ADVANCE SOCIAL SCIENCE ARCHIVE JOURNAL
Available Online: https://assajournal.com
Vol. 04 No. 02. October-December 2025.Page# 1127-1149
Print ISSN: 3006-2497 Online ISSN: 3006-2500
Platform & Workflow by: Open Journal Systems

The Impact of Population Education and Economic Indicators on Crimes: A Longitudinal Study

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ABSTRACT
This study analyzes the impact of population, education, and economic indicators on crime rates in Pakistan from 1971 to 2021. Using the ***Autoregressive Distributed Lag (ARDL)*** *approach and* ***Error Correction Model (ECM),*** *the findings reveal that* ***GDP per capita (p = 0.5164)*** *and* ***foreign direct investment (FDI) (p = 0.1199)*** *have no significant effect on crime rates. However,* ***population size (p = 0.0000)*** *shows a positive and significant relationship with crime, while* ***literacy rate (p = 0.0122)*** *and* ***government expenditure on education (p = 0.0001)*** *have significant negative effects. These results suggest that improving education and managing population growth are key to reducing crime. The study recommends greater investment in education, equitable resource distribution, and integrated policies involving education, law enforcement, and social development to effectively address crime in Pakistan.*

Keywords: *Crime Rate, Population Growth, Education, Economic Indicators, ARDL Model*

1. Introduction

The concept of crime dates back to the Roman jurist Gaius in the 2nd century AD, who defined *crimen* as a wrongful act violating public law and punishable by the state. Crime refers to actions harmful to individuals or society, typically enforced through legal systems. While some rule violations, such as civil disputes, are not considered crimes, criminal acts like murder, theft, and rape are universally condemned. People are generally less likely to commit crimes when they enjoy social respect, equal opportunities, and fear of punishment, as

supported by Anwar et al. (2015). In Pakistan, crime remains a persistent and complex problem affecting the economy, governance, and social stability. Since its independence in 1947, the country has faced rising crime rates due to rapid population growth, unemployment, and limited resources. Reported crimes increased from 73,107 in 1947 to over 538,000 in 2007, though many crimes remain unreported. Despite recent declines in crime rates between 2013 and 2016, the issue continues to challenge national development. This thesis seeks to analyze the causes and factors influencing crime in Pakistan, focusing on links with population growth, education, and economic conditions to better understand the country's crime dynamics.

1.1 Population and crime

Pakistan, with a population of approximately 220 million people, faces major challenges such as poverty, illiteracy, and a high crime rate. The relationship between population growth and crime has long been a topic of interest for researchers and policymakers. According to the Pakistan Bureau of Statistics (PBS), the population increased from 132.35 million in 1998 to 220.89 million in 2021—an increase of over 66%. This rapid growth has placed significant pressure on the country's resources and infrastructure, leading to various social and economic problems, including an increase in the crime rate. Crime is a complex phenomenon influenced by social, economic, and demographic factors. Studies have shown mixed views: some researchers argue that population growth leads to more crime due to resource strain, while others believe it can reduce crime through increased social control and better opportunities. Pakistan continues to experience high crime rates across multiple categories, such as theft, burglary, robbery, and homicide. The limited research available indicates a positive correlation between population and crime in Pakistan (Pakistan Bureau of Statistics, 2021).

Table 1.1- Population and Crime Rates in Pakistan

Year	Population in Millions	No. of Crimes Reported	Crime growth rate
1951	33.82	76519	--
1958	38.12	81124	6.02
1961	42.97	79900	-1.51
1966	51.98	93633	17.91
1971	62.88	129679	38.50
1976	72.12	167032	28.80
1981	83.84	152782	-8.53
1986	97.67	220035	44.02
1991	112.61	403078	83.19
1998	133.61	431854	7.14

2000	139.76	388909	-9.9
2003	149.03	400680	3.03
2005	153.69	453264	13.1
2007	158.17	538038	18.7
2008	162.3	538048	2.30
2011	177.58	610242	4.53

Source: GOP (2012).

1.2 Education and crime

Education is a fundamental human right and a key driver of economic and social development. However, Pakistan faces significant challenges in this sector, including low literacy rates and limited government spending on education, alongside a high incidence of crime such as theft, murder, and kidnapping. Research in criminology has extensively examined the relationship between education and crime, generally finding a **negative correlation,** that is, higher education levels tend to reduce crime rates. However, this relationship is complex and context-dependent, varying by the indicators used to measure both education and crime. This thesis focuses on analyzing the relationship between **education indicators,** specifically literacy rate and government expenditure on education, and crime in Pakistan. It also considers **economic factors** like GDP per capita and foreign direct investment (FDI) inflows as mediating variables influencing both education and crime.

Empirical evidence supports the link between education and reduced criminal activity. For example, Sampson and Laub (1993) found that individuals with higher education levels were less likely to engage in crime. Similarly, Mahmood and Sarfraz (2014) and Butt and Ahmed (2018) reported that higher literacy rates in Pakistan are associated with lower crime rates. However, not all studies are consistent. Abbas et al. (2013) found that while education negatively affected crime, the relationship was not statistically significant.

1.3 Economic indicators and crime

Crime is a complex and multifaceted issue that affects individuals, communities, and societies, posing serious challenges to social and economic development. In Pakistan, crime remains a major concern, including terrorism, robbery, burglary, and homicide, all of which have caused loss of life and property and fostered widespread insecurity. The relationship between economic indicators and crime has been widely debated, with some studies suggesting a positive association and others indicating a negative one, depending on socio-economic and cultural contexts. In Pakistan, limited research exists on how economic factors such as **GDP per capita** and **foreign direct investment (FDI) inflows** influence crime. Despite moderate economic growth—averaging 4.4% between 2010 and 2019—and fluctuating FDI inflows, the country's crime rate has not declined proportionally, suggesting a complex and possibly indirect relationship between economic development and criminal activity. According to the **Global Peace Index (2021),** Pakistan ranks 150th out of 163 countries in terms

of safety and security. The high crime rate not only undermines national stability but also discourages foreign investment, affecting overall economic progress. The relationship between population, education, and economic indicators with crime has been widely examined in criminological and sociological research. Shaw and McKay (1942) explained through social disorganization theory that rapid population growth, poverty, and migration increase crime due to weakened social control. Similarly, Alam (2012) emphasized that social and economic disorganization are key drivers of crime in developing nations, while Asif, Ali, and Rehman (2016) linked poverty and unemployment to rising crime rates in Pakistan. According to Cohen and Felson's (1979) routine activity theory, crime occurs when motivated offenders encounter suitable targets without capable guardians a pattern reflected in Pakistan as noted by Bhatti, Mian, and Shafi (2017). Studies by Reid (1998), Bursik (1988), and Khan and Ali (2018) found that high population density and a large youth population correlate with higher crime rates, while Nizamani (2017) highlighted weak governance as a major contributor. Collectively, these studies indicate that rapid population growth and poor institutional performance significantly shape crime patterns in Pakistan. Education is widely recognized as a major deterrent to crime, enhancing productivity, lawful income opportunities, and moral development. Levitt and Lochner (2001) and Raphael and Winter-Ebmer (2001) found that higher education levels lower crime rates, while Asongu and Nwachukwu (2016), Shamsuddin and Abdullah (2018), and Machin and Marie (2005) showed that increased education spending reduces criminal activity. Similarly, Hanushek and Woessmann (2008) and Aizer (2003) emphasized that education promotes social mobility and discourages crime. In Pakistan, Khalid and Aslam (2008) and Agha and Sana (2013) found that educated individuals are less likely to engage in criminal acts, while Jabeen and Rahman (2015) argued that education also alleviates poverty, a root cause of crime. Sampson and Laub (1993) and Lochner and Moretti (2004) linked literacy with better judgment and lower criminal behavior, a finding supported by Ali, Farooq, and Wajid (2018), Qureshi and Hanif (2017), and Arshed and Jalil (2017), who showed that higher literacy and education spending significantly reduce crime in Pakistan.

Economic factors also play a vital role in shaping crime trends. Goudriaan and Wittebrood (2016) and Landi and Montolio (2015) suggested that economic development lowers crime by improving living standards, while Vollaard (2013) noted variations depending on crime type. In Pakistan, Nasir and Rehman (2017) and Arshed et al. (2019) found that higher GDP per capita reduces crime, whereas Zaidi and Abbas (2017) observed that violent crimes may rise with GDP growth due to inequality and urbanization. Foreign Direct Investment (FDI) also affects crime; while it boosts economic growth, it may increase inequality and social unrest. Fajnzylber et al. (2002) and Bae and Chang (2019) found mixed effects of FDI on social stability, and in Pakistan, Javid and Munir (2011) and Saleem and Javid (2016) reported that FDI inflows sometimes correlate with higher corruption and urban crime. These findings suggest that although FDI supports growth, unequal distribution of benefits can heighten social tension and criminal behavior.

3. METHODOLOGY

Numerous studies have investigated the determinants of crime rates, highlighting population, education, and economic indicators as key factors. Research shows that high population density, poverty, unemployment, and population turnover are often linked with increased crime due to weakened social control mechanisms (Reid,

1998; Bursik, 1988; Sampson & Laub, 1994; Shaw & McKay, 1942; Sampson & Groves, 1989; Alam, 2012). In Pakistan, similar trends reveal higher crime rates in densely populated and socially fragmented areas. Conversely, education is consistently associated with lower crime rates, as higher educational attainment and greater government spending on education reduce the likelihood of criminal activity (Levitt & Lochner, 2001; Lochner & Moretti, 2004; Aizer, 2003; Machin & Marie, 2005). Economic prosperity, reflected by higher GDP per capita, is also linked to lower property and violent crimes (Fajnzylber et al., 2002; Landi & Montolio, 2015). However, foreign direct investment (FDI) shows mixed effects, sometimes correlating positively with crime in regions like South Korea and Latin America (Bae & Chang, 2019; Asongu & Nwachukwu, 2016). Overall, crime tends to rise in socioeconomically deprived and densely populated areas but declines with improved education and economic stability. Following the previous methodologies, the model of this study becomes as;

CR = f(GDPPC, FDI, LR, GEE, POP) (3.1)

Where:

CR = Total reported crimes

GDPPC = GDP per capita in US$

FDI = Foreign Direct Investment or net inflows in current USD

LR = Literacy rate

GEE = Government expenditure on education

POP = Total population

The econometric model of the above functional form becomes as;

$CR_t = b_0 + b_1GDPPC_t + b_2FDI_t + b_3LLR_t + b_4GEE_t + b_5POP_t + e_t$ (3.2)

e_t = white noise error term

To conduct empirical analysis, this study utilizes time series data from the period 1971 to 2021. The analysis employs tools and software such as E-Views, Excel, and SPSS, while some data visualization is performed using Power BI. Data on crime rates (CR) and literacy rates (LR) are obtained from the Pakistan Bureau of Statistics, while GDP per capita (GDPPC), Foreign Direct Investment (FDI), Government expenditure on education (GEE), and total population (POP) data are sourced from the World Development Indicators (World Bank).

3.1 Econometric Methodology

Econometric analysis is essential for understanding economic relationships, but macroeconomic time series data often face non-stationarity issues due to time trends, leading to unreliable regression results. Nelson and Plosser (1982) identified that many macroeconomic variables contain unit roots, indicating non-stationarity, which affects the reliability of the data-generating process. Stationary data revert to their long-run mean after temporary shocks, while non-stationary data experience permanent shocks that cause their mean and variance to change over time. Dickey and Fuller (1979) emphasized that non-stationary series lack a stable mean and have time-dependent variance. To correct for non-stationarity, unit root tests are applied. In this study, the Augmented Dickey-Fuller (ADF) test (1981) is employed to detect unit roots and ensure data stationarity before further econometric analysis.

3.2 Augmented Dickey-Fuller (ADF) Test

The Augmented Dickey-Fuller (ADF) test, proposed by Dickey and Fuller (1981), is a widely used unit root test. The ADF test can be expressed in several general forms. The following equations represent the different forms of the ADF test:

$$\Delta X_t = \delta X_{t-1} + \sum_{j=1}^{q} \phi_j \Delta X_{t-j} + e_{1t} \quad (3.3)$$

$$\Delta X_t = \alpha + \delta X_{t-1} + \sum_{j=1}^{q} \phi_j \Delta X_{t-j} + e_{2t} \quad (3.4)$$

$$\Delta X_t = \alpha + \beta_t + \delta X_{t-1} + \sum_{j=1}^{q} \phi_j \Delta X_{t-j} + e_{3t} \quad (3.5)$$

In the Augmented Dickey-Fuller (ADF) test, $X_t$represents the time series being tested for a unit root, $t$denotes the time trend, and e_tIs the error term with white noise properties? When $j = 0$, the test simplifies to the basic Dickey-Fuller form. Lagged dependent variables are added until the residuals become white noise, and the LM test is used to verify the absence of serial correlation. The hypotheses are: $H_0: \delta = 0$(non-stationary, indicating a unit root) and $H_A: \delta < 0$(stationary).The ADF test checks stationarity by comparing the computed τ statistic with Dickey and Fuller's (1979) critical values. If the τ statistic exceeds the critical value, the null hypothesis is rejected, indicating stationarity. Determining the order of integration—how many times the series must be differenced to achieve stationarity—is essential for reliable modeling, as stationary data maintain constant mean and variance. Co-integration techniques address spurious regression by identifying long-run equilibrium relationships among variables that move together over time. However, traditional tests like Engle-Granger (1987) and Johansen (1991, 1992) require variables of the same integration order and fail when structural breaks exist. To overcome these issues, the Auto Regressive Distributed Lag (ARDL) model developed by Pesaran et al. (1997–2001) can be applied to variables of mixed orders $I(0)$and $I(1)$, performs well with small samples, and captures both short- and long-run dynamics. Based on the Unrestricted Vector Error Correction Model (UVECM), the ARDL approach provides robust and efficient estimates for identifying stable long-run relationships in econometric analysis.

$$\Delta Y_t = \beta_1 + \beta_2 t + \beta_3 Y_{t-1} + \beta_4 ln X_{t-1} + \beta_5 Z_{t-1} + \cdots + \sum_{h=1}^{p} \beta_h \Delta Y_{t-h} + \sum_{j=0}^{p} \gamma_j \Delta ln X_{t-j} + \sum_{k=0}^{p} \phi_k \Delta Z_{t-k} + \cdots + u_{it} \quad (3.6)$$

First, this study will find the direction of the relationship among the variables in the case of Pakistan by applying the bounds test using the F-test.

H_0: β3 = β4 = β5 = 0 (no co-integration among the variables)

H_A: β3 ≠ β4 ≠ β5 ≠ 0 (co-integration among variables)

If there exists a long-run co-integration relationship among the variables, then to find a short-run relationship, the study uses the Vector Error Correction Model (VECM) or Error Correction Regression. The Error Correction Regression or Vector Error Correction Model (VECM) is explained as under:

$$\Delta Y_{it} = \beta_1 + \beta_2 t + \sum_{h=1}^{p} \beta_h \Delta Y_{it-h} + \sum_{j=0}^{p} \gamma_j \Delta \ln X_{t-j} + \sum_{k=0}^{p} \phi_k \Delta Z_{it-k} + \omega ECT_{t-1} + u_t \quad (3.7)$$

4. EMPIRICAL RESULTS AND DISCUSSION

This section of the article presents the estimated results and discussion.

The descriptive statistics of the model have been given in Table 4.1

Table 4.1: Descriptive Statistics

	TRC	GDPPC	FDI	LOG(LR)	GEE
Mean	557839.5	6.75E+02	1.01E+09	-0.980775	2.36E+00
Median	411003	5.05E+02	4.21E+08	-0.962335	2.38E+00
Maximum	1236097	1617.2	5.59E+09	-0.430783	3.0223
Minimum	36828	1.28E+02	-4000000	-1.832581	1.56882
Std. Dev.	449241.5	485.948	1.32E+09	0.409358	0.347569
Skewness	0.406103	0.736879	1.901494	-0.387245	-0.166001
Kurtosis	1.563137	2.020271	6.571857	1.931734	2.519229
Jarque-Bera	5.789041	6.655137	57.84438	3.699683	0.725404
Probability	0.055326	0.03588	0.000	0.157262	0.695794
Sum	28449815	3.44E+04	5.16E+10	-50.01952	1.20E+02
Sum Sq. Dev.	1.01E+13	11807275	8.71E+19	8.378702	6.040201

Table 4.1 presents the descriptive statistics for all variables in the study. The Total Reported Crimes (TRC) show a high mean (557,839.5) with a large variation, indicating significant fluctuations across years. GDP per capita (GDPPC) and Foreign Direct Investment (FDI) also exhibit wide dispersion and right-skewed distributions, suggesting uneven economic performance. The logarithm of literacy rate (LOG(LR)) and government expenditure on education (GEE) display relatively smaller variation and slightly left-skewed distributions, implying stability in education-related indicators. Population (POP) shows a consistent upward trend with moderate dispersion. The Jarque-Bera statistics suggest that GDPPC and FDI deviate from normality, while other variables are approximately normally distributed. Overall, the table summarizes key characteristics, central tendency, dispersion, and normality, highlighting variability across economic and social indicators.

The estimated results of correlation have been given in Table 4.2

Table 4.2: Pairwise correlation						
	TRC	**GDPPC**	**FDI**	**LOG(LR)**	**GEE**	**POP**
TRC	1	0.974703958	0.740141114	0.931979813	0.389234577	0.977182059
GDPPC	0.974703958	1	0.682401832	0.886571332	0.425722516	0.947457986
FDI	0.740141114	0.682401832	1	0.660197969	0.380228804	0.692495208
LOG(LR)	0.931979813	0.886571332	0.660197969	1	0.507712665	0.979945547
GEE	0.389234577	0.425722516	0.380228804	0.507712665	1	0.451788538
POP	0.977182059	0.947457986	0.692495208	0.979945547	0.451788538	1

The correlation matrix reveals strong positive relationships among most variables in the study. Total Reported Crimes (TRC) show strong correlations with GDP per capita (GDPPC), literacy rate (LOG(LR)), and population (POP), indicating that higher economic growth, literacy, and population levels are associated with increased crime rates. Similarly, GDPPC and LOG(LR) are highly correlated with POP, reflecting that economic and educational growth tend to rise with population expansion. Moderate positive correlations exist between FDI, GEE, and the other variables, suggesting weaker yet consistent associations. Overall, all variables move in the same direction, implying interrelated social and economic dynamics. However, since correlation does not imply causation, these results only reflect statistical associations rather than direct causal effects.

The results of unit root tests of all variables used in our model are given in Table 4.3

Table 4.3: Augmented Dickey-Fuller Unit Root Estimation						
	At level		**At first difference**		**At second difference**	
Variables	**T-statistics**	**(prob.*)**	**T-statistics**	**(prob.*)**	**T-statistics**	**(prob.*)**
TRC	-0.298772	0.9174	-3.48738	0.0124	-9.595706	0
GDPPC	0.800399	0.9931	-4.807584	0.0003	-7.119077	0
FDI	-2.52794	0.1152	-4.996189	0.0001	-8.878307	0
LLR	-3.160448	0.0285	-7.768865	0	-11.68202	0
GEE	-3.094696	0.0334	-7.231899	0	-6.772842	0
POP	0.969952	0.9956	-2.817542	0.0207	-5.089263	0.0001

*Mackinnon (1996) one-sided p-values.

The Augmented Dickey-Fuller (ADF) test results indicate that most variables—TRC, GDPPC, FDI, GEE, and POP—are non-stationary at their original levels, while LLR is stationary. After first differencing, all variables become stationary, confirming that none are integrated of order two [I(2)]. This suggests that the data series are suitable for co-integration analysis using the ARDL approach, which can effectively handle variables of mixed integration orders (I(0) and I(1)). Overall, the results imply that the variables exhibit long-run equilibrium relationships once stationarity is achieved through differencing.

The estimated results of the ARDL Bounds test are presented in Table 4.4

Table 4.4 : ARDL Bound Testing Approach		
Dependent Variable: Total Reported Crime		
ARDL (4, 4, 3, 2, 4, 0)		
Critical Values	F-statistic (6.421887)	
	Lower Bound	Upper bound
99%	2.08	3
95%	2.39	3.38
90%	3.06	4.15

The ARDL Bounds test or F-Bounds test is used to assess the existence of co-integration among the variables in the model. Co-integration implies a long-term relationship or equilibrium between the variables. The null hypothesis of the F-Bounds test is that there is no level relationship or no co-integration among the variables. In this case, the F-statistic is 6.421887. To determine whether the null hypothesis can be rejected or not, we compare this test statistic with critical values at different significance levels. At the 5% level of significance, the

critical values for the F-statistic are 2.39 and 3.38. Since the F-statistic (6.421887) is greater than the critical value (3.38), we reject the null hypothesis. This suggests that there is evidence of co-integration among the variables at the 5% level of significance. In summary, based on the F-Bounds test at the 5% level of significance, we reject the null hypothesis of no level relationship or no co-integration among the variables. This indicates that there is a long-term relationship or equilibrium among the variables in the model, including the dependent variable, Total Reported Crimes.

Estimated long-run results have been given in Table 4.5

Table 4.5: Estimated Long Run Coefficients ARDL Approach				
Dependent Variable: Total Reported Crimes				
ARDL (4, 4, 3, 2, 4, 0)				
Time Period (1971 - 2021)				
Regressor	Coefficient	Standard- Error	t-Statistic	Prob.
LOG(LR)	-512912.1	189119.1	-2.712112	0.0122
GEE	-177301.5	39401.13	-4.499908	0.0001
POP	0.012197	0.00215	5.674008	0
C	-1350420	460786.8	-2.930682	0.0073

The long-run ARDL results show that literacy rate (LOG(LR)), government expenditure on education (GEE), and population (POP) significantly influence total reported crimes (TRC) in Pakistan. Specifically, higher literacy rates and greater education spending are associated with lower crime levels, while population growth is linked to higher crime rates. In contrast, GDP per capita (GDPPC) and foreign direct investment (FDI) have no significant long-run effect on crime. Overall, the findings highlight education and population as key long-term determinants of crime reduction in Pakistan.

The Vector Error-Correction Model has been used for examining the short-run relationship among the variables of the model; the outcomes of the short-run dynamic are shown in Table 4.6.

Table 4.6: ARDL Error Correction Regression (ECM)
Dependent Variable: D(TRC)
Selected Model: ARDL(4, 4, 3, 2, 4, 0)
Time Period (1971-2021)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(TRC(-1))	0.033988207	0.103075856	0.329739753	0.744457349
D(TRC(-2))	0.403942453	0.098259348	4.110982446	0.000397903
D(TRC(-3))	0.383949715	0.108126514	3.550930318	0.00162398
D(GDPPC)	205.8431185	49.17208302	4.186178535	0.000328837
D(GDPPC(-1))	9.613878346	62.26529157	0.154401884	0.878583956
D(GDPPC(-2))	352.5045114	72.80176671	4.841977432	6.21E-05
D(GDPPC(-3))	173.717122	79.00288093	2.198870724	0.037766639
D(FDI)	-1.88E-05	5.13E-06	-3.667540896	0.00121492
D(FDI(-1))	2.51E-05	4.12E-06	6.073167205	2.85E-06
D(FDI(-2))	1.44E-05	4.96E-06	2.908109959	0.007711702
DLOG(LR)	68941.14861	65772.55762	1.04817497	0.304999551
DLOG(LR(-1))	124926.6192	67518.00663	1.850271142	0.076623987
D(GEE)	3699.218922	9219.209163	0.40125122	0.691785483
D(GEE(-1))	37144.41276	11377.69423	3.264669627	0.003282724
D(GEE(-2))	54549.08191	10662.52455	5.115963079	3.10E-05
D(GEE(-3))	57657.31667	10267.76547	5.61537141	8.84E-06
CointEq(-1)*	-0.377678911	0.050383387	-7.496100026	9.79E-08

R-squared	0.910651527	Mean dependent var	24941.80851
Adjusted R-squared	0.862999008	S.D. dependent var	33024.10032
S.E. of regression	12223.42326	Akaike info criterion	21.93454976
Sum squared resid	4482362287	Schwarz criterion	22.60375208
Log likelihood	-498.4619194	Hannan-Quinn criterion.	22.18637509
Durbin-Watson stat	2.331751469		

The ECM regression results based on the ARDL (4, 4, 3, 2, 4, 0) model show that several short-run relationships significantly influence changes in total reported crimes (D(TRC)) in Pakistan. Past values of TRC (lags 2 and 3), GDP per capita (lags 0, 2, and 3), FDI (current and lagged values), and government expenditure on education (lags 1–3) have significant effects on crime rates. The error correction term (CointEq(-1)) is negative (-0.3777) and highly significant, confirming that about 37.7% of any disequilibrium from the long-run relationship is corrected each period, ensuring stability toward long-run equilibrium. The model explains about 91% of the variation in D(TRC) (R^2 = 0.9107) with an adjusted R^2 of 0.8630, and the Durbin-Watson statistic (2.33) indicates no autocorrelation. Overall, the ECM confirms a stable, well-fitted model, with diagnostic tests (like Breusch-Pagan-Godfrey) applied to ensure reliability against heteroscedasticity.

The calculated results of the present study are provided in Table 4.7

Table 4.7: Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	1.466227	Prob. F(22,24)	0.1807
Obs*R-squared	26.94916	Prob. Chi-Square(22)	0.2132
Scaled explained SS	5.270257	Prob. Chi-Square(22)	0.9999

The Breusch-Pagan-Godfrey test results indicate no evidence of heteroskedasticity in the regression model. All test statistics — F-statistic (1.4662, p = 0.1807), Obs*R-squared (26.949, p = 0.2132), and Scaled Explained SS (5.270, p = 0.9999) — have p-values greater than 0.05, confirming that the variance of the residuals is constant. Thus, the assumption of homoskedasticity holds, validating the model's reliability.

The calculated results of diagnostic tests of serial correlation of the present study are provided in Table 4.8

Table 4.8: Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	1.600149	Prob. F(1,23)	0.2185
Obs*R-squared	3.057177	Prob. Chi-Square(1)	0.0804

The Breusch-Godfrey Serial Correlation LM Test results show no significant evidence of serial correlation in the regression model. The F-statistic (1.600149) and its p-value (0.2185) indicate that the null hypothesis of no autocorrelation cannot be rejected. Similarly, the Obs*R-squared statistic with a p-value of 0.0804 supports this conclusion. Therefore, the residuals are free from serial correlation. Additionally, model stability was assessed using the CUSUM and CUSUMQ tests by Brown et al. (1975). The results show no structural breaks, indicating that the model is stable over time and provides reliable estimates for total reported crimes in Pakistan.

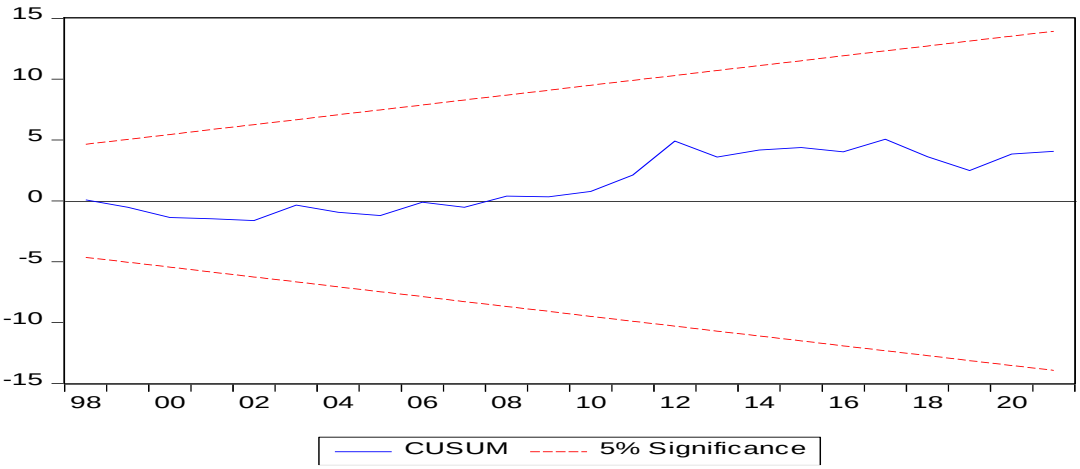


Figure 4.1: Plot of Cumulative Sum of Recursive Residuals

In Figure 4.1**,** the *Jarque-Bera test* is applied to check the normality of the residuals distribution. The Jarque-Bera test is a statistical test that examines whether the data follows a normal distribution based on its skewness and kurtosis. In this case, the value of the Jarque-Bera statistic is 0.805409. The Jarque-Bera statistic measures the deviation from normality, and a smaller value suggests a closer approximation to a normal distribution. The associated probability (p-value) for the Jarque-Bera statistic is 0.668510. This p-value indicates the probability of obtaining the Jarque-Bera statistic or a more extreme value under the assumption that the data is normally distributed. Based on the results, the Jarque-Bera statistic of 0.805409 suggests that the data show a relatively small deviation from a normal distribution. However, the p-value of 0.668510 is relatively high, indicating that there is a high probability of observing the Jarque-Bera statistic or a more extreme value even if the data is normally distributed. Therefore, based on this test, there is no strong evidence to suggest that the data significantly deviates from a normal distribution; hence, the results ensure the normality.

Figure 4.2

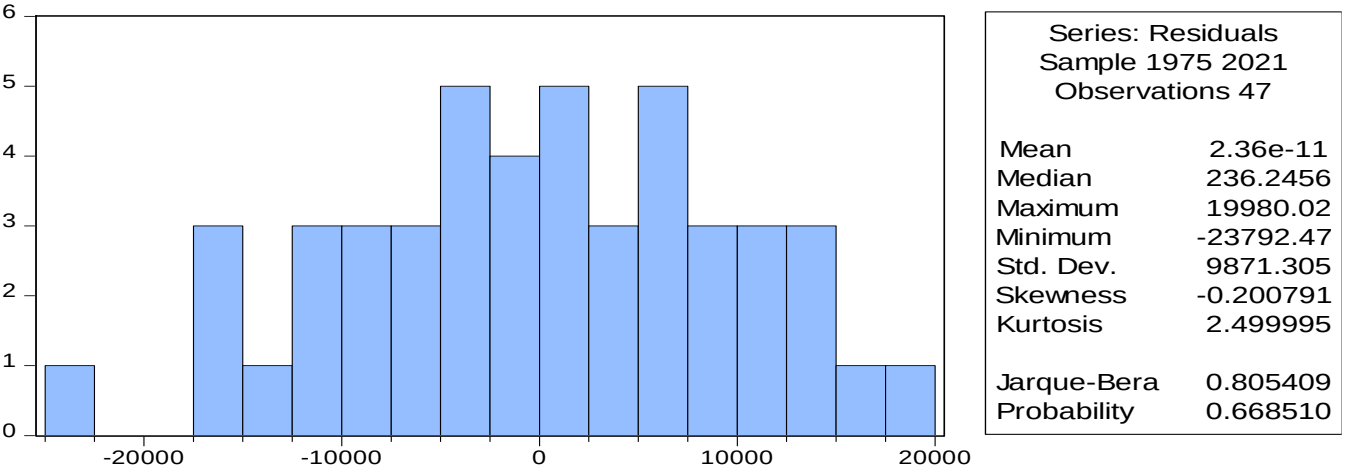
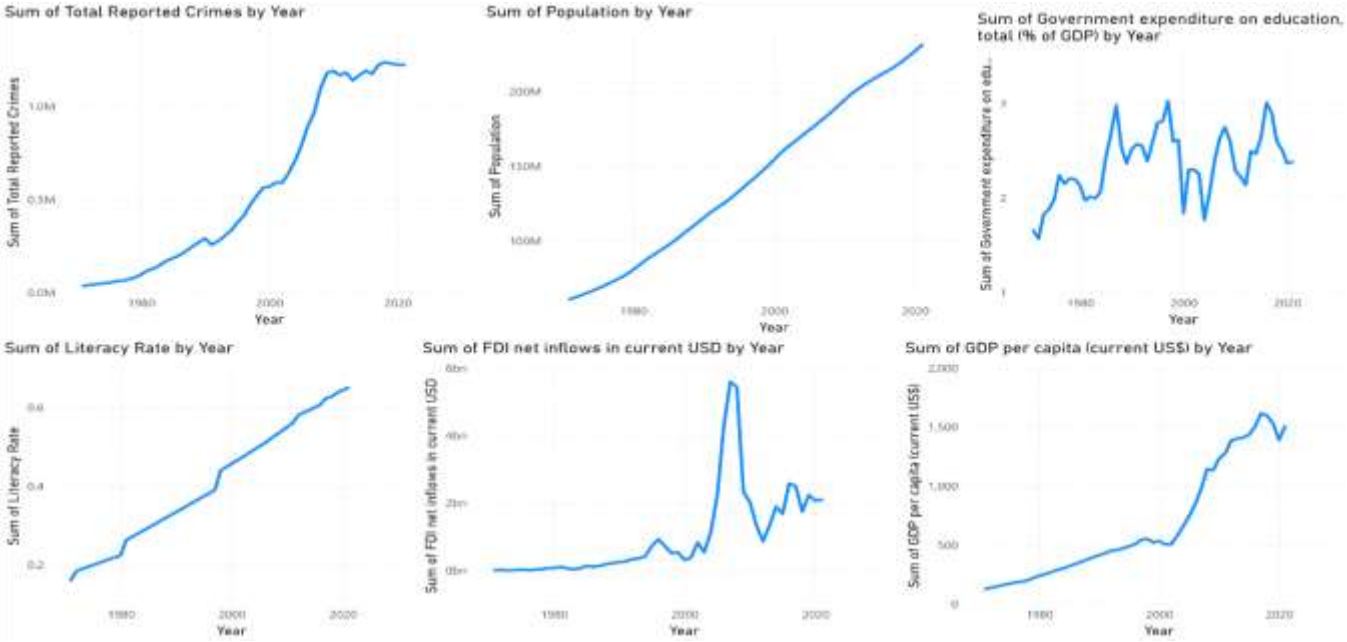


Figure 4.2: Jarque-Bera test for Normality checkup

Below are some visuals of a line chart of Total Reported Crimes, Population, Government Expenditure on Education, Literacy Rate, FDI, and GDP Per Capita. Most variables, like Total Reported Crimes, Population, Literacy Rate, and GDP Per Capita, show increasing trend over time (1971 to 2021) where the graph of Government Expenditure on Education and FDI shows fluctuations over time (1971 to 2021) in Pakistan.

Figure 4.3



Below are some visuals of line chart for comparison of the dependent variable (Total Reported Crimes) with independent variables (Population, Government Expenditure on Education, Literacy Rate, FDI, and GDP Per Capita).

Figure 4.4 Comparison Graph of Total Crimes and GDP

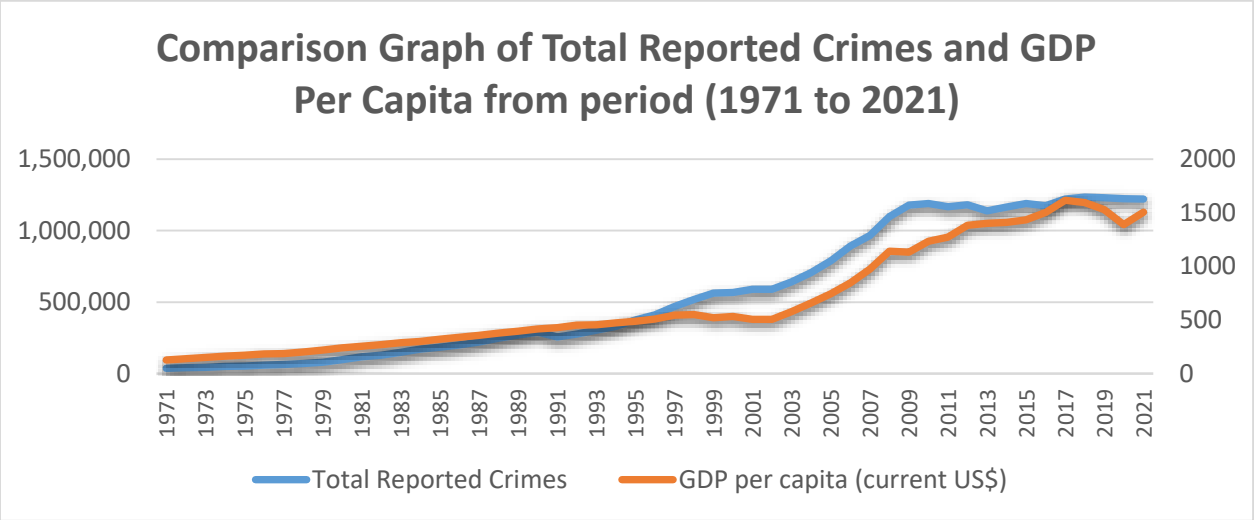


Figure 4.5 Comparison Between Crimes and FDI From (1971-2021)

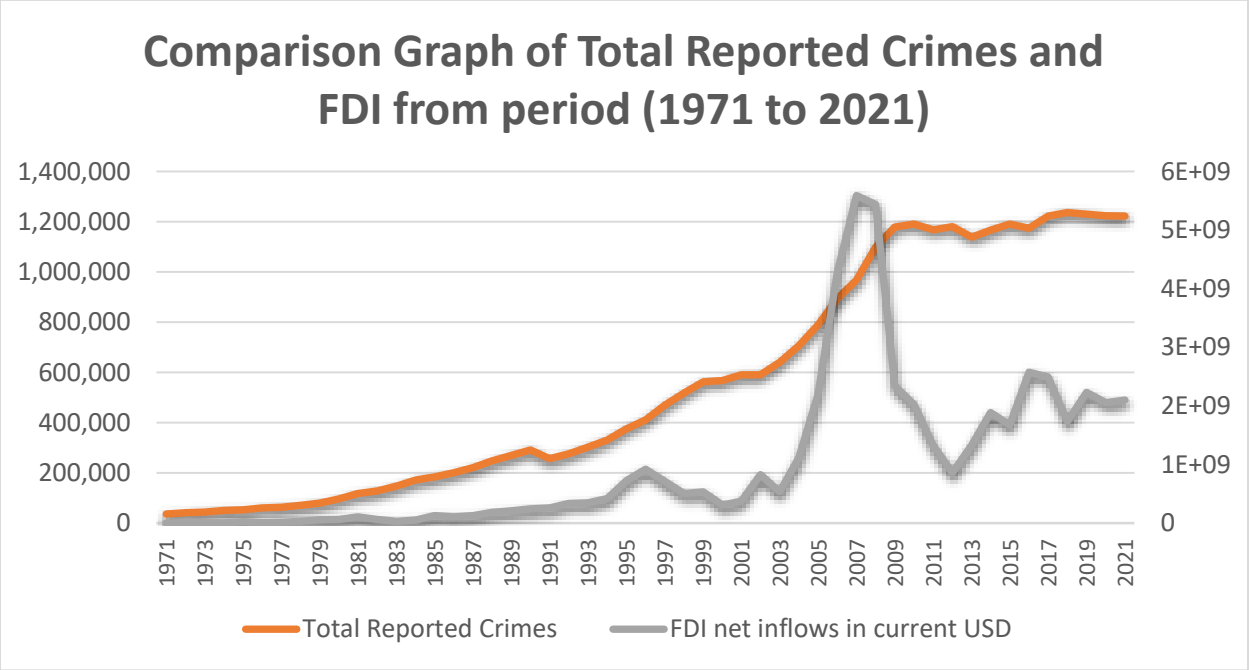


Figure 4.6 Comparison Graph of Total Reported Crimes and Literacy Rate from period (1971 to 2021

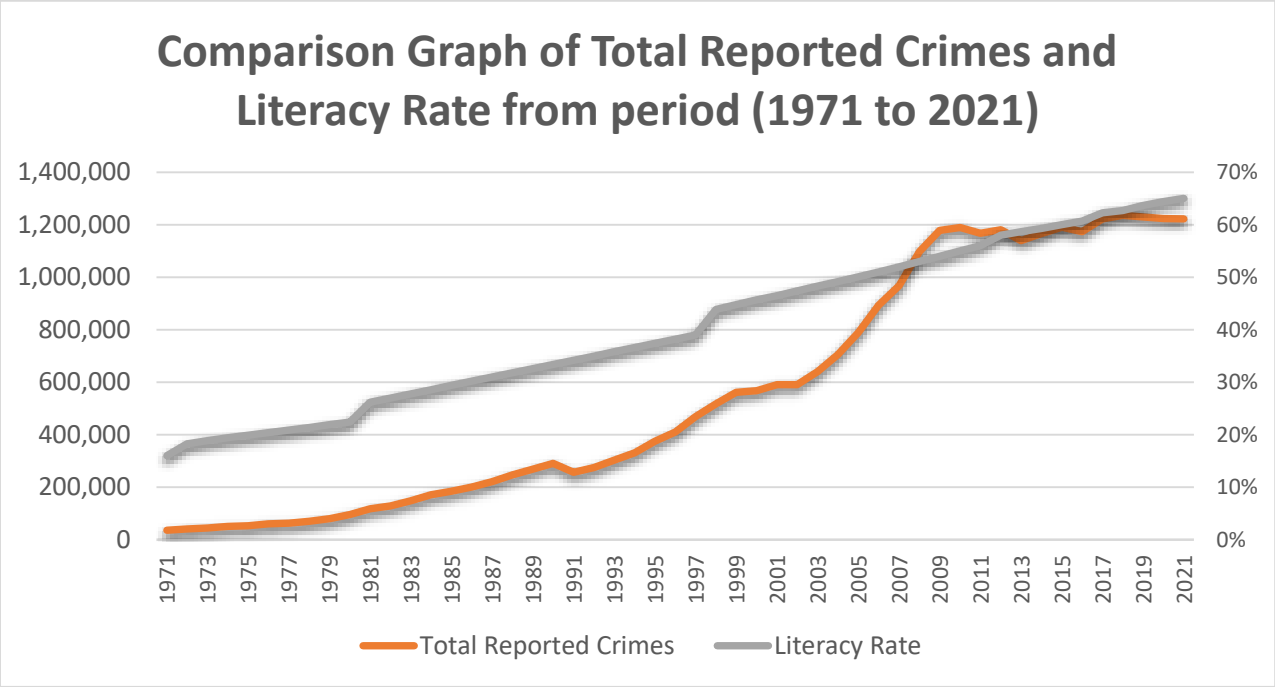


Figure 4.7 Comparison Graph of Total Reported Crimes and Government Expenditure on Education from the period (1971 to 2021)

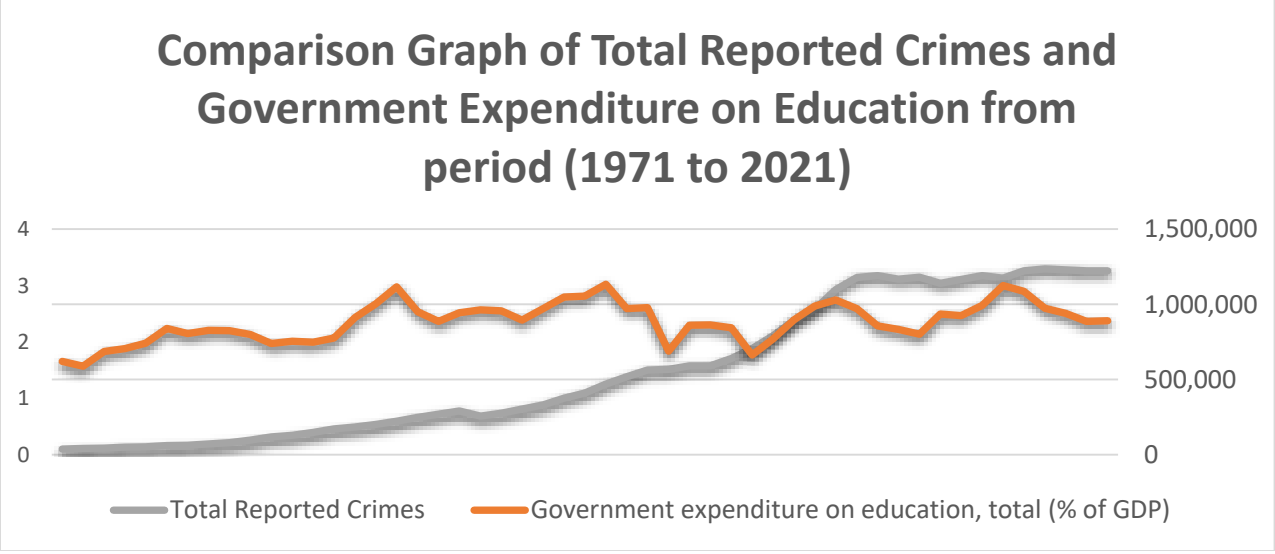
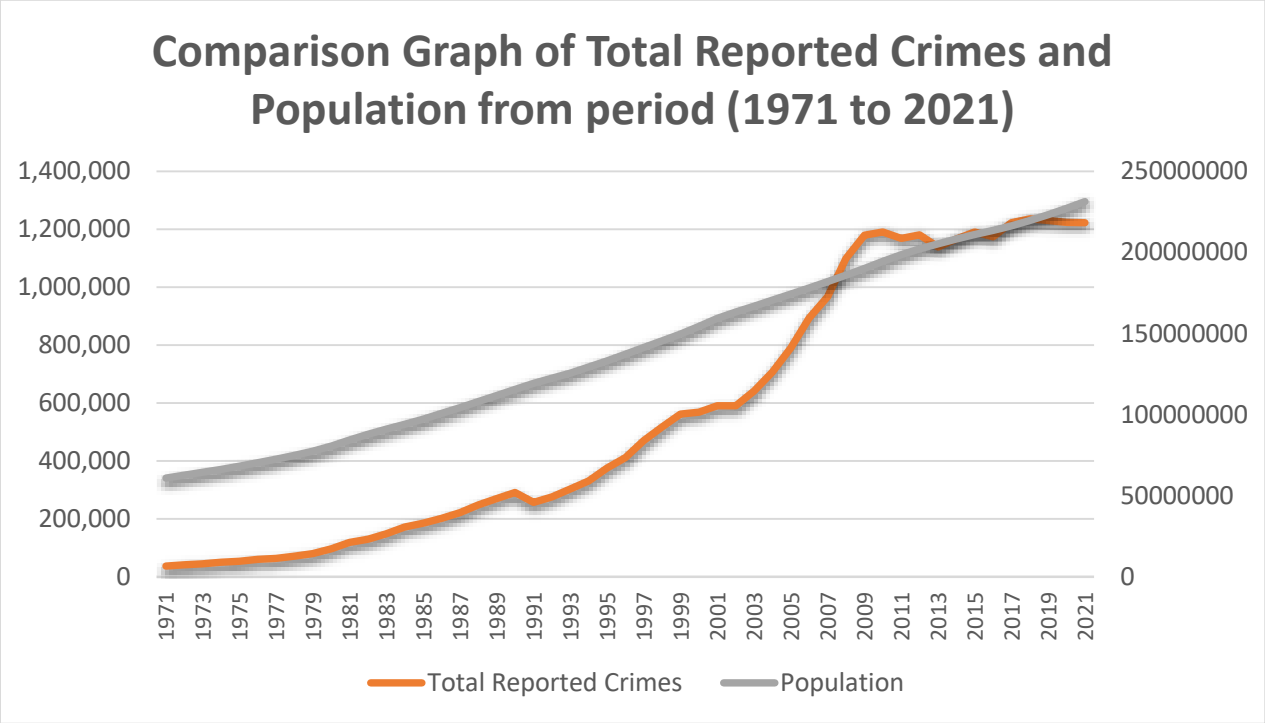


Figure 4.8 Comparison Graph of Total Reported Crimes and Population from the period (1971 to 2021)



Below are some visuals of a scatter plot of Total Reported Crimes, Population, Government Expenditure on Education, Literacy Rate, FDI, and GDP Per Capita. The trend line of all the variables is in a positive or increasing direction. Most variables, like Total Reported Crimes, Population, Literacy Rate, and GDP Per Capita, show an increasing trend over time (1971 to 2021). The graph of Government Expenditure on Education and FDI shows fluctuations over time (1971 to 2021) in Pakistan.

Figure 4.9 Graph of Total Crimes

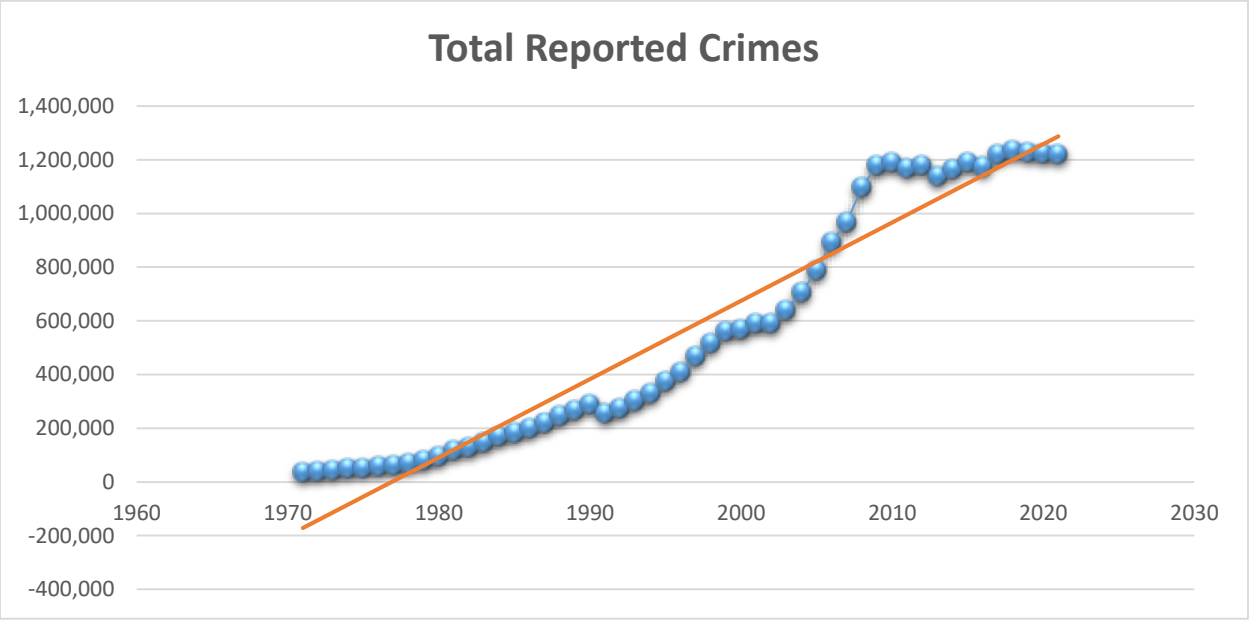


Figure 4.10 FDI Net Inflows in Current USD

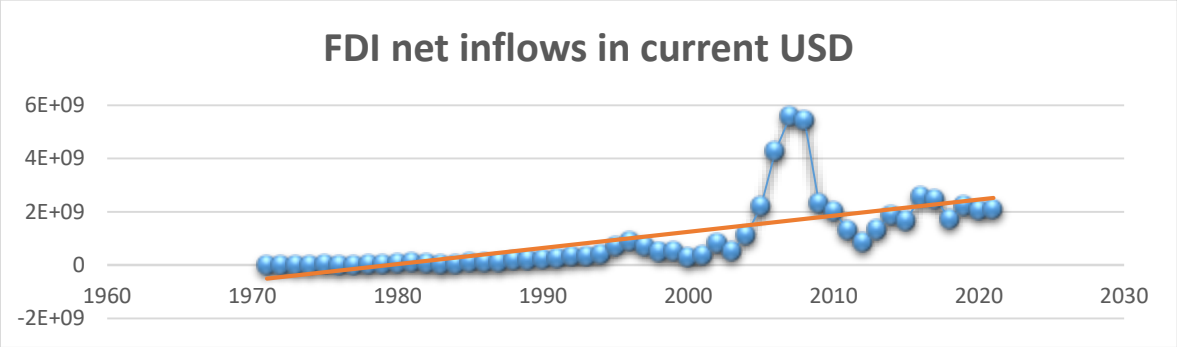


Figure 4.11 Literacy Rate

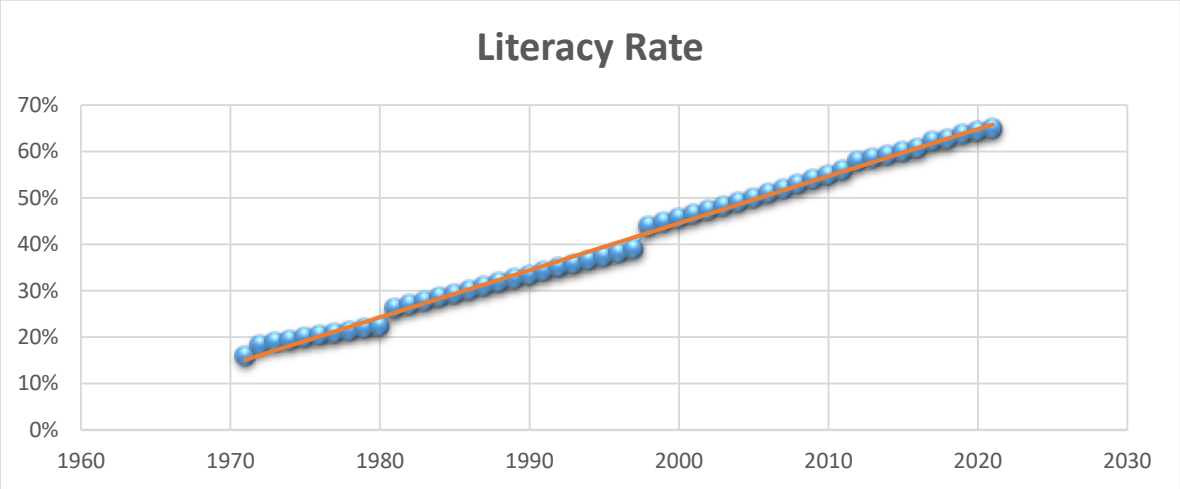
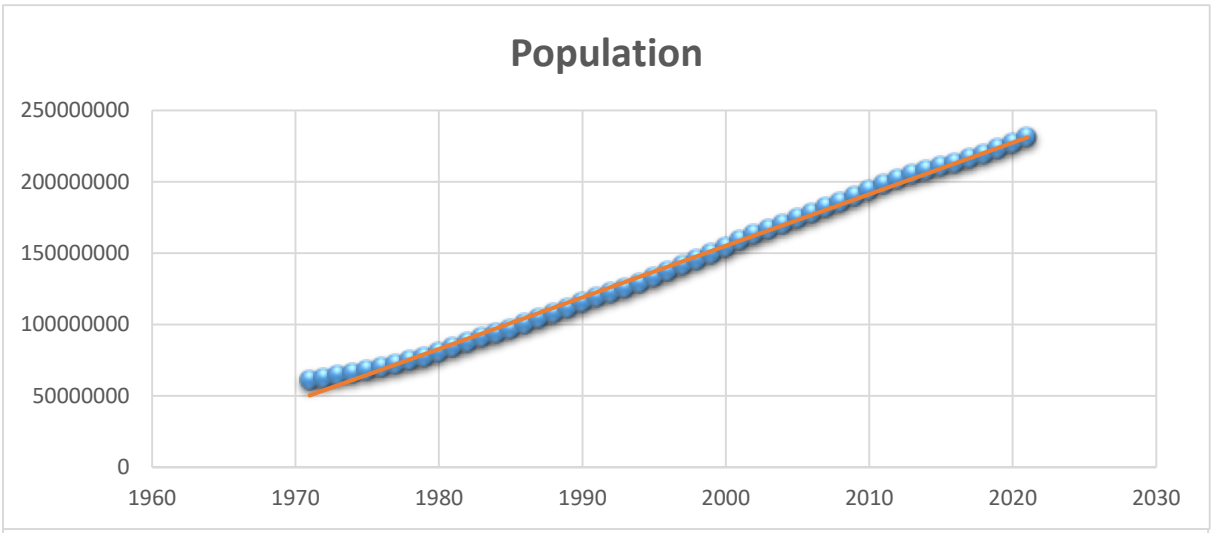


Figure 4.12 Government expenditure on education, total (% of GDP)



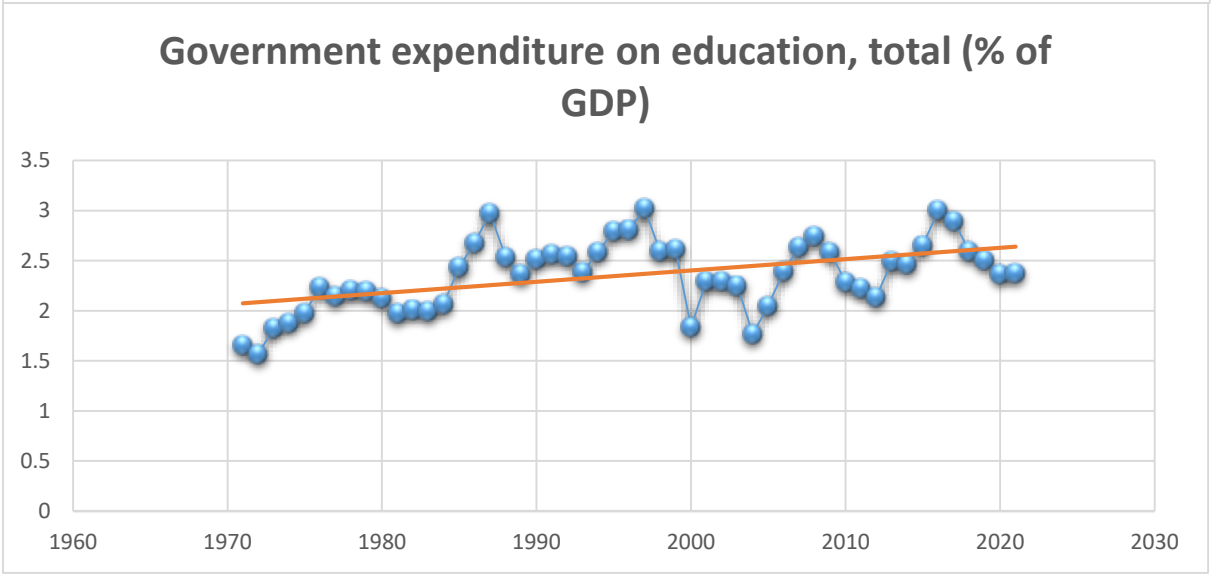


Figure 4.13

5. CONCLUSIONS AND SUGGESTIONS

This study analyzed the impact of population, education, and economic indicators on total reported crimes (TRC) in Pakistan from 1971 to 2021 using a longitudinal approach. The findings reveal that while economic indicators such as GDP per capita and FDI have no significant long-run effects on crime, education variables—literacy rate and government expenditure on education show significant negative relationships with crime rates. Conversely,

population growth has a significant positive effect on crime. Based on these findings, the study recommends strengthening education by increasing literacy and education spending to reduce crime, managing population growth through equitable policies and family planning, and adopting a comprehensive, cross-sectoral approach to crime prevention. Additionally, further research should examine other socioeconomic and demographic factors influencing crime in Pakistan.

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