000
2004.1	2980861750000	**2009.2**	3618250000000	**2014.3**	4467833750000	**2019.4**	5423614500000
2004.2	3076236750000	**2009.3**	3662128500000	**2014.4**	4497837500000	**2020.1**	5370341750000
2004.3	3082803750000	**2009.4**	3691512750000	**2015.1**	4548426750000	**2020.2**	4869361000000
2004.4	3131803500000	**2010.1**	3691512750000	**2015.2**	4548426750000	**2020.3**	5284643500000
2005.1	3191821500000	**2010.2**	3745048250000	**2015.3**	4576740000000	**2020.4**	5369399250000
2000.1	2500544750000	**2005.2**	3230664000000	**2010.3**	3785401250000	**2015.4**	4583019750000

Source: Available at the link

- https://alfred.stlouisfed.org/series?seld-GDP&utm_source-series_page&utm_medium-related content&utm_term-related resources&utm_campaign=alfred

ⁱ *See Appendix (1) and (3)*