Analysis of Gross National Product (GNP) in the form of time series

Hadiseh Mahzooni Najafabadi[1], Ali Karbasi Najafabadi[2], Mehrzad Navabakhsh[3]

[1.] MSc of Industrial Management, Department of Management, Islamic Azad University, Najaf Abad, Isfahan, Iran
[2.] Ph.D in Management, Department of Management, Islamic Azad University, Najaf Abad, Isfahan, Iran
[3.] Ph.D in Industrial Engineering, Department of Industrial, Islamic Azad University, Najaf Abad, Isfahan, Iran
hadisemahzoni@yahoo.com

Abstract: Study about valuable indicators in universities, government agencies and research institutes are really important along with practical improve in government statistics. Among the macroeconomic indicators, GNP and GDP are very important. There are statistics on the time series of potential GDP which can play an important role in various economic analyzes. In this paper, data collected in the framework of GNP were analyzed based on time series and also try to analyze GNP and investigate changes in their rate and also GDP growth rate, to predict them in future years that could be used by different organizations. The data collection for this study is gathering data from library and data analysis have been carried out by inferential statistical methods. The research involves whole country and has been studied over a period of years 1976-2011.
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1. Introduction:

A term of GNP is one of the mostly used words in the public policy arena. The meaning of this word is: total monetary value of final goods and services produced in a given year using factors of production are owned by citizens of a country. Time series analysis has developed rapidly in recent years and has become an important area of work. Time series is analyzed to understand, describe, predict, control and improve the underlying process. Having the time series data of GNP, can play an important role in the economic analysis. A time series of observations which are ordered in time was considered. Time series in different fields of science, statistics, engineering, economics, and management and so on have been used extensively and observations are recorded ad an important tool in the analysis of daily, weekly, monthly, yearly, etc. This paper contains the results of the analysis of the GNP will be analyzed in the form of time series. The data collection for this study is gathering data from library and data analysis have been carried out by inferential statistical methods. The research involves whole count2ry and has been studied over a period of years 1976-2011.

Literature Review:

Based on research carried on at the University of Pennsylvania in America, GNP ratio to GDP for Iran during the years 2006-2010 was 98.39%, 98.93%, 99.25%, 99.26%, 99.35%, respectively (University of Pennsylvania, 2013). The research conducted at the Department of Commerce, Bureau of Economic Analysis, and America's GDP in 2012, equivalent to U.S. $ 16.677 billion in bonds in 2013 would be equal to $ 16.772 billion (Ministry of Commerce of America, 2013). In another study, the effect of oil shocks on real GDP growth in OECD countries has been studied. In this study, a multivariate VAR model using the unconstrained variables GDP, exchange rate, oil prices, and wages, and inflation, short-term and long-term interest rates has been implemented. The results show that in all the countries studied, oil price changes do not directly affect GDP, but also indirectly through other economic variables that affect GDP (Jimenez and Sanchez, 2005).

Research on the effects of GDP, liquidity and taxes on net exports, in order to assess the relationship between each of the economic variables, GDP, liquidity and taxes (taxes on imports) on net exports, in order to identify the extent and direction of these relationship current earnings without reliance on oil revenue has been done. The overall result of the increase in the volume of GDP and net exports increased volume led to reduced liquidity changes to income tax on net exports and imports have no effect (Mohseni, 2001). Investigation on the impact on GDP, liquidity, exchange rate affect exports of the exchange rate, GDP, monetary policy on non-oil exports to the right to increase non-oil exports in order to avoid reliance on oil revenues and increased national income and economic growth has been achieved. The result of this study is that the real effective exchange rate has no significant relationship with Iran's non-oil exports. The direct positive

relationship between GDP and exports of non-oil and non-oil exports and liquidity are negatively related (Rajai, 2005).

In another study, the effect of oil price fluctuations on a number of macroeconomic variables such as GDP, general price level and the level of employment for period 1961-2005. The results have shown that the main oil price shocks in the volatility of macroeconomic variables. Twenty percent of GDP fluctuations, fluctuations in the unemployment rate of thirty percent and sixty percent of the general price level fluctuations due to fluctuations in the price, of oil (Hadian and Parsa, 2006).

Data analysis:

- Analysis of time series data for GNP

The first step in analyzing a time series, the plot is set. This chart can be useful information about the nature of the data obtained. If a time series of observations are plotted against time, we obtained the chart below.

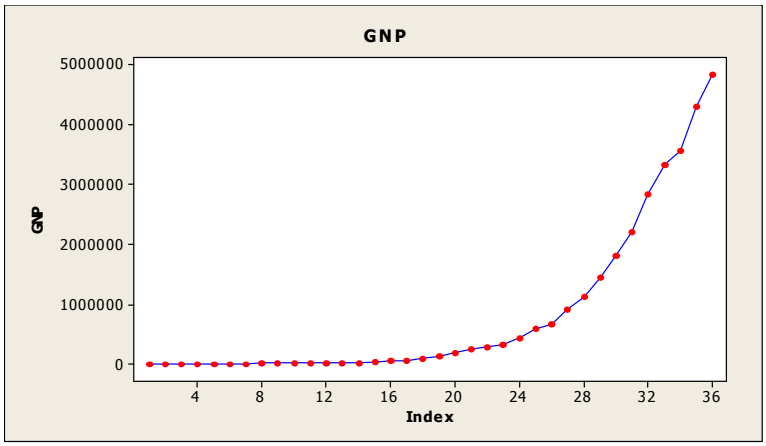

Figure 1-1: Analysis of time series data for GNP

- Calculate the equation of trend line

After charting data over time, turn into the plot line and the fitted function (the model) to the data. The trend line equation is calculated to obtain a general idea of the behavior of the phenomenon, which will help us in the foreseen future.

Several types of trend are available:

1- Linear functions; 2- Exponential function;

Figure 1-2 in charts and graphs, linear trend in the data over time (which is displayed as a straight line in the figure) were heterogeneous. Conclusion that can be drawn from Figure 4.2 is that we are not the ideal trend line is linear trend in the data, because the data trend line on the chart is not fitting properly. So we turned to the class and monitored for two going whether we are good or not.

Figure 1-2 Trend line equation; it is a graceful observation is:

(1) $Y_t = -1040972 + 100685*t$

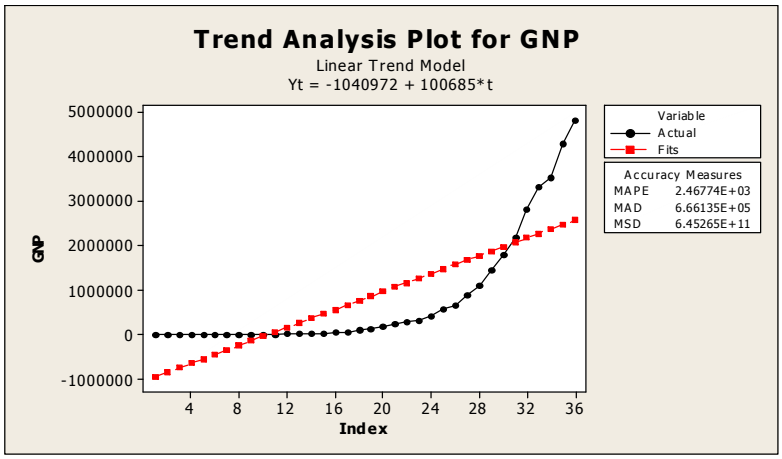

Figure 1-2: Graph of linear trend for GNP data

Figure 1-3, plot the data versus time and graphs of quadratic trend (which is shown as a curve in the figure). Conclusion that can be drawn from Figure 1-3, figure 1-2 was drawn as a conclusion that the reason the previous trend line is not good. Figure 1-3 Trend line equation; it is a graceful observation as follows:

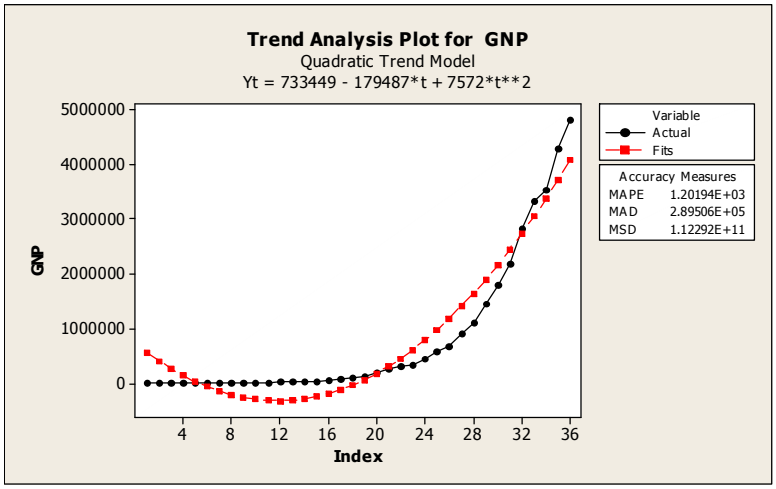

Figure 1-3: Graph of quadratic trend for GNP data

The time came to go and monitored for trends, we view this process as desired or not.
Exponential trend is a trend of longer-term fixed rate period changes. Needless to mention, unlike the exponential trend line, in which the constant rate of change is considered would be important. Often we are faced with exponential trends. The exponential function, the logarithm of a graceful observation is as follows:

(2) $T_t=b_0+b_1X_t$

Figure 1-4 charts and graphs of data over time exponential trend (which is almost tangent is the curve of the graph) were heterogeneous. Conclusion that can be drawn from Figure 1-4 is that the process is desired, almost tangent line to the graph of the data, so the data is exponential.
The exponential function, when the graceful observations are as follows**:**

$Y_t = 2099.17(1.245)\ t$

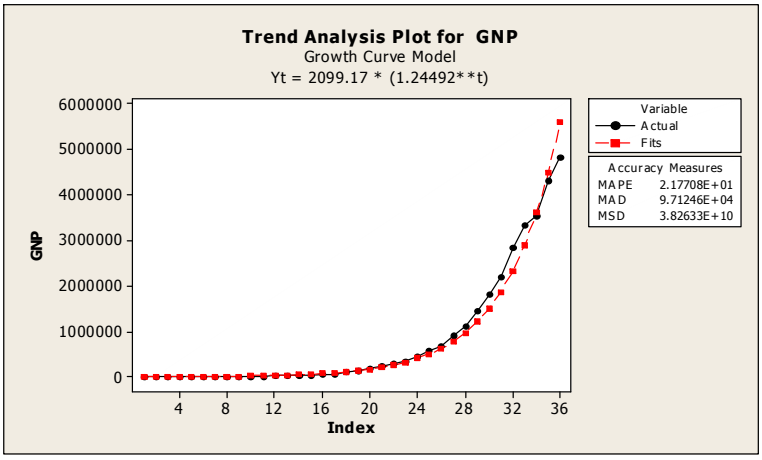

Figure 1-4 Graph of exponential trend for GNP data

Note: According to the equation, the exponential function should be of the form $Y_t = b_0 + b_1t$. The above equation is not acceptable, the base 10 logarithm of the data, and we fit a linear trend, we fitted a linear model is as follows:

$Y_t = 3.3220 + 0.0951*t$

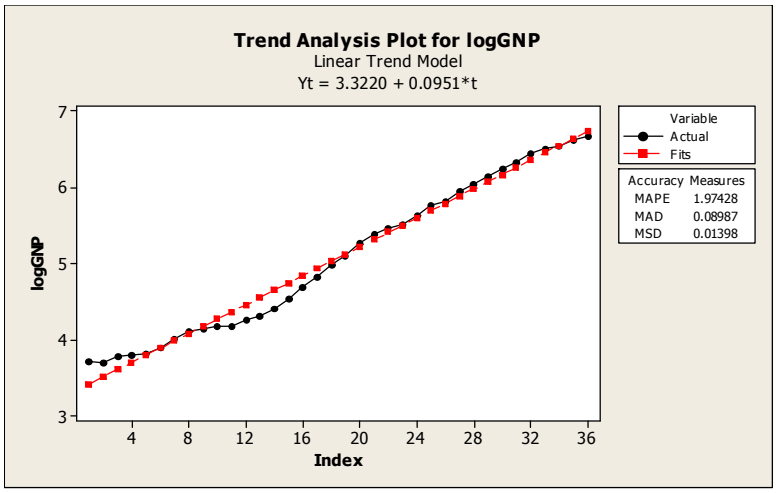

Figure 1-5: graphs of logarithm of an exponential trend line for GNP data

It was observed that the equation of the trend line fitted to the logarithm of the GDP data is given as follows:

(4) $Y_t = 3.3220 + 0.0951*t$

The main advantage of this equation is:

1- Predicts GNP in coming years

2- The growth rate

- Forecasting

GNP forecasts and graphs for the years 2012 to 2019 are drawn to it. Calculations, 2012 and 2019 years are as follows:

$Y_t = 3.3220 + 0.0951*37=6.84233$

Rate of GNP in 2012: antilog $(_{Yt)} = 6955526.346$

$Yt = 3.3220 + 0.0951*44=7.50833$

Rate of GNP in 2019: antilog (Yt) = 32235172.604

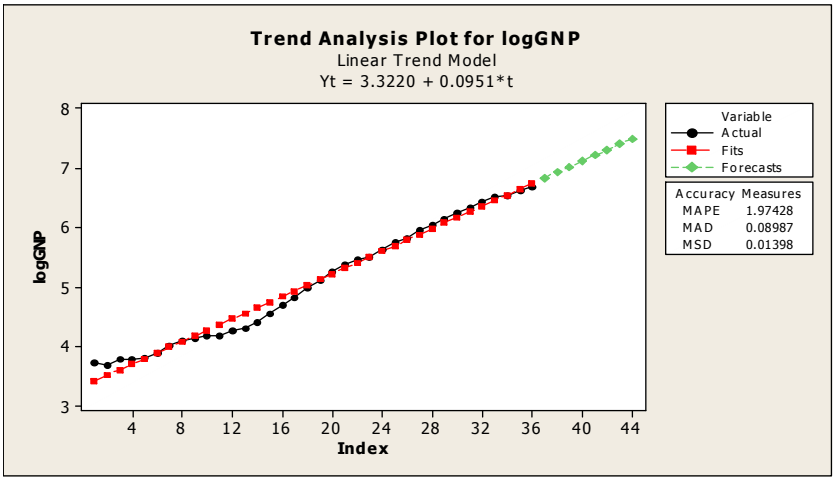

Figure 1-6: GNP forecast rate for 2012-2019

- Growth rate

Constant rate of growth in an exponential trend curve is fitted there and show it by g, is calculated as follows:

(5) g =(antilog b1)

(6) g = (antilog 0.0951) –1 = 1.2448 – 1 = .245

The above statement means that GNP growth of 24.5 percent per year.

- Smoothing methods:

A stationary time series prediction with exponential smoothing model, in order to remove the systematic component or smoothed time series with a moving average to smooth is considered. The smooth component to the next image is considered. By the exponential smoothing moving average model is used to a certain type of weighted moving average.

At period t with an estimate of the process mean and show At period t is called the smoothed estimate. At the current exponential smoothing model to estimate smoothed weighted average of the current observation Yt weight with a previous estimate of

smoothed At-1 with weight 1 - a is calculated. Weight commonly called a smoothing constant is a value between 0 and 2. This method describes the following formula (Netter, 2005)

- Select the beginning and fixed smoothing:

The initial value A0 stationary time series may be very close to the average of the last few observations.

If the observations are not available, the initial value of A0 can be used to make a diagnosis applied to reaction and predict system performance in a significant manner exponential smoothing constant.

The smoothing constant, a larger weight is given to past observations is smaller than the more recent observations.

For example, when a = .1 to Yt - 8 At the calculated weight of 0.1 (1 to 0.1) 8 = 0.043 is given. But then a = .5 .002 Yt-8 is just the weight. So if a smoothed estimate may be too large because of the influence of the irregular component of current and new observations are located. On the other hand, if a is too small, smoothed estimates lose their ability to adapt to any changes in the mean level of the series very slow to respond.

The smoothing constant a must be chosen such that an appropriate balance is achieved between the extreme. (Netter, 2005)

- GNP data exponential smoothing:

Using minitab software exponential smoothing to gross domestic product data for different values of a (smoothing constant) have done. The smoothing constant a = 1.85 was chosen as the best.

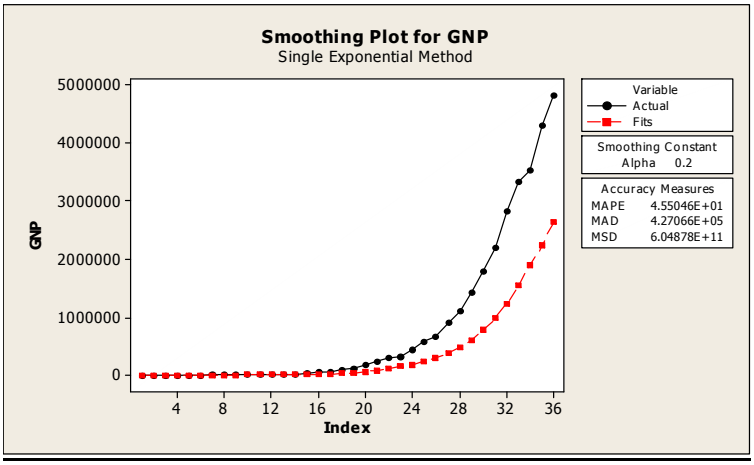

Figure 1-7: GNP data exponential smoothing

In Figure 1-7, a (smoothing constant) is equal to 0.2; a value is not suitable for the chart.

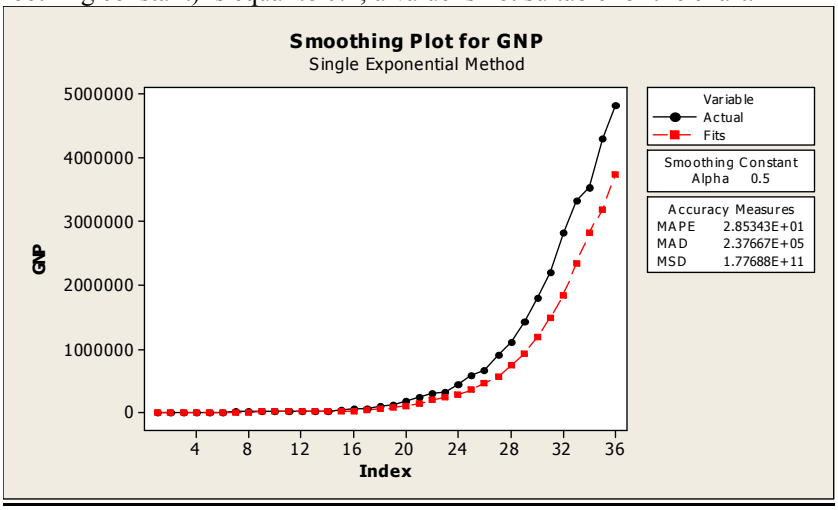

Figure 1-8: GNP data exponential smoothing

In the diagram above, a (smoothing constant) is equal to 0.5; the graph is the value of a good.

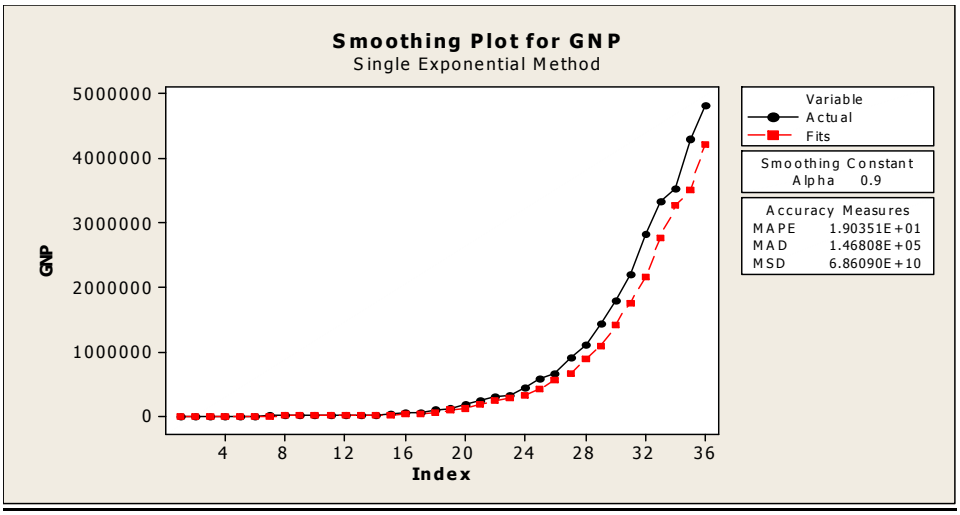

Figure 1-9: GNP data exponential smoothing

In the diagram above, a (smoothing constant) is equal to 0.9, the amount is inadequate.

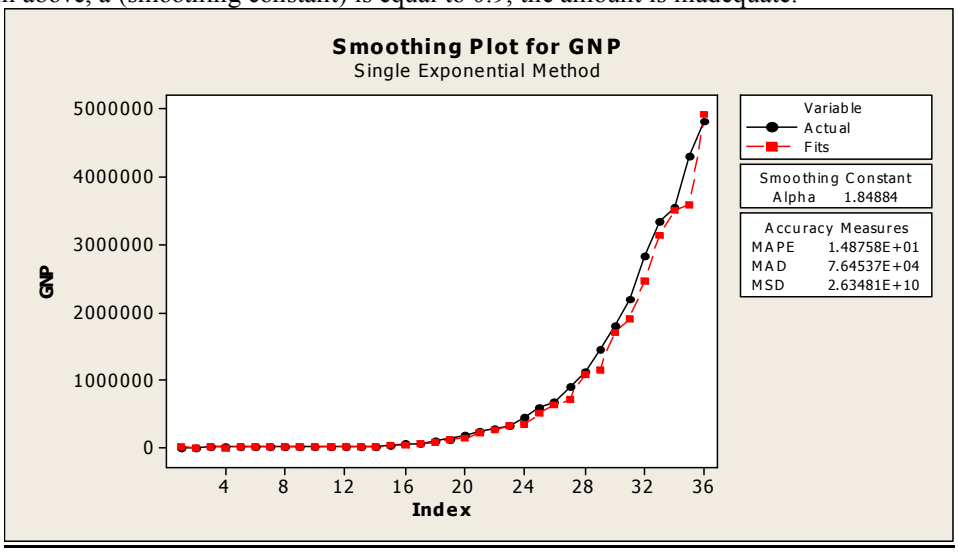

Figure 1-10: GNP data exponential smoothing

In the diagram above, a (smoothing constant) is 1.85; the plot is a little this time.

- Methods of forecasting:

Exponential smoothing model, the mean level of the current estimated smoothed time series prediction process as it applies. The reason for this is the high degree of smoothing of the irregular component is removed from the Mana series. If you expect the same level as the average of the time series in period t +1 and t +2, and so on next Mana remain at current estimates, then the best forecast for future periods. The prediction method can be expressed as symbol (Netter, 2005)

Forecast for period t + k:
Ft+k = At k = 1,2,….
In which:
At the smoothed estimate for the current period t.
Ft + k for k predicted when the unit forward.

GNP forecast rates for years 2012 to 2019:

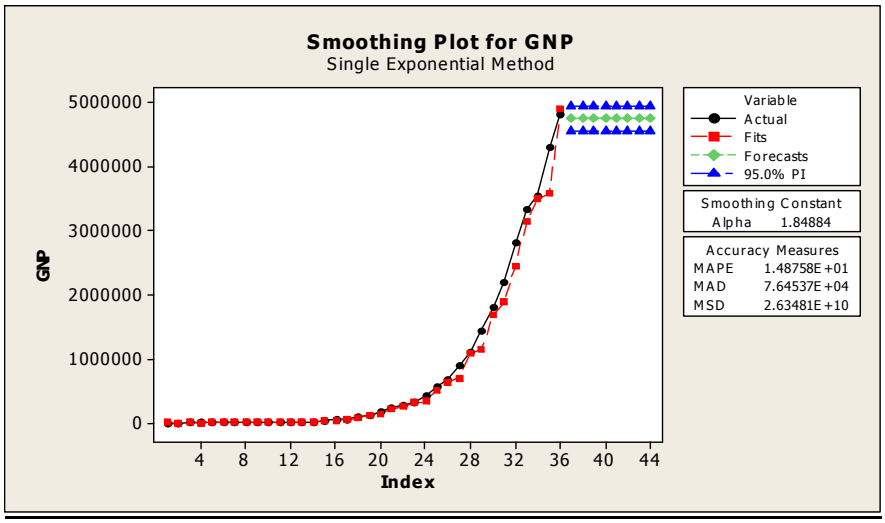

Figure 1-11: GNP forecast rate 2012-2019 years

According to the diagram above for the years 4745380, 2012-2019 are anticipated.

- Exponential smoothing with trend components of the time series:

We have seen exponential smoothing for stationary time series implies a new view for each step during when a component time series exponential smoothing process involves two steps is to update. One of the smoothed estimate and the estimate process is considered. At the smoothed estimate of the mean level of the series in period t to period t is still the trend component is defined as that period of time. The trend estimate for period t with Bt will show that it represents a period of change in the mean number of consecutive periods t and predict is necessary.

Bt can be estimated as the slope coefficient of the linear trend component t in the period considered. (Netter, 2005).

- Manner of update:

To obtain smoothed At, separate from the weighted average of the two estimates, we calculated the mean number of periods t. The first estimate for the current period t is Yt observed. At-1 + Bt-1 is the second estimate.

The current estimate of the mean flow time series in period t based on past observations Yt-1, Yt-2, and to the end. This estimate is the sum of two estimates:

At first smoothed estimate the average level in the previous period. The second change is estimated that Bt-1 prior to the expected change in mean level between periods t-1, t take into account. Weights corresponding to the average of the two estimates of a, 1-a, which is a smoothing constant as before. (Netter, 2005)

Update formula for the smoothed estimate is as follows:

$At = aYt + (1- a)(At-1 + Bt-1)$ $0< a < 1$

The update formula for estimating the weighted average of the two estimates is based on Bt: At-At-1 is the first estimate of the change in the smoothed series between periods t-1, t is the size of the new trend component reflects the observation Yt.

The second estimate Bt-1 to estimate the change in the previous period. These estimates are only based on past observations Yt-1, Yt-2 and so forth are to be determined. The mean weights of the two estimates of b, 1-b are constant b is called the adjustment process. This is generally a fixed value between 0 and 100.

The formula for determining the timeliness of the process is as follows:

$Bt = b(At – At-1) + (1-b) Bt-1$ $0 < b <100$

As we have previously pointed out, the updated estimate and predict the next period is used for smoothing.

Briefly, exponential smoothing method for time series with smoothing parameters involves a two-stage process is as follows:

Step 1- Update the smoothed estimate:

$At = aYt + (1-a)(At-1 + Bt-1)$

Step 2 - Update the estimation process:

$Bt = b(At – At-1) + (1-b) Bt-1$

In which:

tA smoothed estimate for the current period t.

Assessment smoothed At-1 is the previous period t-1.

Yt is observed in the current period t.
It's a smoothing constant. 0 <a <2.
The estimate for the current period t is Bt.
The estimates for Bt-1 are the previous period t-1.
B is a constant process of adjustment .0 <b <100

To apply the above formulas to update the initial values A_0, B_0 is required. These values correspond to the mean level and slope coefficient for the trend component t = 0. (Netter, 2005)

- Choose the initial values of the weighting constants
One last observation time series, time series methods by applying classical methods of time-series regression, exponential smoothing method used for determining the initial value, for example, we observed a trend line to the slope of this line as the beginning of the process used to estimate B0. The trend line or component level during the period t = 0 at t = 0 can be estimated as the initial estimate A_0 to be smoothed.

Fixed values of a and b must be carefully weighted and are not necessarily the same. The implications of this kind of constant R 1 R 0 varies from 0 to 3. If the constants are very small, estimated to slow to react to changes in the underlying is considered.

On the other hand, if the constants are very large, random changes in time series estimates will respond to the extreme.

Some computer software packages for exponential smoothing are the property of spontaneously initial values of the weighting constants based on the first series of observations specific criteria to select. (Netter, 2005)

- Roll up and down Test to confirm the series trend

Roll up and down for the test regression can be performed. Test assumptions are as follows.
H_0: the sequence is generated by a random process.
H1: the sequence by which the stability of the process (process) has been produced.

If the test statistic to test the high and low flow, the greater risk is a result of the call H_0 option, otherwise the outcome H_1 option should be considered.
We will now investigate whether the GNP data, CPI and industrial production trend or not.

Roll up and down test for GNP data:
The results of this test with 0.05, using SPSS software is as follows.

Table -1: Runs Test

	GNP
Test Value[a]	113477.50
Cases < Test Value	18
Cases >= Test Value	18
Total Cases	36
Number of Runs	2
Z	-5.580
Asymp. Sig. (2-tailed)	.000

a. Median

In the above table, the p-valu = 0<.05. H_0 hypothesis is rejected. It means GNP data are in the process.

- Data exponential smoothing for GNP:

Using exponential smoothing software mini tab have done for GDP data, according to the diagram, a = 0.165 (smoothing constant) and b = 3.69 (constant adjustment process) the best values are obtained.

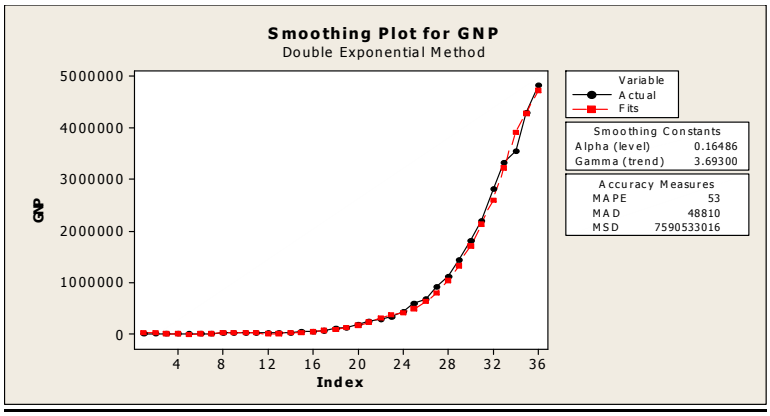

Figure 1-12: data exponential smoothing for GNP

- Methods of forecasting:

Extrapolation of the smoothed series can change the order of the expected forecast for the coming period will be obtained. Predict period t + k the k period ahead prediction based on the estimated smoothed At from current levels will mean that it will add kBt value. This amount represents the expected change in the current series, the mean level of process operation to k period. The prediction method is as follows: (Netter, 2005)

Forecast for t + k period:

$F_t+k = A_t+k B_t$

Which:

A_t is the smoothed estimate for the current period t.

B_t, t is the trend estimate for the current period.

F_t + k, k period ahead forecast for the next t + k period.

The data rates of the GDP forecast for the period 2012-2019 are obtained. Using predictive software to do mini tab. Software mini tab, the exponential smoothing values for this attribute has a self starter and the weighting constants determined based on a number of criteria to select a series of observations.

5247843 ➔ Estimated GNP rate in 2012
5746701 ➔ Estimated GNP rate in 2013
6245559 ➔ Estimated GNP rate in 2014
6744417 ➔ Estimated GNP rate in 2015
7243275 ➔ Estimated GNP rate in 2016
7742133 ➔ Estimated GNP rate in 2017
8240991 ➔ Estimated GNP rate in 2018
8739849 ➔ Estimated GNP rate in 2019

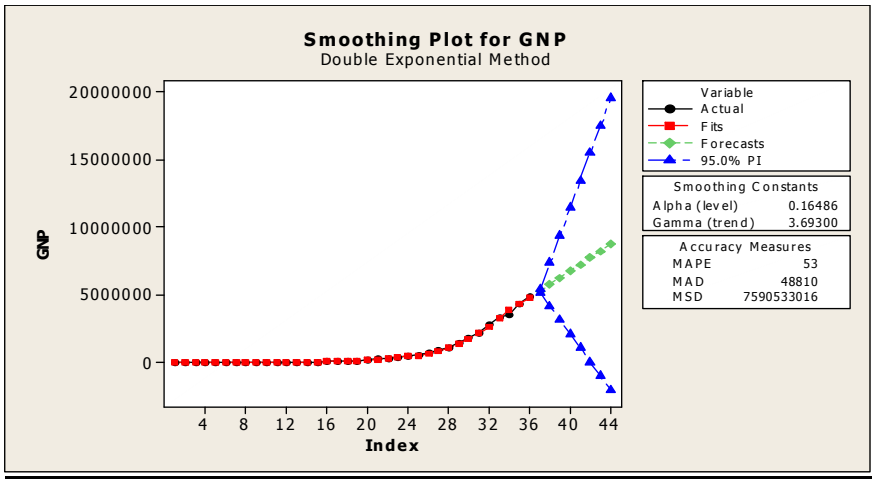

Figure 1-13: forecasting GNP data rate from 2012-2019

Conclusion:

Since the GDP data were obtained during the year are arranged according to the data in the form of time series have been analyzed. This paper uses the analysis of time series data on GDP data, identify trends and based on that equation to predict future values (2012-2019) have been analyzed. The growth rate data obtained from the equation based on

the model and calculate the growth rate of GNP against 24.5 per cent is obtained. 24.5 percent of the country's GNP growth in years.

Smoothing exponentially weighted moving average, which is a special type of paper through the exponential smoothing GNP data, the models obtained based on the model predictions for the years 2012-2019. It is noted that the values predicted by exponential smoothing, are applicable to the more up to date and the ability to adapt to changes happened in the step or period means the series is in average rate. Then, using a regression model for the establishment and validation of the model is the model assumptions, the effect on GNP and industrial production gained industrial production rate is calculated based on the regression model.

References:

1. Anderson, O., 1997, time series analysis and forecasting, Dr. A. Bozorgnia, Astan Quds Razavi Cultural Department, Mashhad
2. Bakhtiari, S., 2005, Macroeconomics, Isfahan University Press, Isfahan
3. Rajai, S., 2005, the effect of GDP, liquidity, exchange rate on exports, MA, Supervisor Mehdi Taghavi, Islamic Azad University Central Tehran Branch, Department of Economic Sciences
4. Hadian, E., 2006, Identification of business cycles in the economy, Iranian Economic Research Quarterly, Year IX, No. 15, pp. 93-120
5. Mohseni Hanjani, F., 2001, The effect of GNP, liquidity and taxes on net exports (1969-1992), MA, Supervisor Mehdi Taghavi, Islamic Azad University Central Tehran Branch, Department of Economics and Accounting
6. Netter, J., and Wasserman, W., and Timur 2004-2005, Applied Statistics, Dr. Ali Amidi, Volume II, Center for Academic Publication, Bozorgnia, A. and Niroomand, H., time series, Cultural Affairs
7. Boskin , M. (2005).“Causes and Consequences of Bias in the Consumer Price Index as a Measure of the Cost of Living, Atlantic Economic Journal No.33, P.131.

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