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Analysis of GDP using the n-variable Regression Model

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ABSTRACT

Purpose: Gross Domestic Product(GDP) depends on Agriculture, Service, and industry performance. The main aim of the study is to assess the relationship between dependent variable GDP and Independent variables agriculture, industry, and service sector by using the n-variable Regression Model at initial condition.

Design/Methodology/Approach: The study is an application of the n-variable Regression Model at the initial condition to analyze the situation of GDP along with reasons not becoming zero GDP even after using the initial condition. The secondary data of the GDP of Nepal from the Central Bureau of Statistics of 10 years till 2019/20 has been analyzed. By finding cofactors of correlation coefficient matrix, Mean and standard deviation of the individual data to establish the linear relationship between dependent and independent variable.

Findings/Result: Under initial conditions, if all the independent variables zero, the GDP is -751028.431 billion, negative sign shows that GDP decreases highly if the entire major factor has no role in GDP. It is non-zero GDP. It means in the 11th year the stated amount will be expended from the previous year saving for forex to import which will not be possible in a sustainable economy. It will not be possible in real conditions however it may be hypothetical possible either because of the impact of informal economy or disinvestment or negative net exports. It is significant for forecasting the future GDP of a country effectively assuming different conditions for policy formulation.

Originality/Value: It is the first empirical research using the n-variable Regression Model for GDP Analysis.

Paper Type: Analytical Policy Research

Keywords: GDP negative, Dependency, n-variable Regression Model, initial conditions, forex

1. INTRODUCTION :

The Bureau of Economic Analysis (BEA) gives a clear definition for GDP: 'Gross domestic product (GDP) is the value of the goods and services produced by the nation's economy less the value of the goods and services used up in production. GDP is also equal to the sum of personal consumption expenditures, gross private domestic investment, and net exports of goods and services, and government consumption expenditures and gross investment [1]. Total GDP may be separated into the commitment of every industry or area of the economy. The proportion of GDP to the absolute populace of the particular political boundary is the per capita GDP and the equivalent is called Mean Standard of Living which depends largely on Agriculture as it is main source of income for most of people in Nepal. Most of people in compression to any other sector are employed in agriculture in Nepal. In 2019, a little more than 50% of Nepal's total national output comes from service area. Farming contributed the second biggest sum, while 13% came from the business area. Most of the Nepalese populace lives in country territories, and are relied upon farming for their business (O'Neill, 2021) [2].

Around 63% of Nepal's 29.6 million occupants are essential for the labor force, for example between 15 to 64 years of age. Despite the fact that the nation has an exceptionally low joblessness rate (likely because of the way that agrarian occupations are normally not considered while ascertaining public joblessness), it is viewed as a nation burdened by high neediness, with a predictable import/export imbalance and an unpredictable expansion rate. Nonetheless, late impressions of youngsters' expectations for everyday comforts when they experience childhood in Nepal are overwhelmingly of

the assessment that the way of life is better. Movements of foreign aid in Nepal is significant for GDP and need to reform internal sources for the sustainable development of Nepal (Mishra and Aithal, 2021) [3].

Nepal has vigorous binds with the nation of India, which is both the country's primary fare accomplice, just as its principle import accomplice. Nepal's economy has been affected by political precariousness throughout the span of the nation's set of experiences: a government until the mid-2000s, it at that point turned into a republic with a Maoist-overwhelmed government. Recently, Nepal made a few endeavours to advance its financial circumstance, yet depends vigorously on settlements and unfamiliar guide (Mishra and Aithal, 2021) [4]. Even a recent study by Chaudhary and Mishra (2021) [5] on Impact of Agriculture on Economic Development of Nepal using Statistical Model shows that agriculture has a significant positive impact on economic development of Nepal and agriculture is the back bone for an economy without which the economy neither can be functioned nor can be survived.

Chaudhary and Mishra (2021) [6] has Development of n-variable Regression Model which is a highly applicable technique to show the predictor and estimator can predict and estimate the impact of dependent variable on independent variables. The process of finding the mathematical function which describe the relationship between a dependent variable and one or more independent variable in regression analysis.

2. RATIONAL OF THE RESEARCH :

Most of the article is in descriptive cum survey, researcher will go through quantitatively and analyse the highly significant data (GDP and agriculture, agriculture and Industry, Industry and Service sector, Service sector and GDP) and establish the linear relationship between all the factors and find out the situation of GDP after using initial conditions. No any research using of n-variable Regression Model has been done as it's a newly developed model. So, the researcher intended to conduct the research as empirical validity of their own developed model.

3. OBJECTIVES :

The main aim of study is to assess the relationship between dependent variable GDP and Independent variables agriculture, industry and service sector by using n-variable Regression Model at initial condition what is the situation of GDP and why GDP not became zero even after using initial condition.

4. RESEARCH METHODOLOGY :

The linear relationship between four factors will be

$$\frac{A_{11}}{\sigma_1} x_1 + \frac{A_{12}}{\sigma_2} x_2 + \frac{A_{13}}{\sigma_3} x_3 + \frac{A_{14}}{\sigma_4} x_4 = 0 \quad (*)$$

Where A_{11}, A_{12}, A_{13} and A_{14} are cofactor of correlation coefficient matrix, $\sigma_1, \sigma_2, \sigma_3$ and σ_4 are standard deviation of the individual data and $x_i = X_i - \mu_i$. Here researcher find cofactors of correlation coefficient matrix, Mean and standard deviation of the individual data and show up the linear relationship between dependent and independent variables (Chaudhary and Mishra, 2021) [6].

Source of Data:

The bureau of statistics and ministry of finance will be main source of data to interpret and analyse and minor source are book, article, magazine etc.

5. RESULTS AND DISCUSSION :

Linear Relationship between Agriculture, Industry, Services and GDP

The association that we have in method and methodology is used to interpret and analyse the data taken from source of bureau of statistics is as given in table 1.

Table 1 : Sectorial Contribution to GDP

FY	Real GDP(X ₁) Rs. in Billion	Agriculture (X ₂) Rs. in Billion	Industry (X ₃) Rs. in Billion	Services (X ₄) Rs. in Billion
2009/10	565.76	205.52	91.29	293.27
2010/11	587.53	214.79	95.25	303.32
2011/12	614.64	224.73	98.11	318.52
2012/13	637.77	227.19	100.73	336.76
2013/14	674.23	237.52	107.84	357.69

2014/15	694.27	240.14	109.40	374.26
2015/16	695.69	240.68	102.44	383.06
2016/17	749.55	253.20	115.14	414.04
2017/18	797.15	260.33	126.16	444.06
2018/19	850.93	273.51	135.90	476.27
2019/20	870.25	280.59	140.29	485.76
Total	$\Sigma X_1 = 7737.77$	$\Sigma X_2 = 2658.20$	$\Sigma X_3 = 1222.55$	$\Sigma X_4 = 4187.01$

Source: Central Bureau of Statistics, 2020 [7]

Under calculation

$$\text{Mean } (\mu_1) = \frac{\Sigma X_1}{N} = \frac{7737.77}{11} = 703.4336$$

The Population standard deviation σ is applicable where entire population can be known along with sq. root of variance. In probabilistic condition, the standard deviation of the entire population can be found by

$$\sigma = \sqrt{\frac{1}{N} \Sigma_{i=1}^N (x_i - \mu)^2}$$

Where x_i is an individual value

μ is the mean/ expected value

N is the total number of values

Under calculation,

$$\begin{aligned} \text{Standard deviation } (\sigma_1) &= \sqrt{\frac{1}{11} \Sigma_{i=1}^{11} (x_i - \mu)^2} \\ &= \sqrt{\frac{(565.76-703.4336)^2 + \dots + (870.25-703.4336)^2}{11}} = 98.1987 \end{aligned}$$

Similarly, one can compute mean and standard deviation for agriculture, industry and services

Mean (μ_2) = 241.6545	Standard deviation (σ_2) = 22.4746
Mean (μ_3) = 111.1409	Standard deviation (σ_3) = 15.721009
Mean (μ_4) = 380.6373	Standard deviation (σ_4) = 64.1748

A Pearson's correlation coefficient (r) whose value of r lies between -1 to 1 inclusively. Formula we have

$$r = \frac{n(\Sigma xy - (\Sigma x)(\Sigma y))}{\sqrt{[n \Sigma x^2 - (\Sigma x)^2][n \Sigma y^2 - (\Sigma y)^2]}}$$

Using the formula for computation one can find all the association values,

$$\begin{matrix} r_{11} = 1 & r_{12} = 0.9952 & r_{13} = 0.9835 & r_{14} = 0.9986 \\ r_{21} = 0.9952 & r_{22} = 1 & r_{23} = 0.9753 & r_{24} = 0.9833 \\ r_{31} = 0.9835 & r_{32} = 0.9753 & r_{33} = 1 & r_{34} = 0.9743 \\ r_{41} = 0.9986 & r_{42} = 0.9833 & r_{43} = 0.9743 & r_{44} = 1 \end{matrix}$$

Let us put these value in matrix form say that matrix as correlation coefficient matrix: is as

$$A = \begin{bmatrix} 1 & 0.9952 & 0.9835 & 0.9986 \\ 0.9952 & 1 & 0.9753 & 0.9833 \\ 0.9835 & 0.9753 & 1 & 0.9743 \\ 0.9986 & 0.9833 & 0.9743 & 1 \end{bmatrix}$$

Then the cofactor of the matrix will

$$A_{11} = (-1)^{1+1} \begin{vmatrix} 1 & 0.9753 & 0.9833 \\ 0.9753 & 1 & 0.9743 \\ 0.9833 & 0.9743 & 1 \end{vmatrix} = \frac{691134007}{50000000000} = 0.001382$$

$$A_{12} = (-1)^{1+2} \begin{vmatrix} 0.9952 & 0.9753 & 0.9833 \\ 0.9835 & 1 & 0.9743 \\ 0.9986 & 0.9743 & 1 \end{vmatrix} = -\frac{491200011}{1000000000000} = -0.0004912$$

$$A_{13} = (-1)^{1+3} \begin{vmatrix} 0.9952 & 1 & 0.9833 \\ 0.9835 & 0.9753 & 0.9743 \\ 0.9986 & 0.9833 & 1 \end{vmatrix} = -\frac{120594087}{1000000000000} = -0.0001206$$

$$A_{14} = (-1)^{1+4} \begin{vmatrix} 0.9952 & 1 & 0.9753 \\ 0.9835 & 0.9753 & 1 \\ 0.9986 & 0.9833 & 0.9743 \end{vmatrix} = -\frac{779841049}{1000000000000} = -0.00077984$$

Substituting cofactor of correlation coefficient matrix, standard deviation and $x_i = X_i - \mu_i$ in (*) one can get

$$\frac{0.001382}{98.1987}(X_1 - 703.4336) + \frac{-0.0004912}{22.4746}(X_2 - 241.6545) + \frac{-0.0001206}{15.721009}(X_3 - 111.1409) + \frac{-0.00077984}{64.1748}(X_4 - 380.6373) = 0$$

or,

$$\frac{691}{49099350} \left(X_1 - \frac{439646}{625} \right) - \frac{307}{14046625} \left(X_2 - \frac{483309}{2000} \right) - \frac{603}{78605045} \left(X_3 - \frac{1111409}{10000} \right) - \frac{2437}{200546250} \left(X_4 - \frac{3806373}{10000} \right) = 0$$

This is required linear relationship between dependent variable GDP and independent variables agriculture, industry and service.

Under initial conditions if all the independent variable zero we found that GDP is -751028.431 billion, negative sign shows that GDP decreases highly if the entire major factor has no role in GDP. It implies that the year in which all factors of production is zero but previously we have saving that will be reduced with amount of negative sign. It is technically possible only when GDP will be considered as sum of private consumption, plus government spending, plus investment and plus net exports which is exports minus imports. So, may in a case investment and net expert will be negative causing the GDP to be negative which will not be sustainable economy. That is why GDP cannot be negative, only growth rate could be negative. In time series of 10 years, GDP with negative sign while we consider all factors agriculture, industry and service as zero shows in 11th year we loss the 751028.431 billion USD from the saving. It is only hypothetically possible because in the current economic system a country needs forex to import everything and any country with absolute zero production is not going to get forex while sitting on its butt. The reason for GDP not becoming zero may be because of missing informal sector contribution or continuity of consumption from previous saving as shrinking of GDP growth. In a real condition, GDP never becomes zero or negative even if people in the country does not work and provided all expenses including medical facilities by government. This could be done by printing tons of tons of local currency but it will come to an end as this currency will come to zero in comparison to other country exchange rate after consuming their reserves. Resulted into zero import still GDP will not be negative however if population is there in a geography definitely, they do some production and GDP will not be Zero. GDP per capita doesn't, be that as it may, reflect contrasts in the average cost for basic items and the swelling paces of the nations; accordingly, utilizing a premise of GDP for every capita at buying power equality is apparently more helpful when looking at expectations for everyday comforts between countries, while GDP is more valuable looking at public economies on the worldwide market.

6. RECOMMENDATIONS :

GDP is a significant national economic analysis technique. So, further study is to be conducted for conforming the other factors significance in contribution of GDP. Factorial Analysis for all factor which might affect GDP should be conducted in a way to prioritize all factor based on its importance. The n-variable Regression Model should be applied to explain all national accounting indicator such Gross National Income, Net National Product, National Income, Personal Income and Disposable Personal Income.

7. CONCLUSION :

GDP can be only hypothetically negative but it could not be even zero or negative in real condition as GDP as country needs forex to import which will not be available for zero production country. But hypothetically, in a country has negative net exports and it is not covered by consumption or investment then GDP can be negative. Illustrate if private consumption was 40 and government consumption was 10 with zero investment and exports was 20 and imports 100, then $GDP = 40 + 10 + 0 + 20 - 100 = -30$. Maybe it can happen if a country imports lots of arms and armament but does not consume anything else. The negative GDP in n-variable Regression Model at initial conditions reflect the stated amount will be consumed from saving of previous year for operation of economic at zero production which is only hypothetical.

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