



# Analysis and interpretation of relationship between Crime and GDP using VAR (Vector Auto-Regression) Model.

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## Introduction:

Vector Autoregressive (VAR) models are widely used in time series research to examine the dynamic relationships that exist between variables that interact with one another. In addition, they are also important forecasting tools that are used by most macroeconomic or policy-making institutions.

### a) Hypothesis:

If we consider a population or a part of it which goes apart of socially accepted moral process and human behaviour defines '**Crime**'. So, crime is border line which creates a literary interpretation for those who goes opposites of Idealized social process and Norms. Thereby, **it will affect the GDP and the over-all welfare of the society and the economy as a whole**. This is the empirical analysis to interpret the relationship between Crime and GDP using VAR model.

### b) Analysis of the variable used: Summery Statistics (Mean and Median).

The variables used : Violent Crimes, Murder, Robbery, Theft and US GDP percapita. Where, US GDP percapita taken as the dependent variable and rest are independent variable. It is the US dataset having 11 crime entities out of which 5 variables used for finding out the relationship with GDP percapita of US. The Excludetion process of remaining 6 variables done through stationarity test (Augmented Dicky Fuller Test and DFGLS test) which will be discussed later in the methodology section.

#### Tabular Presentation (1):

Variables	Mean	Median
<b>Violent Crime</b>	468.438	468.4
<b>Murder</b>	6.37	6.55
<b>Robbery</b>	162.46	149.75
<b>Theft</b>	402.13	431.85
<b>US_GDP_percapita</b>	26168.76	23351.36

From the above the tabular presentation, we can see the range of difference between the two measures i.e., mean and median the variables used is not too big except robbery. There is low skewness in the variables used

### c) Illustration of Variables used in the project:

- **Violent Crimes:** In the context of economics, violent crimes are criminal activities that involve the use of force or threat of force to harm or intimidate individuals. It causes both direct and indirect impact on the society and the welfare of the economy as a whole. Such as: loss of productivity, impact on human capital, medical cost increases for victims, causing fears leads lower tourism and transportation business.
- **Murder:** In economic terms, murder refers to the unlawful and intentional killing of another person, and its economic implications are multifaceted. While the primary focus of murder is on its legal and moral dimensions, it also has economic consequences that affect individuals, communities, and society as a whole. especially in the loss of human capital.
- **Robbery:** In economic terms, robbery refers to a criminal act where an individual or a group forcibly takes property or valuables from another person, typically through the

use of threats, intimidation, or violence. The economic implications of robbery are multifaceted and can affect individuals, businesses, and society as a whole.

- **Theft:** In economic terms, theft refers to the unlawful taking of someone else's property with the intent to permanently deprive the owner of that property.
- **US\_GDP\_percapita:**

## Methodology:

### a) Checking for stationarity: Dicky Fuller & DFGLS.

As mentioned above, the US dataset having 11 crime entities out of which 5 variables used for finding out the relationship with GDP percapita of US. The Excludetion process of remaining 6 variables done through stationarity test (Augmented Dicky Fuller Test and DFGLS test).

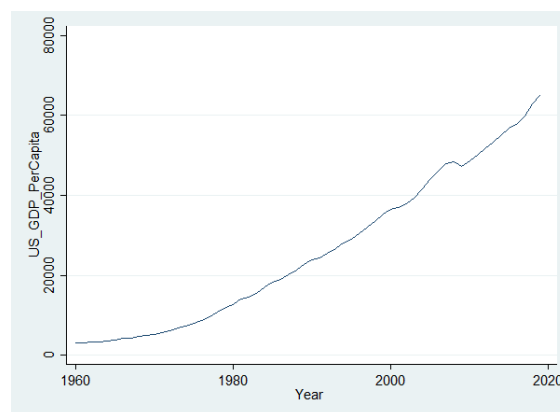
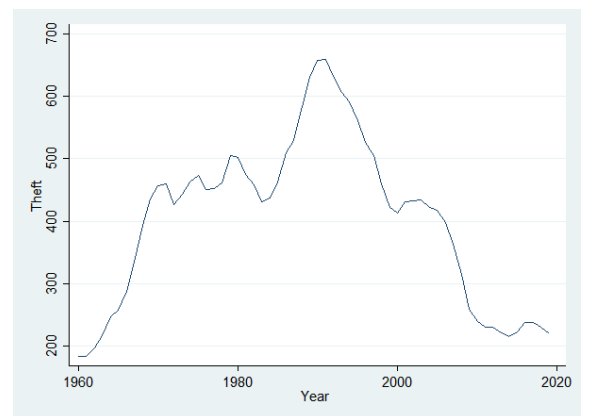
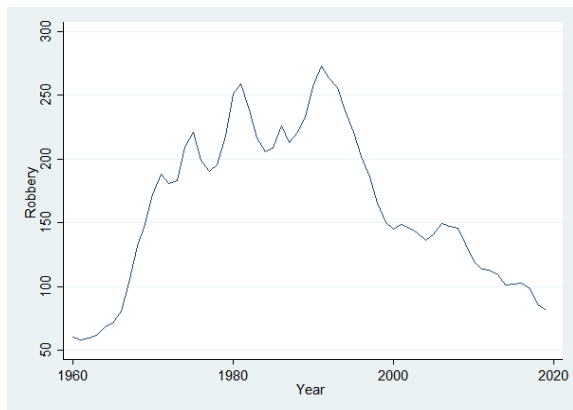
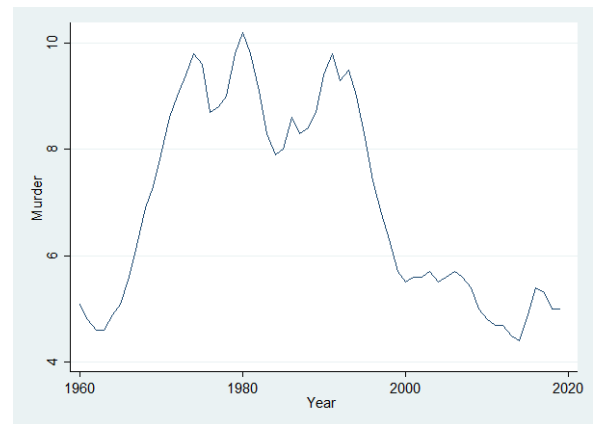
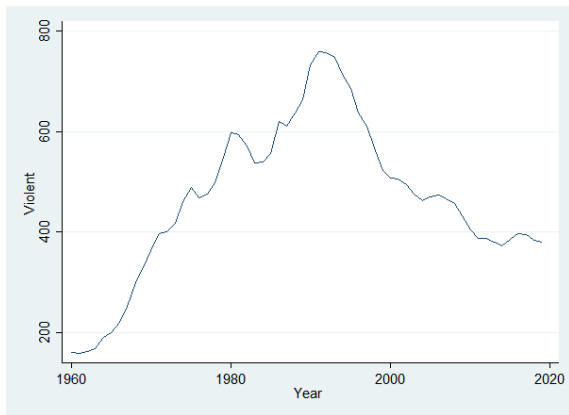
**Firstly**, we have taken all the 11 variables such as : Total Crime, Violent, Property, Murder, Robbery, Aggravated assault, Burglary, Larceny Theft, Theft, US\_GDP\_total and US\_GDP\_percapita and testing for stationarity using Augmented Dicky Fuller test in which the output is insignificant i.e., non-stationary at all levels (1%, 5%, 10%) for all variables. The main reason is the lack of having any pattern as there is an unseen time effect in the variables.

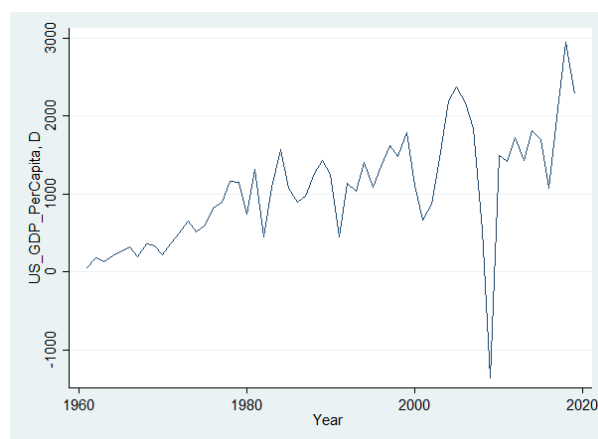
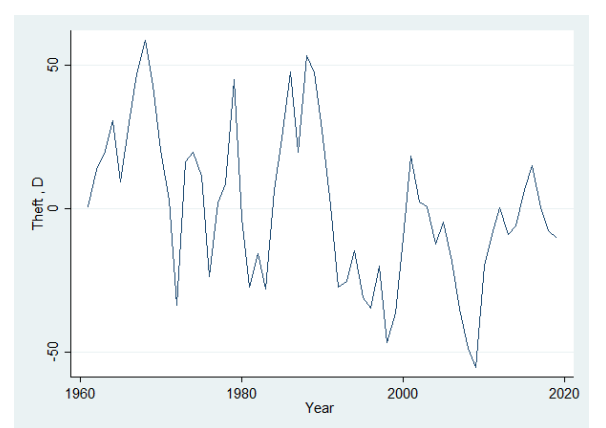
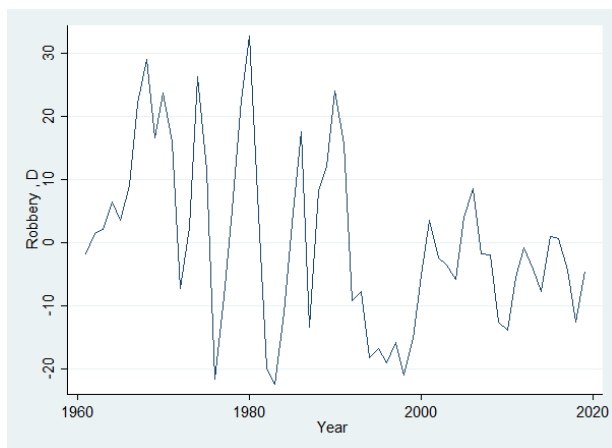
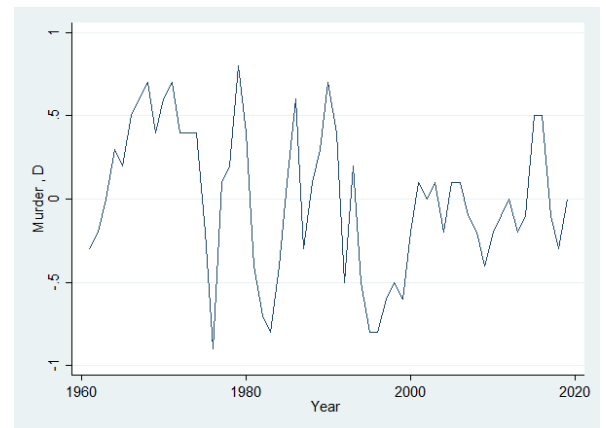
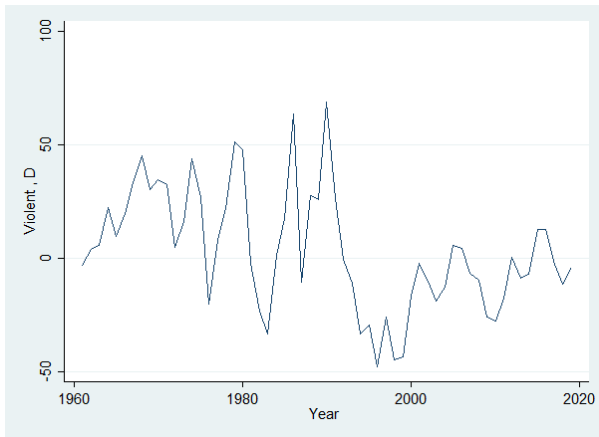
**Secondly**, applying First difference method i.e., converting from values to change values of respective variables for removing the unseen time affect in the variables. Then running the stationary test using Augmented dicky Fuller test. Where, we get: **violent, murder, robbery, Theft and US\_GDP\_percapita satisfies the stationarity condition or we can say these variables are stationary.** Similarly, for **DFGLS test** we have used the first difference of all the variables which are used previously and got the same result as above (**violent, murder, robbery, Theft and US\_GDP\_percapita satisfies the stationarity condition or we can say these variables are stationary.**)

### Tabular Presentation (2):

Table 2: Significance at : 1% = \*\*\*, 5% = \*\*, 10% = \*]

Serial No.	Variables	Dickey-Fuller Statistic (With Trend)	Dickey-Fuller Statistic (Without Trend)	GLS-ADF calculated Statistic (significant lag)
1	Violent	-3.909 (**)	-3.213 (**)	-3.621 (**) (at lag 1)
2	Murder	-4.195 (*)	-3.885 (*)	-4.399 (*) (“)
3	Robbery	-4.338 (*)	-3.44 (**)	-4.416 (*) (at lag 2)
4	Theft	-3.912 (**)	-3.242 (**)	-3.492 (**) (at lag 1)
5	US_GDP_percapita	-4.975 (*)	-3.109 (**)	-4.539 (*) (at lag 1)

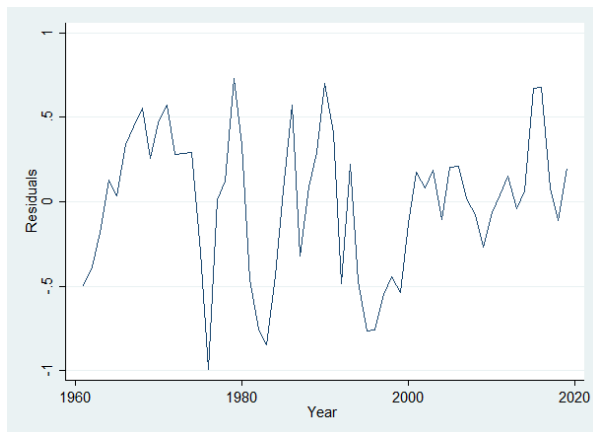
**b) Plotting graph for used variables : before and after using first difference.****1) Before using first difference:**

**2) After using the First difference:**

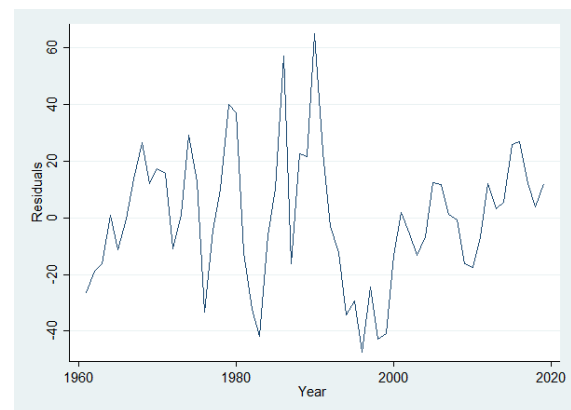
### c) Detrending the variable and plotting the graph of Detrended Variables:

Detrending is the method of converting the variable from time variant to time invariant as with some variable there is an invisible time affect. Against every taking time as an independent variable have obtained residuals which serve as detrended values.

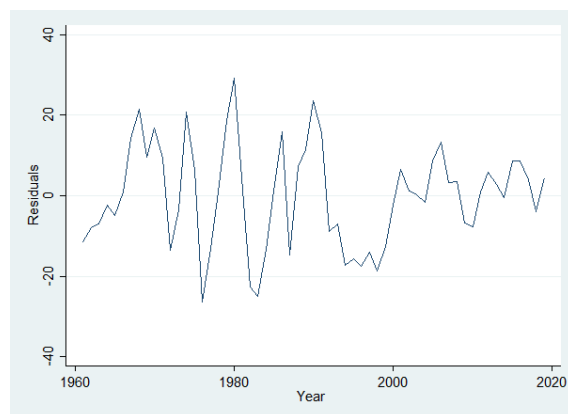
#### Plotted graphs of Detrended Variables:



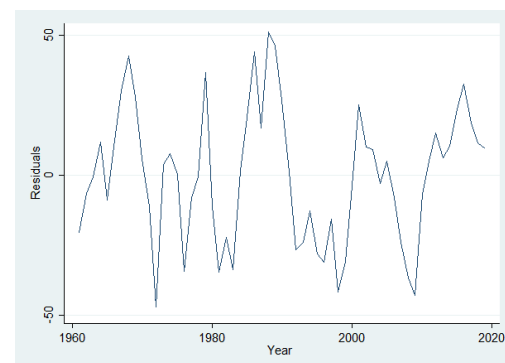
*detrended\_Dviolent*



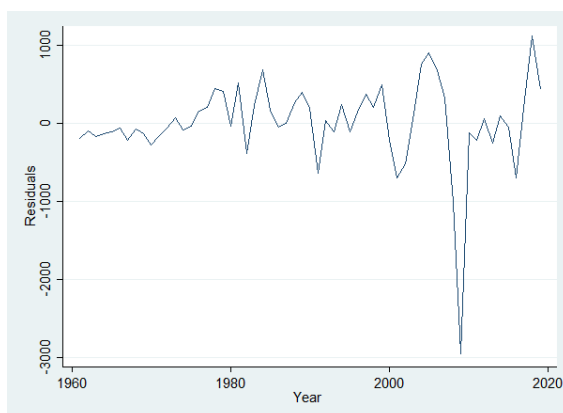
*Detrended\_Dmurder*



*detrended\_Drobbery*



*detrended\_Dtheft*



*Graph 1detrended\_Dus\_gdp\_percapita*

### d) There is no ARCH effect so we will use AR Specification in VAR model:

LM test for autoregressive conditional heteroskedasticity (ARCH)

lags (p)	chi2	df	Prob > chi2
1	<b>0.319</b>	<b>1</b>	<b>0.5724</b>
2	<b>0.347</b>	<b>2</b>	<b>0.8406</b>

H0: no ARCH effects vs. H1: ARCH(p) disturbance

from the above table we can see, the p value is greater than all the significance level (1%,5%,10%) i.e., at lag 1 – 57% & lag 2 – 84% . Here, null hypothesis ( $H_0$ ) is within the accepted region where we can say null hypothesis cannot be rejected rather accepted. So, we can say There is no ARCH effects within the variable used.

So, thereby using AR specifications using VAR Model.

### Analysis using VAR Model:

Null hypothesis taken as – \*  $H_0$  : there is no relationship between the dependent variables taken (Violent, Murder, Robbery , theft) and independent variable ( us\_gdp\_percapita). \*  $H_1$  : there is a relationship between the dependent variables taken (Violent, Murder, Robbery , theft) and independent variable ( us\_gdp\_percapita). if p value of  $\chi^2 > 10\%$  =  $H_0$  is accepted ( no relations ), p value of  $\chi^2 < 10\%$  =  $H_0$  is rejected ( There is a relations ).

#### 1) Analysis 1:

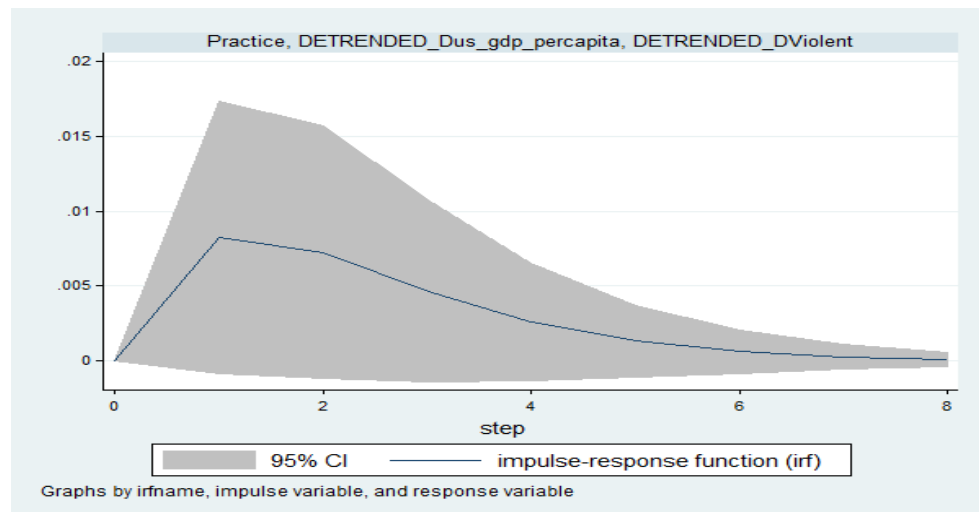
Equation	Parms	RMSE	R-sq	chi2	P>chi2
DETRENDED_Dus_~a	2	517.685	0.1399	9.430304	0.0090
DETRENDED_DVio~t	2	19.6496	0.3203	27.33617	0.0000

	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
<b>DETRENDED_Dus_gdp_percapita</b>						
DETRENDED_Dus_gdp_percapita L1.	.3602926	.1223399	2.95	0.003	.1205108	.6000744
DETRENDED_DViolent						
L1.	-2.712091	2.829043	-0.96	0.338	-8.256914	2.832732
<b>DETRENDED_DViolent</b>						
DETRENDED_Dus_gdp_percapita L1.	.0082112	.0046436	1.77	0.077	-.0008902	.0173125
DETRENDED_DViolent L1.	.5223763	.1073811	4.86	0.000	.3119133	.7328393

From the table, the overall specification of the relationship between Violent crime and `us_gdp_per capita` showing here significance at 1% with a value 0.0090 ( 0.9%). But it is necessary to check the specification alternatively.

- Per unit change in the difference of Violent at lag 1 causes an insignificant ( at all critical levels : 1% , 5%, 10% ) change of value -2.712 in the difference of `us_gdp_per capita` year wise.
- Per unit change in the difference of `us_gdp_per capita` at lag 1 causes an significant ( at critical levels : 10% ) change of value 0.008 in the difference of violent crimes year wise.



## 2) Analysis 2:

Equation	Parms	RMSE	R-sq	chi2	P>chi2
DETRENDED_Dus_~a	3	523.687	0.1355	9.088897	0.0106
DETRENDED_DMur~r	3	.350464	0.3248	27.89957	0.0000

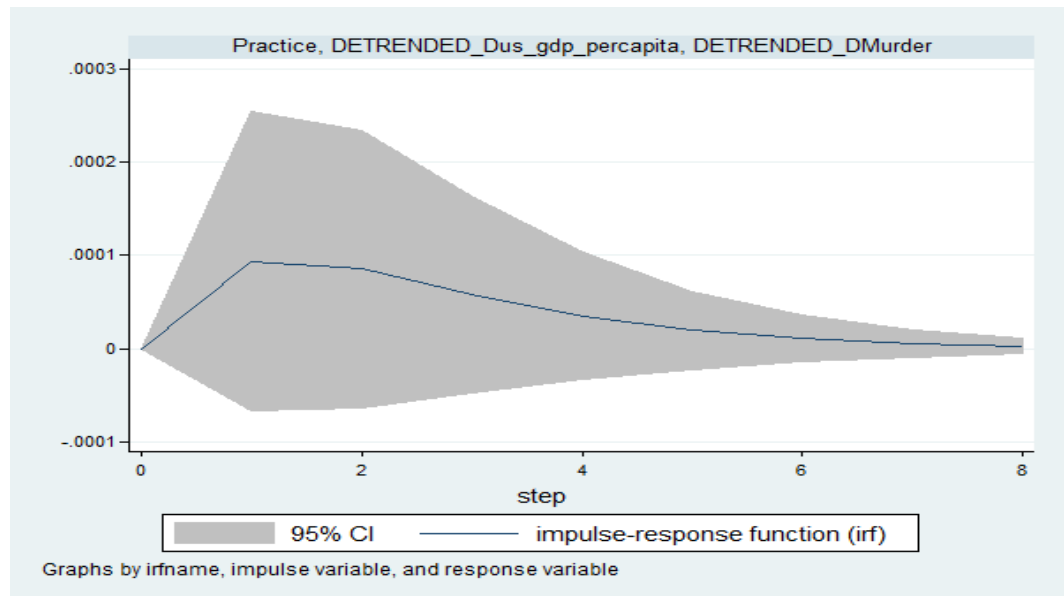
  

	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
<b>DETRENDED_Dus_gdp_per capita</b>						
DETRENDED_Dus_gdp_per capita L1.	.3507667	.1228533	2.86	0.004	.1099787	.5915547
DETRENDED_DMurder L1.	-125.3731	159.8964	-0.78	0.433	-438.7644	188.0181
_cons	5.599234	66.97036	0.08	0.933	-125.6603	136.8587
<b>DETRENDED_DMurder</b>						
DETRENDED_Dus_gdp_per capita L1.	.0000938	.0000822	1.14	0.254	-.0000673	.000255
DETRENDED_DMurder L1.	.5585181	.1070064	5.22	0.000	.3487893	.7682469
_cons	.0111038	.0448181	0.25	0.804	-.0767382	.0989457



From the table, the overall specification of the relationship between Murder and us\_gdp\_per capita showing here significance at 5% with a value 0.0106 ( 1.06%). But it is necessary to check the specification alternatively.

- Per unit change in the difference of Murder at lag 1 causes an insignificant ( at all critical levels : 1% , 5%, 10% ) change of value -125.373 in the difference of us\_gdp\_per capita year wise.
- Per unit change in the difference of us\_gdp\_per capita at lag 1 causes an insignificant ( at all critical levels : 1% , 5%, 10% ) change of value .0000938 in the difference of murder year wise.



### 3) Analysis 3:

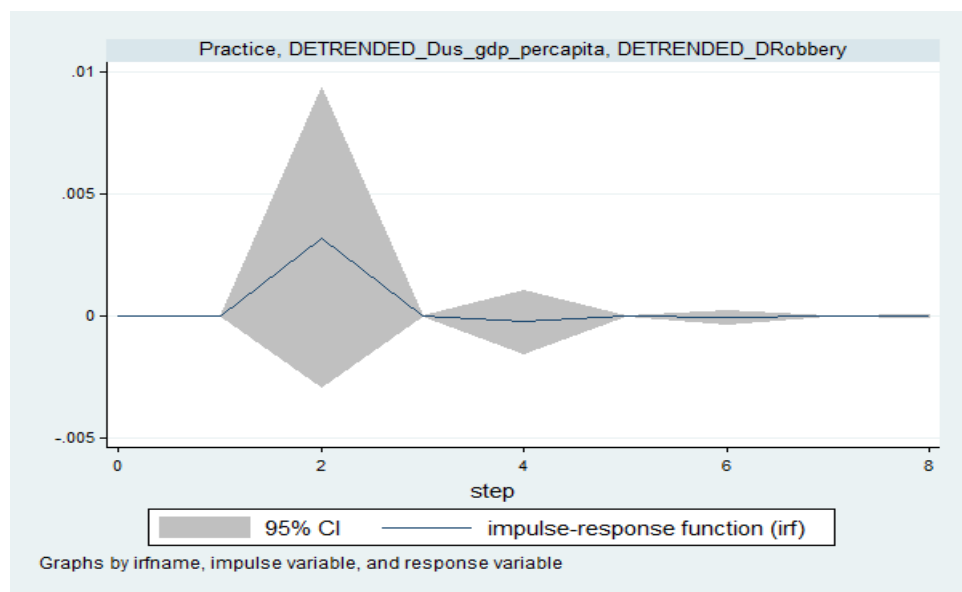
Equation	Parms	RMSE	R-sq	chi2	P>chi2
DETRENDED_Dus_gdp_per capita ~ a	3	561.974	0.0220	1.280655	0.5271
DETRENDED_DRobbery ~ y	3	12.8468	0.0184	1.069334	0.5859

	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
DETRENDED_Dus_gdp_per capita						
DETRENDED_Dus_gdp_per capita L2.	-.0603119	.1367362	-0.44	0.659	-.3283099	.207686
DETRENDED_DRobbery						
DETRENDED_DRobbery L2.	-5.980695	5.689649	-1.05	0.293	-17.1322	5.170813
_cons	3.489518	72.54516	0.05	0.962	-138.6964	145.6754
DETRENDED_DRobbery						
DETRENDED_Dus_gdp_per capita L2.	.0031923	.0031258	1.02	0.307	-.0029341	.0093188
DETRENDED_DRobbery L2.	-.0183151	.1300658	-0.14	0.888	-.2732394	.2366093
_cons	.4275697	1.658388	0.26	0.797	-2.822812	3.677951

From the table, the overall specification of the relationship between Robbery and us\_gdp\_percapita showing here insignificant at all critical values with a value 0.5271 ( 52.71%).

- Per unit change in the difference of Robbery at lag 2 causes an insignificant ( at all critical levels : 1% , 5%, 10% ) change of value -5.980 in the difference of us\_gdp\_percapita year wise.
- Per unit change in the difference of us\_gdp\_percapita at lag 1 causes an insignificant ( at all critical levels : 1% , 5%, 10% ) change of value 0.0031 in the difference of robbery year wise.



#### 4) Analysis 4:

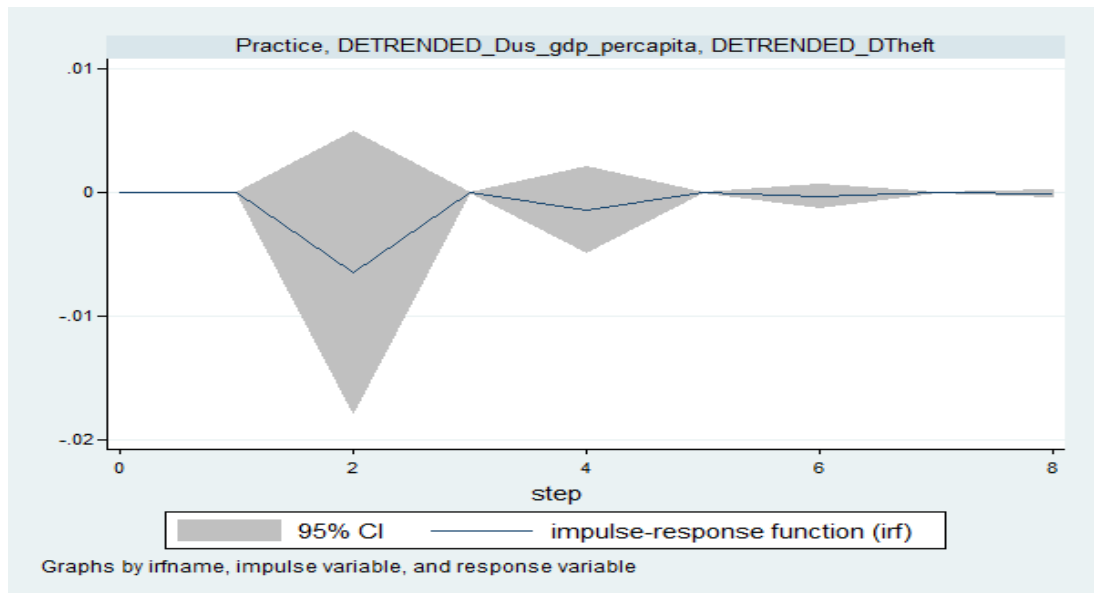
Equation	Parms	RMSE	R-sq	chi2	P>chi2
DETRENDED_Dus_gdp_percapita	3	559.476	0.0306	1.80227	0.4061
DETRENDED_DTheft	3	23.6231	0.1001	6.33843	0.0420

	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
DETRENDED_Dus_gdp_percapita						
DETRENDED_Dus_gdp_percapita L2.	-.0816098	.1374274	-0.59	0.553	-.3509625	.1877428
DETRENDED_DTheft						
DETRENDED_DTheft L2.	3.816758	2.994143	1.27	0.202	-2.051655	9.68517
_cons	4.382857	72.22496	0.06	0.952	-137.1755	145.9412
DETRENDED_DTheft						
DETRENDED_Dus_gdp_percapita L2.	-.0064467	.0058027	-1.11	0.267	-.0178198	.0049263
DETRENDED_DTheft L2.	.3023426	.1264235	2.39	0.017	.0545572	.550128
_cons	.4097377	3.049597	0.13	0.893	-5.567362	6.386838

From the table, the overall specification of the relationship between Theft and us\_gdp\_percapita showing here insignificant at all critical values with a value 0.4061 ( 40.61%).

- Per unit change in the difference of Theft at lag 2 causes an insignificant ( at all critical levels : 1% , 5%, 10% ) change of value 3.816 in the difference of us\_gdp\_percapita year wise.
- Per unit change in the difference of us\_gdp\_percapita at lag 1 causes an insignificant ( at all critical levels : 1% , 5%, 10% ) change of value -0.0064 in the difference of theft year wise.



## Conclusion:

Violent crimes has a relationship between GDP percapita i.e., GDP is affecting on Violent crime but robbery and murder which are the element of violent crime by itself are insignificant. Thus the relationship of violent crimes & GDP is caused by other elements of violent crimes itself. Such as : Non-intentional homicides, arson, Kidnapping, Negligence, etc.

## Reference:

- <https://www.disastercenter.com/crime/uscrime.htm>