

# Banaras Hindu University

Department of Statistics, Institute of Science



## PROJECT- WORK 2021-22

## TOPIC

**“A Regression Analysis on the Relationship of Final Consumption Expenditure (US Dollars) with GDP per capita, gross savings, and Net taxes on products (1975-2020)”**

### UNDER SUPERVISION OF:

**Dr. Vikas Kumar Sharma**  
Assistant Professor  
Department of Statistics  
Institute of science  
Banaras Hindu university

### SUBMITTED BY:

**Manjeet Chaudhary**  
B. A. (Hons) Statistics  
Enrolment No- 197214  
Exam Roll No- 19221STA012  
Faculty of Social Sciences

# CERTIFICATE

The project report titled

**“A Regression Analysis on the Relationship of Final Consumption Expenditure (US Dollars) with GDP per capita, gross savings, and Net taxes on products (1975-2020)”**

Submitted by **Manjeet Chaudhary** (Exam Roll no.-19221STA012) for partial fulfillment of the B.A.(Hons.) in Statistics for the session 2021-22, has been originally completed by her, under my supervision.

Date –

Place - Varanasi

**Dr. Vikas Kumar Sharma**  
Assistant Professor  
Department of Statistics  
Institute of science  
Banaras Hindu University

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Place – BHU, Varanasi

**Manjeet Chaudhary**  
**B. A. (Hons) Statistics**  
**Enrolment No- 197214**  
**Exam Roll No-19221STA012**  
**Faculty of Social Sciences**

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# INTRODUCTION

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## Background of the Study

Consumption is basic economic activity that individuals encounter in their everyday lives. It is actually one of the vital economic activities in an economy. Goods and services in different forms are consumed daily to be able to meet the insatiable wants and needs of people in an economy. Expenditure on consumption significantly contributes as a portion of the Gross Domestic Product that is also known as the income of the country. In Macroeconomics, achieving long-term economic growth is usually the priority of policy makers. Since consumption expenditure is synonymous to total spending, consumption is established to be very influential in evaluating the growth of a country.

As Keynes (1936) said, consumption is a function of national income. Through the years, the government has implemented different sorts of policies that would increase consumption of the country. These policies are called fiscal and monetary policies. Researchers and economists have also conducted many studies regarding the importance of consumption in the economic expansion.

Now that it is established that consumption plays a significant role, this study focuses on the factors that influence the consumption expenditure in an economy. First, GDP per capita is basically GDP or the income of the country divided by the total population. This is a good indicator in evaluating the performance of a country mainly because it is the account of national income (Kuznet, 1946). Secondly, there is gross savings. This study will look into the effects of saving on consumption. Intuitively, there is a negative relationship

between the two variables; however, saving can be made to be able to consume more goods in the future. Irving Fisher clarified that consumers are rational and forward looking, making them make decision that are intertemporal choices which involves taking into consideration different periods of time (Mankiw, 2010). Third, net taxes on products will be studied. As we know, goods that are levied with high tax can result to a lower demand for that good. In this project, the researcher will find out if net taxation on products increases or decreases the consumption expenditure of India.

## **Statement of the Problem**

Variables such as GDP per capita, gross savings and net taxes on products need to be assessed to determine the relationship of these variables to the final consumption expenditure in India. To be able to test the relationship, a statistical analysis has to be generated in order to determine how these variables affect the overall consumption of the India using data dating from 1975 to 2020.

## **Objectives of the Study**

The objectives of this research analysis are the following:

- A. To successfully present the effect of the GDP per capita, gross savings, and net taxes on products on final expenditure consumption base on theories and economic intuition.
- B. To assess the relationship of GDP per capita, gross savings, and net taxes on final expenditure consumption using econometric analysis using data from 1975-2020.
- C. To highlight the efficiency of using the software MS-Excel as statistical tool.

## **Significance of the Study**

As mentioned in the background of the study, consumption is very important as a function of economic growth. Through time, the government has implemented a lot of fiscal and monetary policy measures in order to attain a sustainable growth. Again, consumption contributes significantly as a portion of GDP. Thus, this study is significant due to the fact that consumption is a daily economic activity. It aims to show the readers how factors like GDP per capita, gross savings and net taxes on goods affect the behaviour of consumers in an aggregate perspective. This research aims to identify specific details that will be very useful in order for the reader to fully understand how consumption is affected and how it can affect the economic status of the country.

## **Scope and Limitations**

The study is limited to the data gathered from World Bank (2022). The data includes, Final Consumption Expenditure, GDP per capita, Gross Saving, and Net Tax on goods in the India from 1975-2020. In addition to this, consumption will be discussed according to the principles of Theory of Consumption.

The variables are generally measured in the same units but the researcher has decided to transform the data in ln or percent. For example, initially, GDP per capita, and Gross savings are measured in current US\$ for consistency purposed. These variables will be now measured in terms of percentage as ln form. On the other hand, net taxes on goods are measured in current LCU or local currency unit because net taxes measure in current US\$ lacks data. Like the first two variables, net tax is also transformed into percentage form. The study will only encompass the scope of data analysis provided by Ms Excel. The study may also have flaws like the inability of the data to

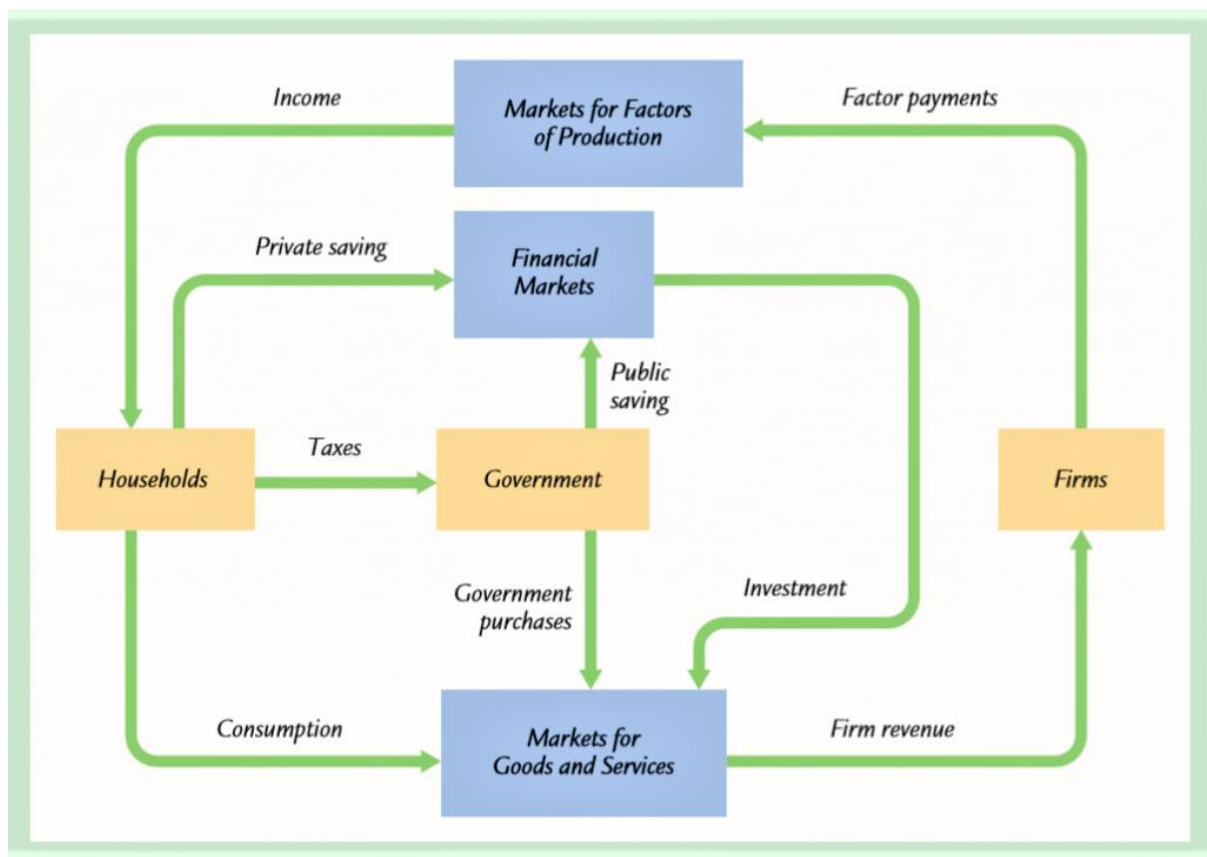


provide consistent information to the readers when it comes to historical events the India has gone through which affected consumption Firms that did not faithfully report their financial statements, which affect the computation of GDP, may also cause conflict in the data. GDP as a statistical account is subject to fraud especially from those who are engaged in tax evasion processes Likewise, the GDP per capita in the data from the World Bank does not count volunteer work and services provided by social workers and charity institutions. It also do not account for reconstruction work and services done due to national disasters and calamities (Madsen, 2006). The hypothesis to be tested is the a-priori expectations and the relationship of each independent variable on the dependent variable given in the project. Other factors such as government expenditure, import and export are assumed to be part of the GDP already. Thus, these will not be tested and evaluated anymore.

# REVIEW OF RELATED LITERATURE

## Final Consumption Expenditure

Mankiw (2010) stated that consumption is made up of the goods and services bought by households. It is made up of three subcategories which are nondurable goods, durable goods, and services. Goods such as food and clothing, goods that temporarily exist, are called nondurable goods. Goods such as cars and computers are called durable goods. These goods last longer. Another subcategory is called services. Haircuts, dentist visits and spas are examples of services. Consumption is part of the GDP equation which will be discussed in the latter part of the project under GDP per capita. To explain this even more, the figure below explains the circular flow diagram.



Here, the reader is able to address the circular consumption expenditure of households, government and firms. The figure shows the flow of received income of the households, how the income is used to pay for taxes to the government, to avail of goods and services, and to save for financial markets where households can invest in. Households may also borrow money from the financial market through the form of loans. The sale of goods and services serve as the revenue of the firms. The revenue is then used to produce for more goods and services. Taxes serve as the revenue of the government. These are used to pay for government expenditures. The excess is then identified as public saving.

One more important thing to be discussed is the theoretical model of consumption as presented by Keynes (1936), Friedman (1956), and Modigliani (1948). Keynes started the modern consumption theory where he analyzed the psychological foundation of consumption behaviour in his “General Theory”. Keynes stated that,

“The fundamental psychological law, upon which we are entitled to depend with great confidence both a priori and from our knowledge of human nature and from the detailed facts of experience, is that men are disposed, as a rule and on the average, to increase their consumption, as their income increases, but not by as much as the increase in their income (The General Theory, 1936, p.96).”

The marginal propensity to consume (MPC) decreases with income. This has the same scenario with average propensity to consume (APC). However, Kuznet (1946) found that the Keynesian consumption theory is inconsistent with the data he had gathered about the economy of the United States. His study showed that constant aggregate APC characterizes the long run time series

consumption of the U.S economy. In response to the study conducted by Kuznet, Milton Friedman (1956) came up with permanent income hypothesis (PIH). He explained that households spend a fixed portion of their permanent income on consumption. He described permanent income is the annuity value of lifetime income and wealth. From this, Friedman came up with a new consumption function:

$$C_t = c.Y_t^*$$

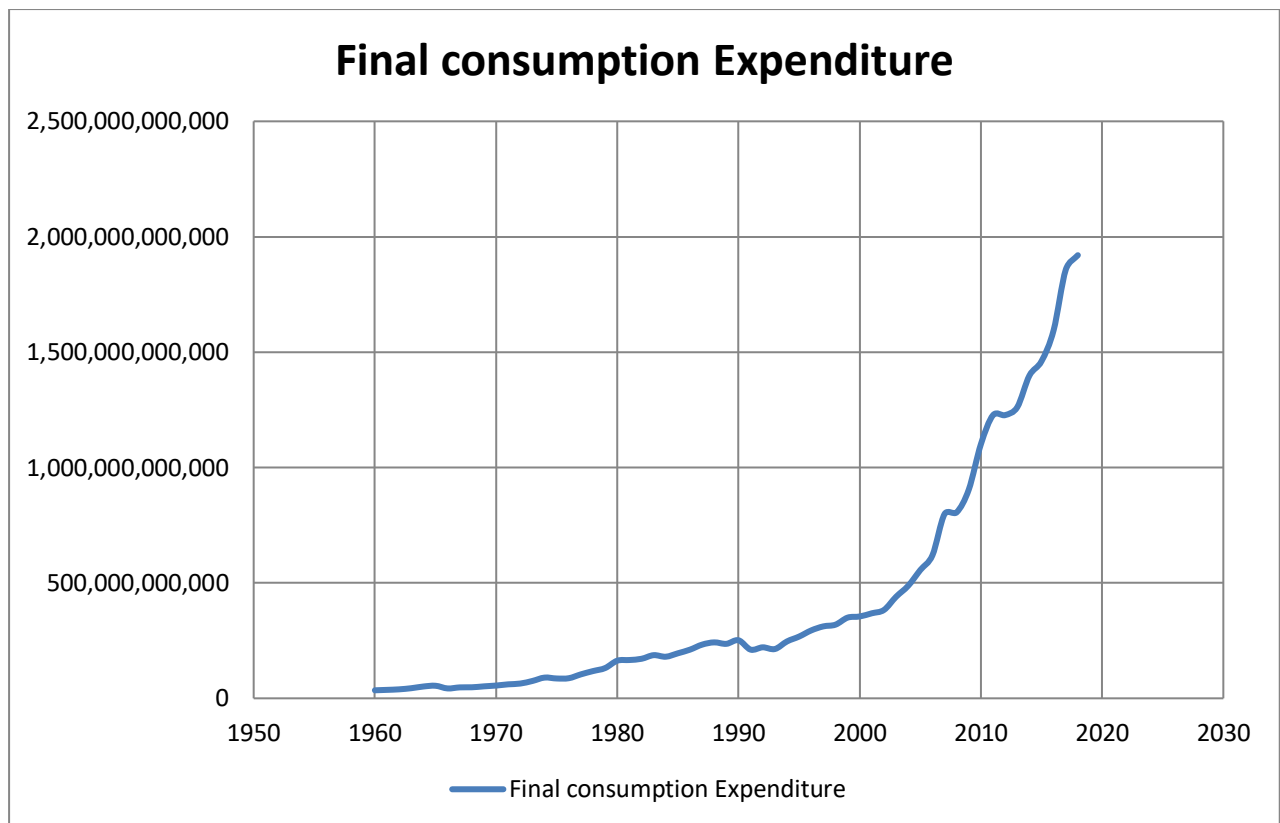
Where  $C_t$ = consumption spending,

$c$ =MPC and

$Y_t^*$  = permanent income.

Modigliani's theory stated that MPC is constant and equal to the APC. While Friedman's theory was being developed, Modigliani was developing his lifecycle theory at the same time. According to this theory, individuals choose a lifetime pattern of consumption that is optimal in their lifetime utility subject to their lifetime budget constraint.

According to Index Mundi (2018), final consumption expenditure (formerly total consumption) is the "sum of household final consumption expenditure (private consumption) and general government final consumption expenditure (general government consumption). This estimate includes any statistical discrepancy in the use of resources relative to the supply of resources. Data are in current U.S. dollars."



\*The latest value for Final consumption expenditure, etc. (current US\$) in India was \$19,19,92,00,00,000 as of 2018. Over the past 58 years, the value for this indicator has fluctuated between \$19,19,92,00,00,000 in 2018 and \$34,79,23,20,000 in 1960 (Index Mundi, 2018).

## GDP Per Capita

Before GDP per capita is explained, GDP must be defined first. Gross Domestic Product is the measurement of final goods and services. It is essentially the sum of consumption ( $C$ ), Investment ( $I$ ), government expenditure ( $G$ ), and net exports ( $NX$ ). The equation of GDP is considered as an identity equation. This must hold all the time. Many economists and policy makers from the government are responsible for setting economic policies that ensures the efficient allocation of resources.

Hence, letting  $Y$  be GDP,

$$Y \equiv C + I + G + NX$$

As discussed above, consumption consists of goods availed in different forms. We now tackle the second component of the GDP

equation, Investment. Mankiw (2010) explained that is it them availing of goods to be used in the future. Like consumption, it is also categorized into three subcategories which known as business fixed investment, residential fixed investment, and inventory investment. Bought property, plant and equipment by firms are considered business fixed investment. When households purchase housing, this type of investment is called residential investment. The increase in the good inventories of firms is called inventory investment. Capital can also be created through investment. Moreover, another component of the GDP equation is called Government Expenditure. These refers to the purchase of goods and services by the government, may it be federal, state, or local governments. Government spends for the military, public infrastructures like government buildings, public schools, public hospitals, highways, bridges, drainage canals, and services provided by the government. Lastly, Net Exports is the measure of value of goods and services that other foreign countries buy from a local country; also known as exports, minus the value of goods a local country buys from foreign countries, also known as imports. Net exports are positive when the value of exports is greater that imports. They are negative when imports exceed exports. Trade balance is present when exports and imports are equal.

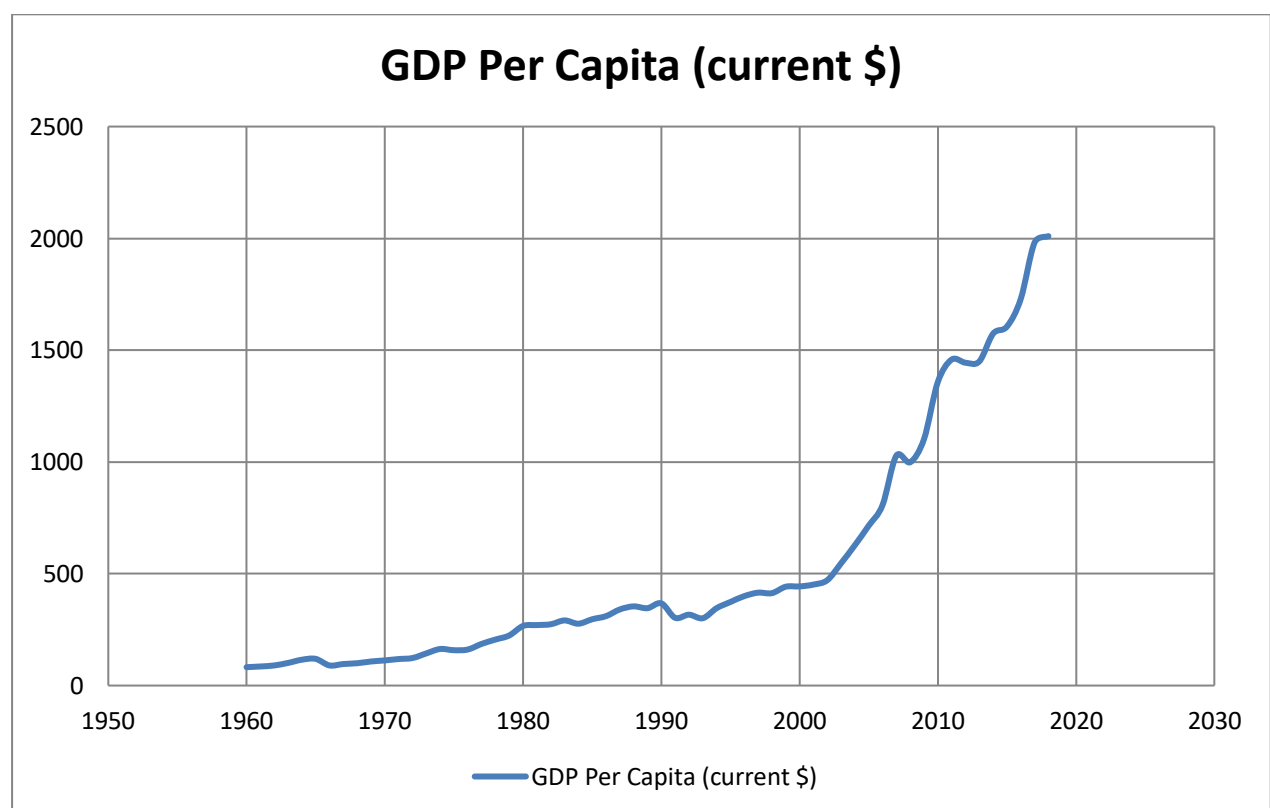
Now that GDP is explained as the total income of a country, it is inferred that GDP per capital solely depends on the value of the computed GDP. GDP per capita is a very reliable indicator of a country's performance.

Madsen (2006) stated that, "GDP per capita is the indicator of the average standard of living of individual members of the population." There is a growth in the economy when the GDP per capita increases. GDP per capita plays a vital role in monitoring the development of the economy through time.

It guides policy makers and forecasters in setting policies that will drive growth and improvement in the standard of living of the population. A decrease in GDP per capita explains a decline in the economy. When there is fall in the trend of GDP per capita, policy

makers must facilitate corrective measures that will bring back the economy to a positive growth.

According to Index Mundi (2018), “GDP per capita is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in current U.S dollars.

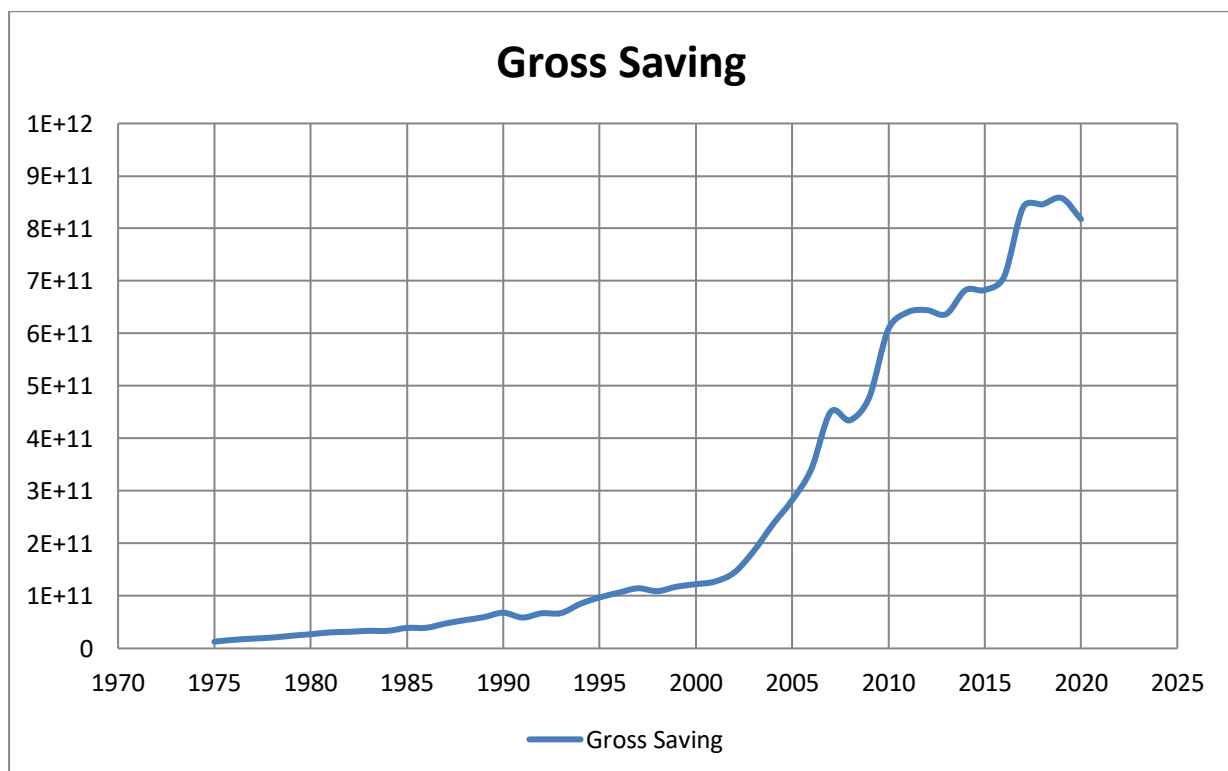


\*The latest value for GDP per capita (current US\$) in India was \$2,009.98 as of 2018. Over the past 60 years, the value for this indicator has fluctuated between \$2,009.98 in 2011 and \$82.19 in 1960 (Index Mundi, 2022)

## Gross Savings

According to Index Mundi (2013), Gross domestic savings is calculated as GDP less final consumption expenditure (total consumption). Data are in current U.S. dollars.

OECD (2011) stated that Gross Saving is disposable income minus general government final consumption. Disposable income is the *“operating surplus plus taxes on the production and imports received minus subsidies payable plus property income received minus property income payable plus net taxes on income and wealth received plus social contributions receivable plus other current transfers receivable minus other current transfers payable minus social benefits and social transfers in kind payable minus that adjustment for the change in net equity of households on pension funds”*, as explained by Index Mundi (2013).



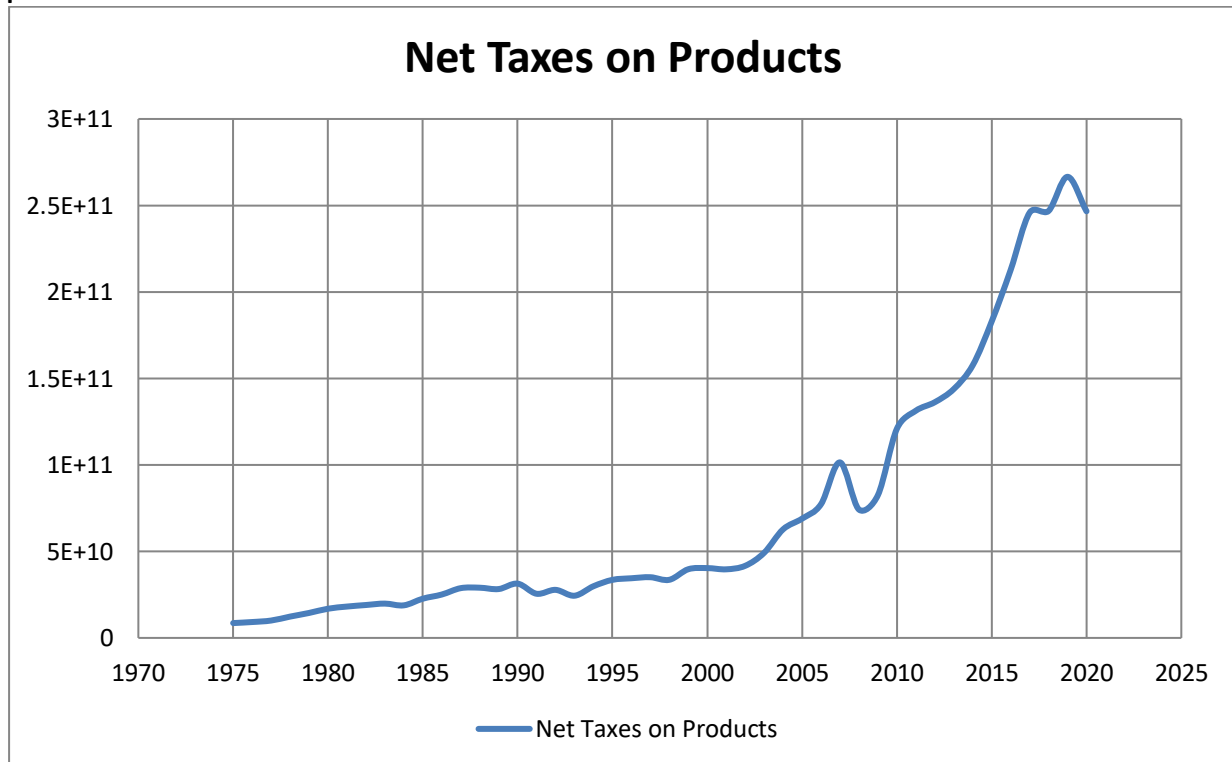
\*The latest value for Gross domestic savings (current US\$) in India was \$818000000000 as of 2020. Over the past 45 years, the value for this indicator has fluctuated between \$818000000000 in 2020 and \$12900000000 in 1975 (Index mundi, 2018).

## Net Taxes on Product

Index mundi (2013) defined net taxes on products (net indirect taxes) as *“the sum of product taxes less subsidies. Product taxes are those taxes payable by producers that relate to the production, sale, purchase or use of the goods and services.”*



Subsidies are grants on the current account made by general government to private enterprises and unincorporated public enterprises. The grants may take the form of payments to ensure a guaranteed price or to enable maintenance of prices of goods and services below costs of production, and other forms of assistance to producers. Data are in current U.S. dollars.



\*The latest value for Net taxes on products (current US\$) in India was \$247,000,000,000 as of 2020. Over the past 45 years, the value for this indicator has fluctuated between \$247,000,000,000 in 2020 and \$85,900,000,000 in 1975 (Index Mundi, 2018)

# **THEORETICAL FRAMEWORK**

Decisions in consumption affect the economy that way it behaves both in the long run and in the short run. This is very crucial in analyzing its role for the economy in the long run.

This study can be supported by the certain theories about consumption proposed by various economists. According to a book written by Mankiw (2010), John Maynard Keynes published General Theory in 1936. He considered the consumption function to be the sole reason for fluctuations happening in the economy during his time. He based his conjectures on introspection and casual observation due to the lack of technological facilities during that time.

First, Keynes proposed that an individual's marginal propensity to consume (MPC) is between zero and one. He confidently explained that men are assumed to increase their consumption as their income increases, but not as much as the increase in their income. A typical individual would consume and save. Second, Keynes conjectured that average propensity to consume (APC) falls as income arises. This only meant that rich people are expected to save more than the poor. Keynes consumption function is written as:

$$C = C + cY \quad C > 0, 0 < c < 1$$

Where C is consumption

Y is disposable income is an constant and

c is the marginal propensity to consume.

For this Project work, we take into consideration the final aggregate consumption of the India. Since the data was already collected, this denotes that MPC and APC is already part of the data. Moreover, this study is also based on Irving Fisher's Intertemporal Choice. This takes into consideration consumers as rational individuals. When consumers spend, they also take into consideration how much to save. They think of both the present and the future. Basically, the less they spend today, the more they spend in the future. In this study, gross saving can be considered as the country's intertemporal choice. Given a country's income or GDP, consumption varies

systematically over people's lives. Having gross savings allows the country to have more income.

## Test the Assumptions of Regression

### Analysis

We have already discussed several issues that determine if it is useful to run a regression analysis. We now turn to discussing the assumptions of regression analysis. If a regression analysis fails to meet the assumptions, regression analysis can provide invalid results. Four regression analysis assumptions are required to provide valid results:

1. The regression model can be expressed in a linear way,
2. The expected mean error of the regression model is zero,
3. The variance of the errors is constant (homoskedasticity), and
4. The errors are independent (no autocorrelation).
5. The fifth assumption is optional. If we meet this assumption, we have information on how the regression parameters are distributed, thus allowing straight forward conclusions on their significance. If we fail to meet this assumption, the regression model will still be accurate but it becomes more difficult to determine the regression parameters' significance.

The errors need to be approximately normally distributed.

## OPERATIONAL FRAMEWORK

### List of Variables

Variable	Notation
Dependent Variable/Regressand	
FINAL CONSUMPTION EXPENDITURE	Fincon
Independent Variable/Regressor	

<b>GDP PER CAPITA</b>	GDPpc
<b>GROSS SAVINGS</b>	grossave
<b>NET TAXES ON PRODUCTS</b>	nettax

## A-priori Expectations of Regressors

Regressor	Algebraic Sign	Intuition
<b>GDP per capita</b>	+	Final consumption expenditure and GDP per capita have a positive relationship with other. GDP per Capita is the income distributed to the population. If the income per person increases, the consumption also increases due to higher purchasing power of consumers. They can demand more and can afford to buy more goods and avail o more services.

## Gross Saving

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It is important to take note that the more a country saves, the less it consumes.

However, a country may also save to be able to spend for future consumption. It is the measure of how much of the country's income of the present generation is set aside for future spending (Mankiw, 2010). Gross savings and final consumption share an indirect relation

Net Taxes on Products	+	The general knowledge is that taxes and consumption share a negative relationship. The more taxes levied to a product, the more expensive the products becomes. However, the government provides subsidies to ensure that prices of goods are stable. Thus, consumers are not directly affected by net taxes on products.
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## Model Specification

Since there are three independent variables and one dependent variable, our model is an example of a multiple regression model. To have an empirical testing, model should be the functional form. Alongside with the dependent and independent variables, a stochastic disturbance term must also be placed. This represents all excluded variables from the model and lack of quantitative information about these variables. Base on theories and intuition given, the model will be estimated with this given equation:

$$fincon = \beta_0 + \beta_1.GDPpc + \beta_2.grossave + \beta_3.nettax + \mu$$

Where *fincon* is the dependent variable final consumption and *GDPpc*, *grossave*, *nettax* are the explanatory variables or

regressors denoting gdp per capita , gross savings and net taxes on product .  $\beta_0$  is the intercept of the term and its function is to give the mean or average effect on *fincon* of all the variables that are not part of the model.

## **METHODOLOGY**

### **Presentation of Data**

This empirical study made use of data containing values for final consumption expenditure, GDP per capita, gross savings, and net tax of the India from 1975-2020. The data was obtained from the online database of the World Bank.

Year	Final Consumption Expenditure	GDP per capita	Gross Saving	Net Taxes on Products
1975	85890197379	158.036171	12898058463	8585605385
1976	87093123892	161.0920922	16399409632	9174587665
1977	1.03806E+11	186.2135042	18715092069	10040987233
1978	1.18062E+11	205.6933833	20675030946	12323472762
1979	1.31101E+11	224.0010188	24125234737	14425001799
1980	1.63031E+11	266.5778508	27065165256	16873597211
1981	1.65954E+11	270.4706009	30586763950	18123774243
1982	1.71249E+11	274.1113337	31725012570	19022671822
1983	1.86911E+11	291.2381101	33513623565	19831157766
1984	1.80251E+11	276.6679583	33511588137	18835835144
1985	1.95099E+11	296.43515	39058065125	22680867225
1986	2.10914E+11	310.4659328	39311168685	25075639980

1987	2.32654E+11	340.4168345	47386948466	28764249569
1988	2.42384E+11	354.1492482	53851103965	29030071310
1989	2.3605E+11	346.1128885	59636070210	28241345640
1990	2.51521E+11	367.5566089	68091088742	31376822854
1991	2.10944E+11	303.0556077	58774830818	25532000812
1992	2.20939E+11	316.9539272	66999236895	27783413342
1993	2.13534E+11	301.1590023	67263075468	24397358398
1994	2.46362E+11	346.1029514	84931289607	29868331572
1995	2.67476E+11	373.7664808	97158642229	33554520423
1996	2.94225E+11	399.9500747	1.06271E+11	34493096265
1997	3.11654E+11	415.4937978	1.14573E+11	35093772126
1998	3.19042E+11	413.2989322	1.09086E+11	33587827142
1999	3.49552E+11	441.9987604	1.1763E+11	39705279149
2000	3.54513E+11	443.3141938	1.2234E+11	40355812212
2001	3.6849E+11	451.5729973	1.27476E+11	39659847933
2002	3.82824E+11	470.9867868	1.44757E+11	41674632908
2003	4.39853E+11	546.7266135	1.85172E+11	49195432719
2004	4.87584E+11	627.7742417	2.36377E+11	62769175039
2005	5.55766E+11	714.8610154	2.82359E+11	68937452471
2006	6.19748E+11	806.7532806	3.41883E+11	77290136227
2007	7.98454E+11	1028.334772	4.50331E+11	1.01457E+11
2008	8.05841E+11	998.5223415	4.34649E+11	74209100779
2009	9.04694E+11	1101.960838	4.77946E+11	82518980099
2010	1.10142E+12	1357.563727	6.08347E+11	1.2089E+11
2011	1.22676E+12	1458.104066	6.4047E+11	1.31336E+11
2012	1.22716E+12	1443.882435	6.44449E+11	1.36249E+11
2013	1.26147E+12	1449.610451	6.36942E+11	1.43858E+11
2014	1.3982E+12	1573.885642	6.82415E+11	1.57609E+11
2015	1.46064E+12	1605.605445	6.82697E+11	1.82893E+11
2016	1.59727E+12	1732.554242	7.07499E+11	2.12677E+11
2017	1.84257E+12	1980.66702	8.40696E+11	2.45812E+11
2018	1.89633E+12	1996.915087	8.4592E+11	2.46807E+11
2019	2.05848E+12	2100.751461	8.57848E+11	2.66537E+11
2020	1.89096E+12	1927.707823	8.1757E+11	2.46615E+11



### Source of data:

- <https://www.indexmundi.com/facts/india/final-consumption-expenditure>
- <https://www.indexmundi.com/facts/india/gdp-per-capita>
- <https://www.indexmundi.com/facts/india/net-taxes-on-products>
- <https://www.indexmundi.com/facts/india/gross-domestic-savings>

## Empirical Procedures

Any empirical procedure of multivariable regression analysis will be encountering main problems interprets the data. First, we have to face the problem of estimation. Estimation includes two methods which are Ordinary Least Squares (OLS) and Maximum Likelihood (ML). However, the we will be using extensively the regression analysis of this research. OLS is considered to be “intuitively appealing and mathematically much simpler” unlike ML.

Second, we should also encounter the problem of inference. The probability value or p-value of the estimate should be less than 0.05. Hence, there should be a 95% confidence interval for the variable to be considered significant. Moreover, tests should also be conducted to assess the correctness of the a-priori expectations and to see whether the data is a good fit to the model.

These methods will be using the software Ms-Excel. Using this software, our aim to see results that are desirable. The results should be sufficient, unbiased, consistent, and efficient. Also, the results will also have to undergo several tests to find multicollinearity, heteroscedasticity, auto-correlation, and test for normality.

# EMPIRICAL TESTING AND INTERPRETATIONS

## Initial Regression

The initial regression of the model is performed through the use of the software Ms-Excel. Below is the attached result of the regression using Ms-Excel.

### SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.999276966
R Square	0.998554456
Adjusted R	0.998451203
Standard Error	22877306883
Observations	46

### ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	3	1.51845E+25	5.06E+24	9670.933283	1.20659E-59
Residual	42	2.19816E+22	5.23E+20		
Total	45	1.52064E+25			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	-93129191886	23113466261	-4.02922	0.000230069	-1.39774E+11	-46484329090	-1.39774E+11	-46484329090
GDP per capita	873298632.3	137838665	6.335658	1.306E-07	595128947.8	1151468317	595128947.8	1151468317
Gross Savings	-0.412792509	0.209756202	-1.96796	0.055697683	-0.836097657	0.010512638	-0.836097657	0.010512638
Net Taxes on Income	2.391403227	0.376827357	6.346151	1.26137E-07	1.630934841	3.151871613	1.630934841	3.151871613

## Interpretation

The generated estimates will now be plugged into the hypothesized econometric model. The regression function that solves the problem of estimation is given below-

$$fincon = -93129191886 + 873298632.3 * GDPpc - 0.412792509 * grossave + 2.391403227 * nettax$$

To solve or the problem of inference, we have to check for a level of significance. This should represent the lowest significant level at which a null hypothesis can be rejected. For this empirical analysis, 5% is the assumed level of significance. The p-value should be an estimate of less than 0.05 to make it significant. Thus, the null hypothesis  $\beta_0 = 0$  must be rejected. Given that the p-value is greater than 0.05, the researcher's estimate is insignificant which means that there is not enough evidence to reject the null hypothesis. Moreover, the p-values of the model indicate if the independent variable is significant enough to influence the dependent variable. The p-values of the model will be discussed in detail right after interpreting the intercept of the model and goodness-a-fit of the model.

## **Interpretation of intercept**

- As seen in the results, the intercept of the model is negative with the value of -93129191886. This implies that the expected value on the dependent variable will be equal to the constant. When explanatory variables are set to 0. Thus, if the independent variables are given to be equal to 0, fincon (Final consumption Expenditure) will be equal to -93129191886. Since the p-value, which is 0.00023, is highly significant. It's significant because 0.00023 is less than 0.05.
- It is also important to observe the r-squared the regressed model. The r-squared measures the goodness-a-fit of the model. Explained that r-squared lies between 0 and 1. The nearer it is to 1, the better fit of the model. It denotes the explanatory power of the model. In the given model, the r-squared is 0.998554. This suggests that the model has a

goodness-a-fit because the model explains 99.8554% of the data.

- Taking a look at the adjusted r-squared, which is 0.998451, means that 99.8451% the model is fitting to the data enough even if it is very slightly lower than the r-squared. The changes in the GDP per capita, gross savings, and net tax explain around 99% of the change in final household consumption. Very high adjusted r-squared may also imply possibility of multicollinearity.

### Interpretation of GDP per capita

- The p-value of the independent variable GDP per capita is  $1.31E-07=0.000000131$ . This would mean that it is significant. Given this, there is strong evidence against the null hypothesis which states that the coefficient is equal to 0: thus, it should be rejected. Since the GDP per capita has a positive coefficient, it has a direct relationship with final consumption expenditure, the dependent variable.
- This proves that the a-priori expectation is correct. The conclusion is that, an increase by one percent in the GDP per capita will increase the final consumption expenditure by  $8.73E+08$  percent.

### Interpretation of Gross Saving

- The p-value of gross saving is 0.055698. Since the p-value is greater than 0.05 and is not even at the 5% significance level, the independent variable gross savings is insignificant. Thus, the evidence to reject the null hypothesis that the coefficient of the variable is 0 is not enough.

- The variable cannot be dropped at the moment. It should be tested first because dropping it would result to omitted variable bias.
- By looking at the coefficient of gross saving, it is not consistent with the a-priori expectation.

### Interpretation of Net taxes on products

- The estimated p-value of net tax is  $1.26137E-07 = 0.000000126137 = 0.000$ (approx). This would mean that the variable is significant because 0.000 is less than 0.05. Again, there is strong evidence against the null hypothesis which denotes the variable to have a 0 coefficient. Since the coefficient is positive, it is consistent with the aforementioned a-priori expectation.
- It has a positive relationship with final consumption expenditure. To conclude, an increase in net tax by one percent increases the final consumption expenditure by 2.391403 percent.

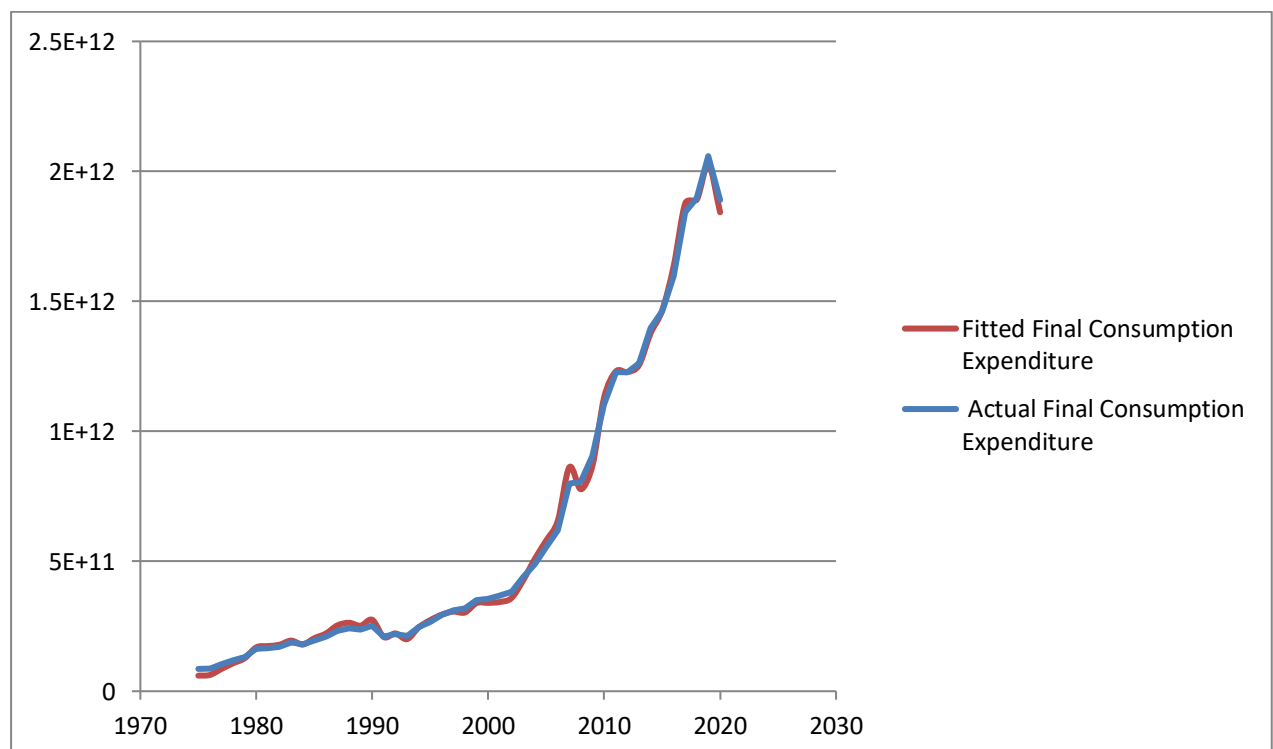
#### Note-

Finally, since the p-value (F) is less than 0.05 at the value of  $1.20659E-59 = 0.000$ , the model is significant and very strong.

**The graph of the initial regression is then given below:**

Year	Final Consumption Expenditure	Estimated final Consumption Income
1975	8.59E+10	6.01E+10
1976	8.71E+10	6.27E+10
1977	1.04E+11	8.58E+10
1978	1.18E+11	1.07E+11
1979	1.31E+11	1.27E+11
1980	1.63E+11	1.69E+11
1981	1.66E+11	1.74E+11
1982	1.71E+11	1.79E+11
1983	1.87E+11	1.95E+11
1984	1.8E+11	1.8E+11
1985	1.95E+11	2.04E+11
1986	2.11E+11	2.22E+11
1987	2.33E+11	2.53E+11
1988	2.42E+11	2.63E+11
1989	2.36E+11	2.52E+11
1990	2.52E+11	2.75E+11
1991	2.11E+11	2.08E+11
1992	2.21E+11	2.22E+11
1993	2.14E+11	2E+11
1994	2.46E+11	2.45E+11
1995	2.67E+11	2.73E+11
1996	2.94E+11	2.95E+11
1997	3.12E+11	3.06E+11
1998	3.19E+11	3.03E+11
1999	3.5E+11	3.39E+11
2000	3.55E+11	3.4E+11
2001	3.68E+11	3.43E+11
2002	3.83E+11	3.58E+11
2003	4.4E+11	4.26E+11
2004	4.88E+11	5.08E+11

2005	5.56E+11	5.79E+11
2006	6.2E+11	6.55E+11
2007	7.98E+11	8.62E+11
2008	8.06E+11	7.77E+11
2009	9.05E+11	8.69E+11
2010	1.1E+12	1.13E+12
2011	1.23E+12	1.23E+12
2012	1.23E+12	1.23E+12
2013	1.26E+12	1.25E+12
2014	1.4E+12	1.38E+12
2015	1.46E+12	1.46E+12
2016	1.6E+12	1.64E+12
2017	1.84E+12	1.88E+12
2018	1.9E+12	1.89E+12
2019	2.06E+12	2.02E+12
2020	1.89E+12	1.84E+12



# Test for the Significance of the Model

## ANOVA

To be able to test for the overall significance, Analysis of Variance (ANOVA) will be used.

ANOVA is used to assess the statistical significance if the dependent variable has a linear relationship to the independent variable. Given that the model is in the form of a multiple regression analysis with a joint hypothesis, ANOVA is the test that should be conducted because it is more general than the t-test. ANOVA is identified as the Total Sum of Squares (TSS) equals Estimated Sum of Squares (ESS) plus the Residual Sum of Squares (RSS). The model's significance can be assessed by consulting the values present in the ANOVA table. For this study,

### Hypothesis:

Ho: All coefficients of the independent variables are 0.

H1: All coefficients of the regressors are not equal to 0.

If the p value of the observed F is sufficiently lower than 5% level of significance, the researcher rejects the Ho.

ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	3	1.52E+25	5.06E+24	9670.933	1.20659E-59
Residual	42	2.2E+22	5.23E+20		
Total	45	1.52E+25			

## Interpretation

Interpreting the result from above, the F-statistic has the value of 9670.933. We see the p-value given by Result above. Since the p-value of is 1.20659E-59 less than the 5% level of significance, Ho is rejected because the model is significant overall.

## Test for Multicollinearity-

Classical linear regression model (CLRM)'s Assumption states, "there is no multicollinearity among the regressors included in the



regression model.” However, there are instances wherein certain models are violated by multicollinearity. Multicollinearity was founded by Ragnar Frisch. It was originally defined as the existence of perfect linear relationship among some or all regressors involved in the regression model. OLS could retain being BLUE even if there is the presence of Multicollinearity in a regression model. Christopher Achen stated that multicollinearity does not violate assumptions about the regression. However, this result to small standard error and the researcher will have a hard time getting the coefficient estimates. In the case of multicollinearity, the model is likely to experience the following consequences:

- A. There is a large variances and covariance in the OLS estimators (imprecise).
- B. Due to the 1st consequence, there are wider confidence intervals which lead the researcher to accept the  $H_0$ .
- C. Due to the 1st consequence, there is/are statistically significant t-ratio of one/more coefficients.
- D. The overall measure of goodness of fit ( $R^2$ ) can be very high.
- E. Standard errors and OLS estimators can be sensitive to small changes in the data.

## Variance Inflation Factors

To be able to test if the model suffers the dangerous degrees of multicollinearity, we compute variance inflation (VIF) factors with the tool data analysis. VIF is at the speed with which variances and covariances increase. The given formula is:

$$VIF = \frac{1}{(1-R_j^2)}$$

If the VIF is greater than or equal to 10, this would mean that the model is inflated by the presence of multicollinearity. Gujarati & Porter (2009) also noted Klein’s rule of thumb that there is a

dangerous multicollinearity when adjusted  $R^2$  is greater than  $R^2$ . Another rule of thumb is that, if the VIF exceeds 10, the variable is highly collinear. In the presence of Multicollinearity, certain measures can be done to remedy the model.

In Ms Excel we use for computing  $R_j^2$  we use regression in data analysis tool.

We choose a dependent variable any out of three independent variable and compute  $R^2$  and write corresponding regression row.

Regression Statistics	
Multiple R	0.999276966
R Square	0.998554456
Adjusted R	0.998451203
Standard E	22877306883
Observatio	46

ANOVA					
	df	SS	MS	F	Significance F
Regression	3	1.51845E+25	5.06E+24	9670.933283	1.20659E-59
Residual	42	2.19816E+22	5.23E+20		
Total	45	1.52064E+25			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%	VIF	$R_j^2$	1/VIF
Intercept	-93129191886	23113466261	-4.02922	0.000230069	-1.39774E+11	-46484329090	-1.39774E+11	-46484329090			
GDP per ca	873298632.3	137838665	6.335658	1.306E-07	595128947.8	1151468317	595128947.8	1151468317	585.9651	0.998293	0.001707
Gross Savir	-0.412792509	0.209756202	-1.96796	0.055697683	-0.836097657	0.010512638	-0.836097657	0.010512638	312.2198	0.996797	0.003203
Net Taxes (	2.391403227	0.376827357	6.346151	1.26137E-07	1.630934841	3.151871613	1.630934841	3.151871613	67.32061	0.985146	0.014854

Variable	VIF	1/VIF
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GDP per capita	585.9651	0.001707
Gross Saving	312.2198	0.003203 0.014854
Net Taxes on Products	67.32061	
Mean	321.8352	

## Interpretation

It can be observed that GDP per capita (GDPpc), gross savings (grossav) and net tax on products (nettax) have VIF values Greater than 10. It is therefore concluded that the model suffers from multicollinearity. This means that the independent variables are perfectly intercorrelated

## **Correlation between independent Variables**

	<i>Net Taxes on Products</i>	<i>GDP per capita</i>	<i>Gross Saving</i>
Net Taxes on Products	1		
GDP per capita	0.98353543	1	
Gross Saving	0.968869603	0.996472927	1

## **Note-**

There are various measures that can be taken to remedy multicollinearity. The first one is to do nothing. Blanchard mentioned that, "Multicollinearity is God's will, not a problem with OLS or statistical technique is general." It is a data deficiency. Thus, the researcher has no control over his data. The next option is to remove the culprit variable. The researcher may also choose to transform variables, change the data, and, etc. Given the data discussed in VIF above, the grossave is considered to be the culprit variable. However, we cannot omit the variable because theoretically, savings affects consumption.

## **CONCLUSION**

- The aim of the project is to determine how GDP per capita, gross Savings, and net tax influence a very important economic factor which is the final consumption expenditure.
- A model with three independent variables which are GDP per capita, gross savings, and net taxes on products, and one dependent variable, final consumption expenditure, was used in a regression analysis and we find GDP per capita and net taxes on products play significant role in final consumption expenditure.
- Multicollinearity was corrected by choosing the option to do nothing to avoid omitted variable bias through dropping a variable.

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