Crime and Socioeconomic Factors of India: Cointegration and Causality analysis

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Abstract: In recent decades, the variation of crime creates a major puzzle in a social science discipline. Crime is one of the important determinants of social pollution, and it showcased the negative development of the society. Free from crime is a principal aspect of qualities of life. Developing countries are facing more problems with crime issues. In this study, some of the most significant socioeconomic factors are utilised to measure the relationship with a crime such as GDP, HDI, inflation rate, and rate of unemployment in India. The study mainly focuses on the periods from 1900 to 2015. The data are non-stationary or stationary is investigated through the ADF (Augmented Dickey-Fuller) test. To investigate the Cointegration and causality relations among the socioeconomic factors and crime rate two methods are applied such as Johansen Cointegration test and Granger Causality test (Toda Yamamoto approach). The results showcase that there is a unidirectional causal relation between unemployment, GDP and HDI. However, the most puzzling result is that crime rate has not unidirectional causal relationships among the variables. It can be concluded that socioeconomic progress always not assured the crime.

IndexTerms **- Science discipline, Quality of life, Social pollution, socioeconomic factors, Crime, society.**

I. INTRODUCTION

Crime is the pollution of society which showcases the negative development of the society. Crime history has linked with the ancient period of humanity. Every society considered crime is the source of lower social protection and discomfort (Gillani, Rehman, & Gill, 2009). To measure the quality of life crime rate is always considered for its plagued role in good society (Diener & Suh, 1997; Katz, Webb, & Schaefer, 2001; Cobb, 2000). Societal insecurity and fear due to the victims are affected by the human well being (Diener & Suh, 1997). High unemployment rate prompts the people to assign the crime. Average inflation rate mainly highlights the condition of price stability. The increasing inflation rate decreases the peoples purchasing power. Lower income peoples forced towards criminal activity for their livelihood (Cantor & Land, 1985).

In the industrialised era, societal inequality increases day by day. Inequality has a substantial effect on the rise of crime rate as it is predicted in three ecological crime theories such as Merton's strain theory (1938), Shaw and McKay's social disorganisation theory (1942), and Becker's economic theory of time (1968). In the real context, economic progress also not assured the reduction of crime rate (Diener & Suh, 1997).

Crime is an esoteric topic, not permanent or universal definition is prevailing as it changes according to the time and spaces. Definition of crime considered as problematic academic tribulations of the law (Williams, 1955). According to the Indian criminal law, "crime disallows the behaviour perceived as harmful, threatening or endangering to the health, safety, property and moral welfare of the citizens all-encompassing of one's self".

Every country set some criminal law according to their perspective of crime to punish the criminals (Gillani, Rehman, & Gill, 2009). Law of crime principally concerned with immoral committed against all the citizens. Criminal law usually is well defined and governed by the various statutes of the country. The principal rule of thumb for crime is that a person should be punished for his or her committed offence. However several exceptions are there in the conflict of crime. Government spotlighted with the

crime with the help of Police, corrective justice, and prison system. For restorative justice different category of the court is established within the country.

Criminal behaviour and crime both are harmful to society. People are harmed psychologically or physically by the crime. Fear from crime significantly impacted social security as well as the lifestyle of people (Fajnzylber, Lederman, & Loayza, 2002).

In recent decades urban areas are highlighted most violent crime only for the racial, socioeconomic inequality (Blau, & Blau, 1982). Modernisation and Urbanization rate rapidly increases through the time and space along with crime rate. Income inequality or poverty significantly correlated with assault and homicide than robbery and rape (Hsieh, & Pugh, 1993).

II. Literature review:

Numerous studies already have been done regarding crime and its economic determinants. The result of previous studies highlighted several socioeconomic factors that are accountable for encouraging the crime rate. In recent decades several researchers applied modern economic theories models and techniques to justify the criminal activities (Block & Heineke, 1975). In the recent decade, economic analysis is succeeding to analyses the crime, but it is very complicated to understand the social process. Correctly understanding of crime scenario and determinants of crime, there still many gaps for further performs and studies (Freeman, 1999). Fleisher (1966) in his study finds out that the income level influenced the juvenile delinquency. Becker (1968) developed a theory of collusion. His theory was based on expected utility. He concluded that crime mainly includes cost and benefit (punishment/ un-punishment) analysis of the criminals. However, the unemployment rate has a positive impact on crime. The effectiveness of law enforcement has been leading to decrease crime but the risk in societal loss (Ehrlich, 1973). The U-C (U=Unemployment, C= crime) relationship can be null, negative or positive because it is not a consistent association. It depends on the criminal motive or criminal opportunity (Cantor, & Land, 1985). Per capita consumption, Level of development, GNP has been strongly correlated with the total crime and property crime rate (Krohn, 1976). Longitudinal and cross-sectional analysis of inequality and crime data has been vouched that inequality strongly correlated with crime. Areas of high inequity are intended to more crime only for most underprivileged peoples of the society (Kelly, 2000). Macroeconomic policies such as fiscal policy affect the crime rate. However, the inflation rate leads to the crime by site and situation (Teles, 2004). From the perspectives of policy, education system or others useful works lead to a human capital addition that may enhance the person's market wages and productivity which likely reduces the crime rate (Machin & Meghir, 2004).

Edwardes (1924) in his book "Crime in India" draw attention to the crime scene of India. He concludes several socioeconomic, political and religious factors that influenced crime. Police and criminal laws are not working correctly due to some such barriers which create the insecurity in society. According to Dreze & Khera (2000), Different socioeconomic conditions and crime rate are not strongly correlated in the state level of India. They resulted out that the literacy and crime rate negatively correlated except 'cheating'. They also conclude that high levels of urban expansion may be the reason behind the high crime rate in cities of India. Caste system plays an influential role in the crime. In India, SC political empowerment in local councils amplified the no of crime where the victims are particularly beleaguered only for their caste (Iyer, Mani, Mishra, & Topalova, 2012). In the case of North India, societal intervention and socioeconomic progress lead to notably decreasing domestic violence. Husband, the primary invader, is tinted as a critical indicator of sensitive risk in sexual and physical violence (Koenig, Stephenson, Ahmed, Jejeebhoy, & Campbell, 2006).

III. Crime and socioeconomic determinants scenario in India:

Crime rate statistics of India spotlights the dynamic character of crime over the time. Crime rate fluctuation may be because of inequality of income, high unemployment rate, poverty, and dynamics of inflation. Some others socioeconomic factors also influenced the crime. The socioeconomic progress of the country well not assured to decrease the crime rate. The motive of the crime is not always confined (Baumann & Friehe 2013). Educational attainment and crime have a reverse relation, and it leads to reduce the susceptibility of commit crimes (Lochner, 2007; Lochner, & Moretti, 2004). Some of the cases well-educated persons also involved with crime. However, sometimes many wealthier persons have been involved in crime to exploit their loopholes

(Gillani, Rehman, & Gill, 2009). India showcases high inequality and a high crime rate which creates lower social protection. Sexual assault is the essential alarmed issue among all types of crime in India. National Crime Records Bureau (NCRB) of India published the year-wise crime report from 1953 to 2015.

In recent decades crimes become organised, and few criminals have achieved the support of influential leaders (Sanderson, 2004). The Government of India takes several steps against the crime to reduce the crime. Unfortunately all the steps against crime disappointing because of poor planning to implement the policies, high corruption, the involvement of influential leaders, terrorist attacks.

The crime report showcases that the crime rate is much dynamic in India. In 1953 crime rate is 592.3 and in 2015 it becomes 581.8. So the crime rate decreases over time (Ansari, Verma, & Dadkhah, 2015). Still, the crime rate is much high in India from the perspective of all countries in the world. Large numbers of crimes are not recorded by police (Van Dijk, 2007). The police's primary goal is to show a low crime rate and high clearance rate, which is the principal reason to fail proper crime accountability (Ansari, Verma, & Dadkhah, 2015). So, several crimes are unreported or unaccountable which not considered to measure the crime rate. This unreported crime can change the rate of crime. The peoples are alarming about their social insecurity when checking the headlines of their daily newspaper about the increasing trend of crime.

Table 1: presents the crime rate and other socioeconomic factors of India from 1990 to 2015.

year	crime rate	estimated midyear pop(lakh)	HDI	Average inflation (CPI)	GDP	unemployment rate
1990	592.3	8270	0.427	8.92	316.7	NA
1991	594.3	8496	0.432	13.88	266.5	3.83
1992	604.8	8677	0.438	11.88	284.36	3.72
1993	614.8	8838	0.445	6.31	275.57	3.74
1994	612.8	9000	0.452	10.24	322.91	3.65
1995	654.3	9160	0.46	10.22	355.48	3.72
1996	675.6	9319	0.467	8.98	387.66	3.81
1997	671.2	9552	0.473	7.25	410.32	4.06
1998	636.7	9709	0.48	13.17	415.73	4.06
1999	497.8	9866	0.488	4.84	452.7	4.06
2000	515.7	10021	0.493	4.02	462.15	4.32
2001	520.4	12070	0.498	3.77	478.97	4.33
2002	526	10506	0.504	4.31	508.07	4.43
2003	514.4	10682	0.517	3.81	599.59	4.31
2004	555.4	10856	0.5526	3.77	699.69	4.37
2005	455.8	11027.9	0.535	4.25	808.9	4.4
2006	455.7	11197.8	0.545	5.79	920.32	4.24
2007	504.5	11365.5	0.556	6.39	1201.11	4.06
2008	515	11531.3	0.564	8.32	1186.95	4.12
2009	570.8	11694.4	0.57	10.83	1323.94	3.75
2010	569.3	11857.6	0.581	12.11	1656.62	3.54
2011	516.7	12101.9	0.591	8.87	1823.05	3.53
2012	497.9	12133.7	0.6	9.3	1827.64	3.62
2013	540.4	12287.8	0.607	10.92	1856.72	3.46
2014	581.1	12440.4	0.618	6.37	2039.1	3.41
2015	581.8	12591.1	0.627	5.88	2102.4	3.49

Source- Crime rate and population- NCRB of India; The unemployment rate- International Labour Organization; HDI: UNDP Human Development Reports; Average Inflation rate: Inflation.eu; GDP: World Bank. NA- Not Available

IV. Methodology:

4.1 Unit Root Test and Order of Integration:

Unit root tests are tests for non-stationary (statistical properties are not constant over time) and stationary (statistical possessions such as mean and variance, are all invariable over time) in a time series data. Unit roots are one of the principal reasons in a time series data for non-stationary.

"Order of integration" is a summary statistics (summarise and highlighted information about the sample data) utilised to illustrate a unit root in time series data investigation. "Order of integration" generally depicts about the minimum number of differences required to stationeries a time series data. Integration order can be tested through several techniques such as Kwiatkowski, Phillips, Schmidt and Shin (KPSS) test, Augmented Dickey-Fuller test (ADF) and Phillip-Perron test (Dritsaki, 2017). One of the favourite unit root test technique is the Augmented Dickey-Fuller Test (ADF), which is applied in this study to determine the order of integration of the time series data.

In this article two econometrics technique is utilised, Cointegration and causality, to analyse the crime and socioeconomic factors.

4.2 Cointegration:

Cointegration analysis is an applied econometrics technique which utilised to estimate the long run relationship among the time series variables. Cointegration technique is the utterly true principle which entailing that the mean and variance being constant are not reliant on time. In recent, Cointegration analysis is a crucial process in existing time series analysis. However, time series have a trend either it stochastic (random walk) or deterministic. Due to the complexity, in reality, stochastic trends analysis becomes the most crucial aspects of the macroeconomic model. According to Nelson & Plosser (1982), various US macroeconomic time series have stochastic trends. Therefore, standard F and t-test are not valid for stochastic trends analysis because of its constancy doctrine. Regression of two independent and non-stationary time series variables vouches for the result as "spurious regression". If the variables are showing a trend with time (non-stationary), the coefficient seems to be significant when they are naturally not. This problem acknowledged as the spurious regression problem. Philips has given the solution to the spurious regression model (Giles, 2007).

In recent decades, many economists contributed to developing the Cointegration analysis, and it has become the revolutionary phase in econometrics (Johansen, 2009; Gillani, Rehman, & Gill, 2009). Cointegration analysis is a new technique in econometrics for estimation of short-term and long-term relationships with non-stationary variables. Johansen Unrestricted Cointegration test is applicable for testing various dynamic models as well as can be applied for testing the soundness of fundamental economic theories. Johansen Unrestricted Cointegration test is only utilised where the same order of integration vouches in the time series data (Dritsaki, 2017). A significant advantage of the Johansen test is that it consents more than one cointegrating relationship. In this study, Johansen Unrestricted Cointegration test (Trace and Maximum eigenvalue) is applied to test the relation between crime and socioeconomic variables.

4.3 Granger Causality Test using Toda Yamamoto Approach:

Granger causality method becomes most trendy causality analysis due to its computational simplicity in time series data analysis. The spurious regression results are leads by the usual Granger causality test. In Granger Causality test F-test statistics result is not suitable except the factors in levels are cointegrated (Alimi, & Ofonyelu, 2013). Recent models (the error correction model and the vector autoregressive model) present the substitute for the testing of causality among the time series data (Gillani, Rehman, & Gill, 2009). Toda Yamamoto (1995) highlighted that these tests are unwieldy and most sensitive to the values of the nuisance constraints in limited samples and estimation results are unreliable. Toda Yamamoto introduced a new causality measurement technique in 1995 for a significant conclusion based on augmented level VAR with cointegrated and integrated processes. The

principal advantage of this approach is that it circumvents the probable pretest prejudices. Toda Yamamoto approach utilised MWALD (Modified Wald) test and estimated a $(k+d_{max})$th order VAR, where d_{max} represents the maximal order of integration. This approach generally tests nonlinear and linear restrictions on the first k coefficient matrices by the help of standard asymptotic theory (Toda & Yamamoto, 1995). The Granger causality test using Toda Yamamoto approach has been done through the EViews 10 SV software.

V. Empirical Findings:

The dataset consists of socioeconomic variables of India such as crime rate, unemployment rate, GDP, HDI, an average inflation rate. Unit root test has been done through ADF test to justify the time series data properties. The ADF test performed for a unit root in level and first difference include in test equation with intercept, trend and intercept. Schwarz Info Criterion (SIC) preferred for lag length for the entire variable in unit root test.

The ADF unit root test carried out the following hypothesis: [Null hypothesis: $\beta=0$; Y_t =Non-stationary], [Alternative hypothesis: $\beta \neq 0$; Yt= Stationary]. The ADF test uses a negative number, more negative represent more probability to reject the null hypotheses. Simply, the variables have been considered stationery when the null hypothesis rejected, and alternative hypothesis accepted. In this study, the first difference value is taken to make the variables stationary. The ADF test report presents in below table.

Table 2: Unit Root Test using ADF test for socioeconomic factors

Variable	Intercept (T statistics and prob.*)	Trend and Intercept (T statistics and prob.*)
Crime rate		
Level	-1.833686 0.3564	-1.883312 0.6330
1st Difference	-4.515227 0.0017*	-4.452420 0.0088*
Average Inflation rate		
Level	-2.645116 0.0977	-2.652676 0.2625
1st Difference	-6.882256 0.0000*	-6.754982 0.0001*
GDP		
Level	2.016212 0.9997	-1.543548 0.7862
1st Difference	-3.783058 0.0090*	-4.520553 0.0076*
HDI		
Level	0.844747 0.9926	-3.904546 0.0272*
1st Difference	-7.100299 0.0000*	-5.491365 0.0010*
Unemployment rate		
Level	-3.156826 0.0375*	-0.887634 0.9419
1st difference	-4.094745 0.0044*	-4.300734 0.0122*

*Mackinnon (1996) one-sided p values.
Exogenous: Constant.

To identify the dynamics of variables in the model optimal lag length measure is essential. EViews 10 SV software is utilised to measure the lag length under different criteria. Standard VAR type applied for VAR specification with 1 2 lag interval in endogenous. Lag result showcases in below table.

Table 3: represents Lags under different criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-281.4646	NA	16040.98	23.87205	24.11747	23.93716
1	-186.0214	143.1648*	47.77596*	18.00178	19.47435*	18.39245*
2	-157.5959	30.79429	49.18538	17.71632*	20.41603	18.43255

*indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Johansen Unrestricted Cointegration rank test (trace and maximum eigenvalue) results highlighted in table 4. In Johansen Cointegration test, no of CE value represents at most 4 [Number of the variable (5) – 1]. No of Cointegration variables are represents like r =0; r ≤ 1; r ≤ 2; r ≤ 3. The table showcased the results of Unrestricted Cointegration rank test and highlighted the existence of at most two cointegrating vectors in the system at five percent levels. The result guides to conclude that there is cointegration between the socioeconomic variables and crime.

Table 4: Johansen Unrestricted Cointegration Test result

Hypothesized No. of CE(s)	Eigenvalue	Unrestricted Cointegration Rank Test					
		Trace Statistics	0.05 C value	Prob.**	Maximum Eigenvalue	0.05 C Value	Prob.**
None*	0.914507	150.8752	69.81889	0.0000	56.56450	33.87687	0.0000
At most 1*	0.846644	94.31071	47.85613	0.0000	43.12479	27.58434	0.0002
At most 2*	0.790766	51.18592	29.79707	0.0001	35.97891	21.13162	0.0002
At most 3	0.432832	15.20701	15.49471	0.0552	13.04331	14.26460	0.0773
At most 4	0.089784	2.163699	3.841466	0.1413	2.163699	3.841466	01413

Trace test and the Max-eigenvalue test indicates 3 cointegrating e qn(s) at the 0.05 level
*denotes rejection of the hypotheses at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p values

The Granger causality test using Toda-Yamamoto approach results vouch in table no 5. The Granger causality test using T-Y approach analysed the causality with the help of Chi-sq statistics and probability values.

Table 5: Granger Causality Test result using Toda Yamamoto Approach

	Crime Rate	**Average Inflation Rate**	**GDP**	**HDI**	**Unemployment Rate**
Crime Rate	**0**	**0.960207** **0.6187**	**2.077513** **0.3539**	**1.314967** **0.5182**	**3.297080** **0.1923**
Average Inflation Rate	**2.023733** **0.3635**	**0**	**2.086712** **0.3523**	**1.490473** **0.4746**	**1.301308** **0.5217**
GDP	**2.474602** **0.2902**	**0.023755** **0.9882**	**0**	**4.321737** **0.1152**	**15.06282** **0.0005***
HDI	**2.506285** **0.2856**	**3.405341** **0.1822**	**3.198411** **0.2021**	**0**	**2.462779** **0.2919**
Unemployment Rate	**4.054776** **0.1317**	**3.168978** **0.2051**	**14.51157** **0.0007***	**7.469257** **0.0239***	**0**

*denotes the values are significant at 5 % level.

The results showcase that there is a unidirectional causal relation between unemployment, GDP, HDI, average inflation and crime rate.

VI. Conclusion:

The principal objective is to investigate the relationship among the crime and socioeconomic factors. This study concludes that there is a cointegration among the socioeconomic variables with the crime. According to the Johansen unrestricted cointegration test, the socioeconomic factors are leads to encourage the crime. The above causality analysis discloses that the rate of unemployment in India has been unidirectional causality with GDP and HDI. Human Development Index (HDI) measured through the life expectancy, education and GNI. GDP and HDI have not any unidirectional causality with a crime. From this result, it is clear that social progress or human development cannot assure the crime.

To decrease the crime rate economic growth with socioeconomic justice is essential. Economic growth should be in favour of poor class people in society. The policymakers should consider all socioeconomic variables for measuring the crime and implementing the policy.

VII. Conflict of Interest:

The authors have no conflict of interest relevant to this article.

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