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ORIGINAL PAPER

Investigating the impact of government economic policies on crime in Pakistan

Sumera Arshad[1)], Muhammad Zahid Naeem[2)], Cristi Spulbar[3)], Ramona Birau[4)], Petre Valeriu Ninulescu[5)]

Abstract:
This study was conducted in an effort to better understand how decisions made by the government in Pakistan regarding taxation and spending have affected crime rates over the years 1980 to 2020. The Vector Error-Correction model suggests that the government's policies have a causal effect on crime rates in the long run. The study concludes that rising direct taxes and defence expenditures decreases the reported crime rate in Pakistan. Moreover, the empirics revealed that rising unemployment rate increase crimes. The income inequality has also portrayed positive relationship with reported crimes. The impulse responses affirm the persistent long run relationship trends in which both unemployment rate and income inequality increases crime rate and the direct taxes and defence expenditures decreases crime rate in the country.

Keywords: *labor market, government economic policies, crime rate, income inequality, taxation, economic misery, poverty, unemployment.*

[1)] Department of Economics, University of the Punjab, Lahore, Pakistan, Email: ecomaster68@yahoo.com.
[2)] School of Business and Economics, University of Brunei Darussalam, Brunei Darussalam, Email: drmznaeem@gmail.com.
[3)] University of Craiova, Faculty of Economics and Business Administration, Doctoral School of Economic Sciences, Craiova, Romania, Email: cristi_spulbar@yahoo.com.
[4)] University of Craiova, Doctoral School of Economic Sciences, Craiova, Romania, Email: ramona.f.birau@gmail.com.
[5)] Faculty of Economics and Business Administration, University of Craiova, Romania, Email: petre.pregi@yahoo.it.

1. Introduction

Taxes, subsidies, government spending, overseas loans and grants, and alternative forms of debt financing are all examples of governmental policy. The health of the economy as a whole is largely dependent on these elements. The effects of these actions are both immediate and long-term. Defence, subsidies, and public transportation are all examples of indirect effects that can be directly attributed to taxation. Indirectly affecting the labor market, taxes and subsidies promote the creation of products and services. The unemployment rate reflects the accessibility of available job openings in the economy. An uptick in the jobless rate indicates fewer individuals are working and earning a living. When unemployment and rising costs are factored together, the problem becomes especially acute for the poorest members of society (Gillani et al., 2009). All of these things contribute to the economic woes and mental anguish of the poor. They consider their economic needs before law and order and ultimately commit crimes. However, there is no single reason for crime, the major reasons for crime could be economic misery, mental stress or the habit of people (Aurangzeb 2012).

Economic misery is caused due to low income or decrease in purchasing power. The latter is effected through purchasing power that is affected by imposition of taxes. The taxes can be direct or indirect but increase in either of them or both lead to decrease the real income of the individuals. These lower incomes, in comparison with the incomes before taxes imposition, due to taxes accelerate crimes (Chamlin et al., 1999). Increase in taxes lowers incentive to business as well, if the taxes are imposed on the producers and it resulted in decrease in their demand that in turn increases unemployment. The combination of high unemployment and wide income disparity is a major contributor to criminal activity (Wu and Wu, 2012). Deprivation among the lower-income population is a reflection of the unequal distribution of wealth that is depicted by the measure of income inequality. For this reason, many people point to income inequality as a primary motivation for criminal activity (Fajnzylber et al., 2002). More crimes occur in areas with wide income gaps because those with lower wages feel the effects of the economy and try to steal from those with higher salaries (Kelly, 2000). On the other hand, Spulbar and Birau (2019) investigated the implications of cybercrime on the banking industry in ASEAN countries even considering propagation effects.

Law and order is another major determinant of the crime rate as it increases the likelihood of the criminal being caught after the crime. The lower the chances of being caught the larger would be the incentives to crime. Defense spending by the government results in a larger and more effective military and police force, which benefits the economy as a whole.

As a result, offenders are more likely to face consequences for their actions, which in turn reduces the crime rate (Anwar et al., 2015). The monetary and human losses incurred as a result of criminal activity have significant implications for society (Arshad et al., 2016). Therefore, it is in the best interest of policymakers to examine the causes of economic crime and work to eliminate them. Poverty, economic inequality, unemployment, and lack of education are among characteristics that economists have identified as contributing to crime rates in many economies (Neumayer, 2005; Buonanno and Leonida, 2005; Arshad et al., 2016).Reported crimes in Pakistan observe many fluctuations from independence to now, for brief view of recent statistics on reported crimes, figure 1 shows the time series data on all reported crime from 1980 to 2020.

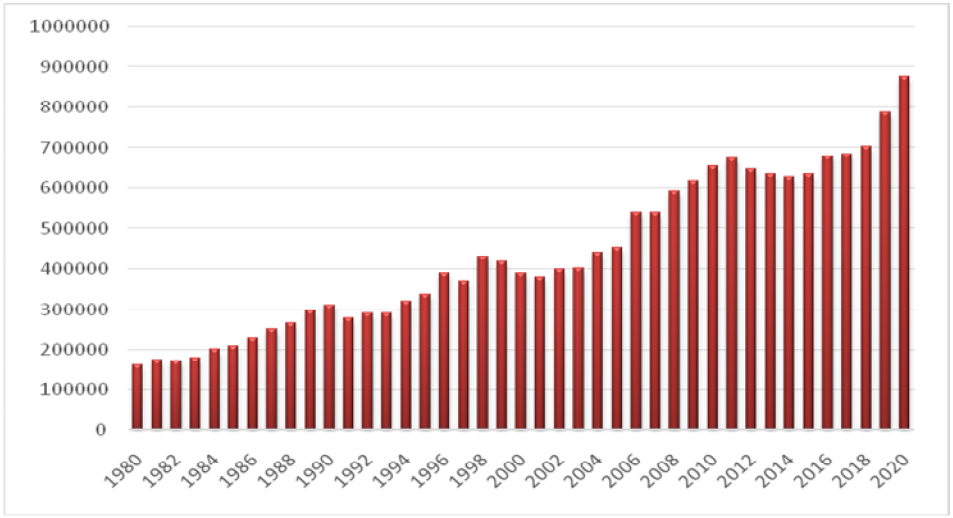

Figure 1: All Reported Crime in Pakistan
Federal bureau of Statistics

Figure 1 show that reported crimes increase till 1990 then it reduces to some extent and increased even more by 1998, after it crime decreased a little and start raising again till 2011 then it start falling again till 2015. The fall in the reported crimeswas majorly due to Pakistan army operationslike Zarb-e-Azab, Rah-e-Nijat and Raah-e-Raastagainst terrorists at that time. However, after 2016 the country is facing surge in the crime rate that has accelerated enormously in 2020. As a developing nation it is a challenge for Pakistan to control crimes. Government of Pakistan uses its defence expenditures for this purpose which are financed through taxes and using Loans and grants from other nations. Spulbar et al. (2021) the effects of some selected taxes on the complex dynamics of GDP at European Union - 28 member countries. But taxes have negative impact on production of goods and services while loans and grants are accompanied by restrictions, then how far these policies are impacting crime? Does policies regarding taxes and expenditures are effective in controlling crime in Pakistan? These questions have not got much attention earlier, however this study is an attempt to answer them and point out those economic factors which can effectively control crime in Pakistan that makes it a healthy contribution towards relevant literature.

2. Literature Review

Crime has been discussed in the researches on both developed and developing countries. According to Wilson and Cook (1985), in 1976 the US Congress blamed rising unemployment for a rise in crime rates. The following report, from 1984, will connect disparities in employment, real per capita income, and other economic indicators with criminal activity. Several previous studies have examined the causes of criminal behaviour. Some authors attach crime to social reasons other emphasis on demographic, economic and socio-economic aspects. There are few studies that relate crime to government policy variables like taxes, loans and grants and expenditures; however, many exist in case of other economic variables. Among a lot of studies some most important related to current paper are discussed as follows:

In analyzing urban economies, Kelly (2000) finds that inequality becomes a motive for individuals to commit violent crime significantly more than other economic characteristics.

The study indicated that police presence and economic hardship had a significant effect on property crimes but had no bearing on violent crime. According to research by Demombynes and Ozler (2005), extreme poverty and inequality fuel criminal activity in South Africa. It appears that the barrier wall erected by the colonies and their wealthier neighbors has reduced property crime. The results indicate that when poverty rises, crime rates tend to fall. Economics in Pakistan were studied by Asghar et al. (2016), who looked at data from 1984 to 2013. The study disentangles the impact of economic, social, and political elements on criminal behavior. In the end, the study suggests that having stricter laws actually makes things worse, whereas having a more reliable government is beneficial in reducing crime. It has been discovered that poverty contributes to a rise in criminal activity. A positive correlation between economic disparity and crime is found in the study. Omotor (2009) found that unemployment was a key cause of crime in Nigeria, despite the fact that in this study, it remained negligible.

Unemployment and military spending have a significant and negative impact on crime rates in the United States, as discovered by Raphael and Winter-Ebmer (1998). According to the findings, a rise in crime rates is linked to persistently high unemployment rates. Unemployment has been observed to be reduced in correlation with an increase in military spending and an increase in the number of available jobs. According to an examination of the same economy by Chamlin and Cochran (2000), persistent joblessness contributes to a rise in criminal activity. People who have been out of work for more than 15 weeks have been linked to an increase in property crime. From 1964 to 2008, Jalil and Iqbal (2010) looked at how unemployment and urbanization affected crime rates in Pakistan. The research also indicated that income disparity and inflation played a role in driving criminal activity in Pakistan.Long-term data research showed a high correlation between urbanization and crime.Crime is higher in rural regions compared to cities in the Sidama Zone and neighboring economies, according to a study published in 2016.

Using cross-sectional statistics on the American economy, Gumus (2003) examines the correlation between urbanization and crime. Researchers conclude that unemployment, population growth, and income disparity all have a role in keeping cities lawless. For 33 countries across Europe, Altindag (2012) examines the correlation between unemployment and criminality. The analysis relied on panel data, and both OLS and 2SLS were utilized to ensure the accuracy of the findings. There is a growing empirical link between joblessness and criminal activity. Due to the rise in unemployment, property crimes have been on the rise, and the increase is more pronounced in 2SLS than in OLS. The unemployment rate is heavily influenced by people with lower levels of education. To what extent poverty contributes to criminal activity in Germany is estimated by Mehlum et al., 2005. To estimate this connection, the study makes use of the instrumental variable method. The research used both ordinary least squares (OLS) and instrumental variables estimates, revealing both bias in the OLS method and a somewhat substantial impact of poverty on crime via the latter. Several years later, Traxler and Burhop (2010) reexamined the same data and found that poverty is indeed directly linked to property crime. Both analyses confirmed a significant inverse relationship between poverty and violent crime. Mehlum et al. (2005)

posit that this could be due to the high cost of beer, but later studies find that if beer consumption is included in, this effect disappears.

According to Bourguignon (2001), crime is a societal cost associated with economic development irregularities. Increased crime rates are a general consequence of both relative poverty and income inequality. The study analyse US economies data and highlight Latin America due to its certain characteristics. This state observed high crime rate and more unequal income distribution. The process of economic growth also observes high volatility. The study declares crime a high expense attached to inequality and poverty and it can be even more severe in recession periods in those economies where existing crime rate is huge. Bourne (2011) analysed crime in Jamaica economy. This research considers a wide range of macroeconomic variables as potential causes of violent crime. Unfortunately, neither joblessness nor poverty were shown to be important in attempting to account for the occurrence of criminal activity.

The correlation and causality between inequity and crime have been estimated by Fajnzylber et al. (2002). More than 30 economies are represented in the study's panel data. Rising inequality has been proven to be a significant factor in both cross-country and within-country studies of crime rates. Neumayer (2005) examines the worldwide connection between crime and poverty. A lack of correlation between poverty and criminality was found. Inequality in income and criminal activity may both be influenced by factors that are external to individual economies, according to the findings. In order to determine whether or not crime is related to a community's economic status, Patterson (1991) analyzed data from 57 tiny societies. Based on the data, it appears that income disparity has no bearing on criminal activity in societies.In addition, it was revealed that poverty and population density were major factors in violent crime. By looking at 25 different districts in Punjab (Pakistan) from 2005 to 2011, Anwar et al. (2015) analyze what factors lead to property and violent crimes. The report breaks down total criminal activity into two categories: property crimes and violent crimes. All sorts of crime were found to be influenced by population density and criminal profits.

The effects of tax policy on crime are studied by Chamlin et al. (1999). The study suggests that a significant rise in tax deductions is to blame for the alarming rise in violent crime. For property crimes, the impact is much smaller. According to the research, changing taxes in order to encourage social charity has the opposite effect of what was hoped for: an increase in criminal activity. The study recommends lowering the tax rate and introducing new charitable giving programs to reduce crime. According to Martinez (1991), tax amnesty and crime are bad for the American economy. Tax amnesty is the forgiveness granted to the disobeyed persons rather punishment. After policy about tax is cleared then further disobeyers have both civil and criminal penalties. The study declares tax evasion a crime. However, the study is not certain about long time effects of amnesty. According to Zimring and Hawkins (1993), economic inequality was a major contributor to crime during the 1980s US crisis. The significance of deregulation in describing those losses is highlighted in the report. As a result, they can't tell if criminal behavior stems from individual choices or systemic problems.

The role of economic considerations in explaining crime is examined by Wu and Wu (2012).

In order to understand the correlation between income disparities, unemployment, and criminal activity, this research builds models. The established model is strongly supported by empirical evidence from the British economy. The study finds

that unemployment and income inequality provide a satisfactory explanation for criminal activity. The research concludes that property crime, in particular, is an economic phenomenon motivated by financial benefits. Burdett et al., (2004) provide an extended investigation of the same relationship in the context of the job search. Quantitative methods are used alongside the establishment of many equilibria that detail the emergence of various outcomes. The study concludes that expanding unemployment benefits causes both joblessness and criminal activity to rise. The special equilibrium situation that reveals the non-monotonous connection between crime and poverty is also examined. Arshad et al. (2016) use data collected in Punjab (Pakistan) between 2005 and 2013 to assess the effect of economic factors on crime. Spending on healthcare and law enforcement has been shown to contribute to an upward trend in crime rates. Government spending was also proven to be a factor in reducing crime. The research indicates that decreasing crime in Punjab can be accomplished by increased funding for primary education rather than for police.

More police officers and more inmates are two key factors that Levitt (2004) found to reduce crime. The study explains why crime rates fell from 1991 to 2001 in the United States' economic sector. The analysis found no evidence that these factors affected crime rates in the past and concluded that increased police recruiting will reduce crime going forward. According to research by Haider and Ali (2015), when all districts of Punjab, Pakistan are taken into account, rising rates of unemployment and population density are responsible for the country's rising crime rate. The report calls for reforms to government policy, such as reorganizing police departments, lowering poverty rates, and limiting population growth and corruption, in order to bring about a decline in crime rates.From 1975 to 2007, Gillani et al. (2009) analyze the connection between crime and economic indicators in Pakistan's economy. According to the results, unemployment, low wages, and poverty all have a role in fueling criminal activity. From 1980 to 2010, Aurangzeb (2012) examines crime in Pakistan's economy. According to the findings, lower crime rates are associated with rising GDP and pay rates. There is a direct and substantial relationship between population growth and changes in the crime rate. Based on the findings, the report recommends reducing political power to improve security. The existing literature has indicated many economic and non-economic factors that affect crime in economies. However, as the researchers we have to pick the parsimonious model that cares for degrees of freedom as well. Hence, the focus of present study remained on unemployment rate, income inequality, government expenditures and taxes to explain the crime rate in long run.

3. Economic theory and econometric methodology

Economists analyse the economy and comes with the theories that explains the economic reality well. These theories could be verified further by establishing the econometric models. These models provide information, forecasting and a guide to policy makers. There are many factors that affect some particular factor of economy, however certain factors are assumed constant in one model or taken as endogenous in the other model. Crime occurs mostly as constant whereas its effects lie in the root of each economic indicator. Since crime is effected by both economic factors and government policies. What could be deriving factors behind crime in the long run? This study points out some economic and government policy factors that drive crime in Pakistan economy. Many studies including Aurangzeb (2012), Asghar et al., (2016) and Raphael and Winter-Ebmer (2001) have focused on crime and points out different

economic factors. Following the directions from existing literature on crime, this study has chosen unemployment rate,income inequality (gini coefficient) and government policy variables, all in the form of percentage of GDP, are defence expenditures,loans and grants, direct and indirect taxes. The data is taken from Pakistan economy over the period from 1980 to 2020. Data on variables is taken from different issues of Economic Surveys of Pakistan, Statistical Year Book and World Development Indicators.

Macroeconomic variables have a unit root problem, as discovered by Nelson and Plosser (1982) using time series data. They conclude that determining whether or not a unit root exists is a useful way to validate the data's source. There are a few key distinctions between stationary and non-stationary data. Temporary shocks in stationary time series data eventually fade away, and the series revert to their long-run averages. While stationary time series data can recover from shocks, non-stationary data cannot. A number of unit root tests exist in the literature to determine if a time series is stationary. The Augmented Dickey-Fuller (ADF) unit root test was used for this analysis (1981). The stationarity problem in the time series data makes its regression estimates vulnerable and the researchers then seeks the cointegration among the variables. Various cointegration tests are available in the literature for use in econometric research. The Engle-Granger (1987) test, the Johansen (1991/1992) Maximum Likelihood test, and the Johansen-Juselius (1990) test are the three most well-known and widely-used cointegration tests. These studies aid in empirically indicating the long term link between variables through the Vector Error Correction model (VECM) that they established. To study the interrelationships between crime, unemployment, defense spending, income inequality (GINI coefficient), government aid (grants and loans), government revenue collection (direct taxes and excises), and taxation (both direct and indirect), we apply a vector error correction model (VECM. This technique of analysis also allows multiple equilibriums through trace statistics that identify the number of long run relationships, or there could be no long run relationship detected at all. Using VECM, we would be able to identify that is there any empirical evidence of causality, uni-directional or multi-directional, between government policies and crime rate in Pakistan. Later, the diagnostic tests would discuss the reliability of the estimates.

4. Empirical Results and Discussion

The pre-requisite for applying VECM is checking stationarity of the variables. The results of Augmented Dickey-Fuler test of all variables in the model are reported in the table 1. The empirics has revealed that all the variables included in this study are not stationary at level.However, they became stationary at first difference. Hence their order of integration is **I**(1). Since variable have unit root the ordinary least squares would lead to spurious regression. In order to avoid spurious results, it is pivotal to estimate the cointegration among variables of the model.

Table 1: Unit Root Estimation

	At level	**At First Difference**
Variables	T-Statistic(Prob.*)	T-Statistic(Prob.*)
LCr	-0.842(0.8065)	-6.513(0.0000)
Unrate	-1.638 (0.4633)	-5.131 (0.0000)
DirT	-1.695(0.4339)	-5.977(0.0000)
DefX	0.044(0.9620)	-5.616 (0.0000)
INI	-2.572(0.0990)	-5.188(0.0000)

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

The next step after checking stationarity is the determination of the lag length. Lag order determines not only the number of lags to be included in the model but also it affects the degrees of freedom. The more lags are included in the model on the cost of loss in the degrees of freedom. Therefore, it is desirable to obtain the optimal lag order. This optimal lag order is usually taken by using the information criteria. The lowest values of information criterion, in most of the criteria, indicates the optimal lag length of the variables included in the model. The results of different information criteria used in this study are given in table 2. We have initially tested for the 4 lags. The optimal lag length is one that indicated by the AIC, HQIC and SBIC; only LR indicate the four lags to be included that we have ignored as the other three criteria are pointing to include only one lag. It also intend to save loss of degrees of freedom.

Table 2: Lag Length Selection Criteria

Lag	LR	AIC	HQIC	SBIC
0		6.573	6.650	6.791
1	389.33	-2.597*	-2.137*	-1.291*
2	36.897	-2.243	-1.399	0.151
3	47.739	-2.182	-0.954	1.301
4	48.185*	-2.133	-0.521	2.438

Note: * indicates optimal lag length.

Further, we use Johansen Tests for Cointegration to check long run relationships in the model. The Johansen Tests for Cointegration provides this benefit that we decide on the basis of data that how many long run relationships exist among the variables. The results of our dataset are depicted in table 3. We have allowed the five long run relationships as there are five variables in the model. In addition, we have also allowed the zero cointegration equation. The Trace Statistic has indicated that there is only one long run relationship exist among our variables, the maximum eigen values also affirms the same results (indicated in the appendix). Hence, there is only one cointegration, long run, relationship exist among the reported crimes, direct taxes, unemployment rate, income inequality and defence expenditures.

Table 3: Results of Johansen Tests for Cointegration

Maximum Rank	LL	Eigen-value	Trace Statistic	5% Critical value
0	61.244		72.711	68.52
1	75.816	0.526	43.568*	47.21
2	88.364	0.474	18.472	29.68
3	95.375	0.302	4.449	15.41
4	97.557	0.106	0.087	3.76
5	97.600	0.002		

Note: * indicates selected rank

The only long run relationship exist in our model is given in equation 1. The equation indicate that, in the long run, the crime rate is positively affected by income inequality and unemployment rate, and it is negatively affected by defence expenditures and direct taxes. All the variables are highly statistically significant, at 1 percent level of

significance, which provide empirical evidence in the favour of long run relationship (details are given in the appendix).

$$LCr = 23.070 + 1.116\,INI + 0.177\,Unrate - 0.295\,DefX - 0.696\,DirT \quad (1)$$

Equation 1 is indicating the long run relationship that describes the impact of income inequality, unemployment rate, defence expenditures and direct taxes on crime rate of Pakistan. The coefficient of unemployment rate indicates the positive relationship with crime. It describes that the increase in unemployment rate would translate into increase in the crime rate in the long run. When the people are unemployed, they do not earn their living from legitimate activities and take the road of crimes. It is also affirmed in other studies including Haider and Ali (2015), Omotor (2009) and Altindag (2012). The result assures that Pakistan economy is suffering from crime due to the rising unemployment rate in the economy. It is also depicted by the recent surge in the data for crime in which the year 2020 took a spike from 2019 due to the unemployment rise in the era of COVID-19 lockdowns.

The estimate of income inequality (gini coefficient) also depicts the positive relationship with the crime rate, its magnitude is the largest among other coefficients. It highlights that the income inequality has the strongest effects on the crime rate among unemployment rate, defence expenditures and direct taxes. A small change in the income inequality could possibly bring a large change in the long run equilibrium rate of crime. This finding is in line with Kelly (2000) and Fajnzylber et al., (2002). The income inequality is somehow a weak measure of disparity among the population. If there is higher inequality, the poor feel deprived and many of them could choose to be criminals to get the higher standard of living that their status quo is living. Therefore, we can say that the rise in income inequality is causing an incentive for the poor to commit crimes in Pakistan over the long run.

The estimate of defence expenditures, as the percentage of GDP,is revealed negative.It indicates that with increase in the defence expenditure the crime rate reduces in Pakistan economy. The defence expenditures have received mixed results in literature as Arshad et al., (2016) indicate that defence expenditures increases crimes while Levitt (2004) finds the defence expenditures decreases crimes. The differences in results could possibly emerge from the difference in quality of institutions in the economies that in turn determines the efficiency of defence expenditures. We have found the strong evidence that the rise in defence expenditures, as the percentage of GDP, is decreasing crime rate over the long run in Pakistan. This result could also suggest that the defence expenditures allocated by the government in the past have been used elegantly, to improve law and order, which in turn has reduced the crimes over the long period of time.

This study has found direct taxes, as the percentage of GDP, decreases the crime rate in long run in the Pakistan economy. Its coefficient is larger than the defence expenditure. This finding is against the argument that increase in taxes leads to cause economic misery which leads to increase crime (Aurangzeb, 2012). It is because we have discriminated between direct and indirect taxes while the earlier literature dealt both as the same. The direct taxes are imposed on the middle and higher income brackets in Pakistan. The direct taxes support the poor by exempting them from the tax structure. However, the indirect taxes in the country do not discriminate between the rich

and poor. Hence, it would be interesting to check if there is a long run relationship between crime rate and the indirect taxes. We have tried to find out such long run relationship that includes indirect taxes but the Johansen Tests for Cointegration has declined the existence of any long run relationship existence when we replaced direct taxes with the indirect taxes in the model (results of this model lag length criteria and cointegration test are depicted in the appendix). Similarly, we have attempted to replace the defence expenditures by the development expenditures of the government and loans and grants as well but Johansen Tests for Cointegration also provided zero long run equations indicating no such relationship existence in the long run (results of these models lag length criteria and cointegration tests are reported in the appendix).

The VECM also allows us to find the impulse response functions of the variables of the model. Since we have only one long run relationship that explains crime, so the unemployment rate, direct taxes, income inequality and defence expenditures will affect the crime. Moreover, the relationship between the variables will remain limited to the one-way in which the impulse in any of the four indicators would affect the crime rate. It is interesting to note that VECM usually indicates many equations in the long run but in our study the indication of one equation highlights that the crime in the only factor whose long run relationship could be explained using the unemployment rate, direct taxes, income inequality and defence expenditures; and there is no other dimension of the long run relationship exists indicating crime rate is not affecting the government economic policies.

The results of impulse response functions of our study are reported in figure 2 (table of impulse response function is in the appendix). We find that the impulse in defence expenditures leads to decrease crimes sharply in Pakistan and the decrease is sharp till first five years. Later, the decreasing trend remains there but only slightly as compared to its values before. It indicates that the rise on defence expenditures, as the percentage of GDP, decreases the crime rate in Pakistan even after ten years. Similar results are found for the direct taxes, as the percentage of GDP, where the one time rise (impulse) in the direct taxes leads to decrease the crimes in Pakistan over the long run. The trend shows rapid fall in the crime rate in the earlier years which become static approximately after six years but still it maintains the negative path. On the contrary, according to our estimate, a sudden rise in the income inequality increases the crime rate in the country. The figure indicates that crime increases, by an impulse in income inequality, initially as an increasing rate until seven years approximately and then at the decreasing rate. The results of unemployment rate impulse are also somehow similar to that of income inequality. However the magnitude of these results differ much as the impulse in income inequality has higher impact on the crime rate than that of impulse in unemployment rate. It is very interesting to note that the magnitudes of impulse response functions are small. However, the variables of analysis are in the form of natural logarithm (crime), percentage of GDP (direct taxes and defence expenditures), rate (unemployment rate) and index (gini coefficient); that means a smaller value in them would be actually very large when these values are converted into numbers.

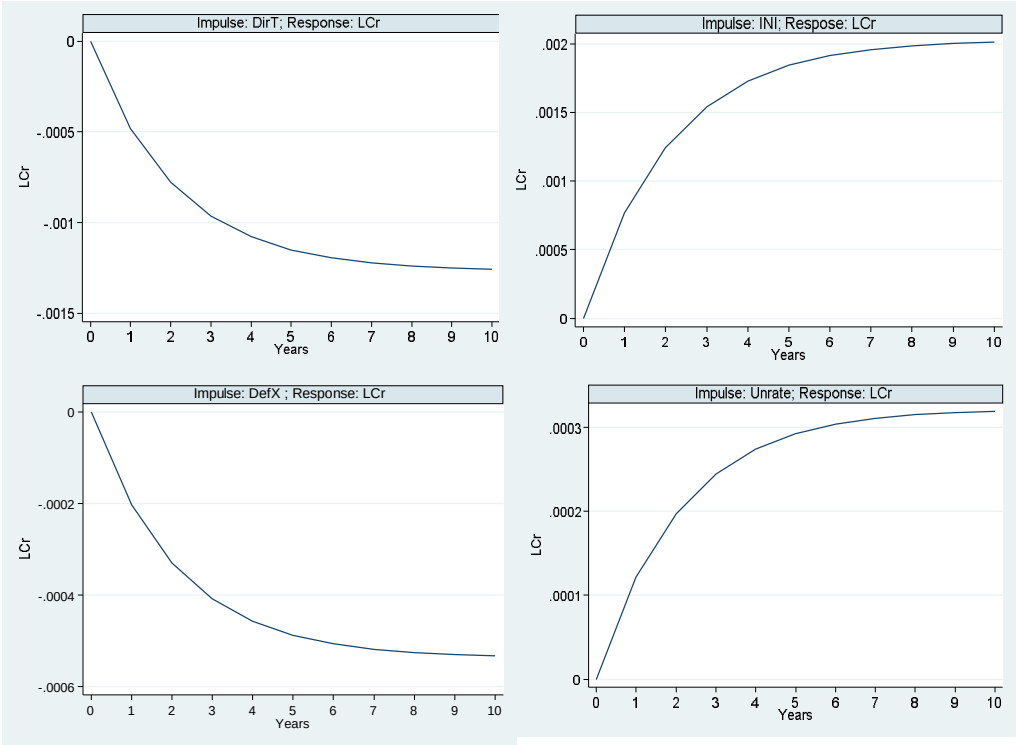

Figure 2: Impulse Response Functions (Author's calculations)

5. Diagnostic Tests

After estimating the cointegration, it is inevitable to discuss the nature of residuals that are obtained in the process. Hence, we first test for the autocorrelation through Lagrange-multiplier test (results are indicated in the appendix); its results revealed that there is no autocorrelation in the residuals obtained from this study. Then, we check for the normality, skewness and kurtosis by applying various tests (results are in appendix). The results of Jarque-Bera test declared normality in residuals distribution. The variables used in the analysis have also shown no divergence in the analysis of skewness and kurtosis. Therefore, we can say that our estimates are empirically valid and reliable. Moreover, the cointegration relationship we have found has come up from the empirical analysis of data and not by any error in the estimation process.

6. Conclusions

The present study explores the impact of unemployment rate, income inequality and government policies regarding taxes and expenditures on crime in Pakistan from 1980 to 2020. The results of Augmented Dicky Fuller test ensured data non-stationarity on level and stationarity on the first difference that lead towards cointegration. Johansen Tests for Cointegration revealed only one long run relationship among the variables. The Vector Error-Correction model affirms that crime possess unidirectional long run relationship with the government policies, in which crime is determined by the policies, in which crime is explained by the other variables. We further applied the Lagrange-multiplier test to investigate the autocorrelation and Jarque-Bera estimates are used for

checking normality of residuals; the results of sooner indicated no autocorrelation and the latter ensured the normality in the residuals estimated from our model.

The empirics have revealed that an increase in both unemployment rate and income inequality leads to increase the crime rate in Pakistan, between them the latter has stronger impact on crime rate. Further, the empirics highlighted that rising direct taxes and defence expenditures decreases the reported crime rate, in long run, in Pakistan. The impulse response function has indicated that the rise in direct taxes are decreasing crimes more than the rise in defence expenditures. In addition, the impulse responses also indicate that one-time rise in direct taxes and defence expenditures have spill-over effects over the long period of time. Similarly, the one-time rise in unemployment rate and income inequality continue to increase crime rate after several years. In a nutshell, the study revealed that government policies regarding direct taxes and defence expenditures playa significant role in determining long run trends of crime rate in Pakistan. Therefore, we suggest to policy makers to increase both defence expenditures and direct taxes to control effectively the crime surge in the country.

Authors' Contributions:

The authors contributed equally to this work.

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Appendix
Stationarity

dfullerINI

Dickey–Fuller test for unit root Number of obs = 40
Variable: INI Number of lags = 0

H0: Random walk without drift, d = 0

	Test	Dickey–Fuller critical value		
	statistic	1%	5%	10%
Z(t)	-2.572	-3.648	-2.958	-2.612

MacKinnon approximate p-value for Z(t) = 0.0990.

. dfuller d.INI

Dickey–Fuller test for unit root Number of obs = 39
Variable: D.INI Number of lags = 0

H0: Random walk without drift, d = 0

Dickey–Fuller

```
                 Test      -------- critical value ---------
statistic          1%          5%         10%
------------------------------------------------------------------
Z(t)          -5.188      -3.655      -2.961      -2.613
------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000.

. dfullerunrate

Dickey–Fuller test for unrootNumber of obs  = 40
Variable: unrate                Number of lags =  0

H0: Random walk without drift, d = 0

                                Dickey–Fuller
                 Test      -------- critical value ---------
statistic          1%          5%         10%
------------------------------------------------------------------
Z(t)          -1.638      -3.648      -2.958      -2.612
------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.4633.

. dfullerd.unrate

Dickey–Fuller test for unrootNumber of obs  = 39
Variable: D.unrate              Number of lags =  0

H0: Random walk without drift, d = 0

                                Dickey–Fuller
                 Test      -------- critical value ---------
statistic          1%          5%         10%
------------------------------------------------------------------
Z(t)          -5.131      -3.655      -2.961      -2.613
------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000.

. dfullerdefexpgdp

Dickey–Fuller test for unrootNumber of obs  = 40
Variable: defexpgdp             Number of lags =  0

H0: Random walk without drift, d = 0

                                Dickey–Fuller
                 Test      -------- critical value ---------
statistic          1%          5%         10%
------------------------------------------------------------------
Z(t)           0.044      -3.648      -2.958      -2.612
------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.9620.

. dfullerd.defexpgdp

Dickey–Fuller test for unrootNumber of obs  = 39
Variable: D.defexpgdp           Number of lags =  0
```

H0: Random walk without drift, d = 0

	Test	Dickey–Fuller critical value		
statistic	1%	5%	10%	
Z(t)	-5.616	-3.655	-2.961	-2.613

MacKinnon approximate p-value for Z(t) = 0.0000.

. dfullerdirtaxgdp

Dickey–Fuller test for unit root Number of obs = 40
Variable: dirtaxgdp Number of lags = 0

H0: Random walk without drift, d = 0

	Test	Dickey–Fuller critical value		
statistic	1%	5%	10%	
Z(t)	-1.695	-3.648	-2.958	-2.612

MacKinnon approximate p-value for Z(t) = 0.4339.

. dfullerd.dirtaxgdp

Dickey–Fuller test for unit root Number of obs = 39
Variable: D.dirtaxgdp Number of lags = 0

H0: Random walk without drift, d = 0

	Test	Dickey–Fuller critical value		
statistic	1%	5%	10%	
Z(t)	-5.977	-3.655	-2.961	-2.613

MacKinnon approximate p-value for Z(t) = 0.0000.

. dfullerloansgdp

Dickey–Fuller test for unit root Number of obs = 42
Variable: loansgdp Number of lags = 0

H0: Random walk without drift, d = 0

	Test	Dickey–Fuller critical value		
statistic	1%	5%	10%	
Z(t)	-1.560	-3.634	-2.952	-2.610

MacKinnon approximate p-value for Z(t) = 0.5038.

```
. dfullerd.loansgdp

Dickey–Fuller test for unit root          Number of obs  = 41
Variable: D.loansgdp                      Number of lags =  0

H0: Random walk without drift, d = 0

                                  Dickey–Fuller
                 Test      -------- critical value ---------
statistic          1%          5%          10%
------------------------------------------------------------
Z(t)          -8.894      -3.641      -2.955      -2.611
------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000.

. dfullerindtaxgdp

Dickey–Fuller test for unit root          Number of obs  = 40
Variable: indtaxgdp                       Number of lags =  0

H0: Random walk without drift, d = 0

                                  Dickey–Fuller
                 Test      -------- critical value ---------
statistic          1%          5%          10%
------------------------------------------------------------
Z(t)          -1.167      -3.648      -2.958      -2.612
------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.6876.

. dfullerd.indtaxgdp

Dickey–Fuller test for unit root          Number of obs  = 39
Variable: D.indtaxgdp                     Number of lags =  0

H0: Random walk without drift, d = 0

                                  Dickey–Fuller
                 Test      -------- critical value ---------
statistic          1%          5%          10%
------------------------------------------------------------
Z(t)          -7.246      -3.655      -2.961      -2.613
------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000.

. dfullerlnc

Dickey–Fuller test for unit root          Number of obs  = 40
Variable: lncrime                         Number of lags =  0

H0: Random walk without drift, d = 0

                                  Dickey–Fuller
                 Test      -------- critical value ---------
statistic          1%          5%          10%
------------------------------------------------------------
```

```
Z(t)          -0.842       -3.648       -2.958       -2.612
------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.8065.

. dfullerd.lcr

Dickey–Fuller test for unit root          Number of obs  = 39
Variable: D.lcr                           Number of lags =  0

H0: Random walk without drift, d = 0

                                 Dickey–Fuller
                Test      -------- critical value ---------
statistic         1%          5%         10%
------------------------------------------------------------
Z(t)          -6.513       -3.655       -2.961       -2.613
------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000.
```

VECM
lcrINIunratedefexpgdpdirtaxgdp

Lag-order selection criteria

```
  Sample: 1984 thru 2020                          Number of obs = 37
 +-------------------------------------------------------------------------+
 | Lag |    LL      LR      df    p      FPE       AIC      HQIC      SBIC   |
 |-----+-------------------------------------------------------------------|
 |   0 | -116.611                    .000493   6.57355    6.6503   6.79124 |
 |   1 |  78.0543  389.33   25  0.000 5.2e-08* -2.59753* -2.13705* -1.29138* |
 |   2 |  96.5028  36.897   25  0.059 8.0e-08  -2.24339  -1.39918   .151215  |
 |   3 |  120.372  47.739   25  0.004 1.1e-07   -2.1823  -.954353   1.30077  |
 |   4 |  144.465  48.185*  25  0.004 1.7e-07  -2.13324  -.521563   2.43828  |
 +-------------------------------------------------------------------------+
  * optimal lag
  Endogenous: lcrINIunratedefexpgdpdirtaxgdp
   Exogenous: _cons
```

Rank of VECM
Johansen tests for cointegration

```
Trend: Constant                       Number of obs  = 39
Sample: 1982 thru 2020                Number of lags =  2
------------------------------------------------------------
                                          Critical
Maximum                                    Trace     value
rank  Params         LL  Eigenvalue   statistic       5%
    0     30   61.244304         .     72.7112     68.52
    1     39   75.815939    0.52634     43.5679*    47.21
    2     46   88.363988    0.47454     18.4718     29.68
    3     51   95.375444    0.30202      4.4489     15.41
    4     54     97.5566    0.10583      0.0866     3.76
    5     55     97.5999    0.00222
------------------------------------------------------------
                                          Critical
Maximum                          ------Eigenvalue-----    value
rank  Params         LL               Maximum            5%
```

```
    0     30   61.244304          .     29.1433     33.46
    1     39   75.815939    0.52634     25.0961     27.07
    2     46   88.363988    0.47454     14.0229     20.97
    3     51   95.375444    0.30202      4.3623     14.07
    4     54    97.5566    0.10583      0.0866      3.76
    5     55    97.5999    0.00222
-----------------------------------------------------------
* selected rank
```

Vector error-correction model

```
Sample: 1981 thru 2020                  Number of obs     =        40
                                        AIC               = -2.626857
Log likelihood =  66.53714              HQIC              = -2.413131
Det(Sigma_ml)  =  2.47e-08              SBIC              = -2.035749

Equation           Parms      RMSE     R-sq      chi2     P>chi2
----------------------------------------------------------------
D_lcr                  2     .064141   0.3124   17.26842   0.0002
D_INI              2     .055345   0.3534   20.76496   0.0000
D_unrate               2     .705272   0.2156   10.44191   0.0054
D_defexpgdp            2     .341212   0.1071   4.557572   0.1024
D_dirtaxgdp            2     .306485   0.0917   3.837126   0.1468
----------------------------------------------------------------
```

Short Run Estimates

```
------------------------------------------------------------------------------
             | Coefficient  Std. err.      z    P>|z|     [95% conf. interval]
-------------+----------------------------------------------------------------
D_lcr        |
       _ce1 |
        L1. |   -.000688   .0309276    -0.02   0.982    -.0613051     .059929
             |
       _cons |   .0422057   .0105254     4.01   0.000     .0215763    .0628351
-------------+----------------------------------------------------------------
D_INI        |
       _ce1 |
        L1. |   .0947398   .0266865     3.55   0.000     .0424353    .1470442
             |
       _cons |   .0163725    .009082     1.80   0.071    -.0014279    .0341729
-------------+----------------------------------------------------------------
D_unrate     |
       _ce1 |
        L1. |    1.01948   .3400695     3.00   0.003     .3529559    1.686004
             |
       _cons |   .0416607   .1157336     0.36   0.719    -.1851729    .2684943
-------------+----------------------------------------------------------------
D_defexpgdp  |
       _ce1 |
        L1. |   .2510496   .1645266     1.53   0.127    -.0714166    .5735158
             |
       _cons |  -.1034131   .0559922    -1.85   0.065    -.2131559    .0063296
-------------+----------------------------------------------------------------
D_dirtaxgdp  |
       _ce1 |
        L1. |  -.2370982   .1477819    -1.60   0.109    -.5267453     .052549
```

```
          |
      _cons |   .0760539   .0502936     1.51   0.130    -.0225197    .1746276
------------------------------------------------------------------------------
```

Cointegrating equations (Long Run)

```
Equation          Parms    chi2     P>chi2
-------------------------------------------
_ce1              4   188.7866   0.0000
-------------------------------------------
```

Identification: beta is exactly identified

```
                Johansen normalization restriction imposed
------------------------------------------------------------------------------
beta | Coefficient  Std. err.      z    P>|z|     [95% conf. interval]
-------------+----------------------------------------------------------------
_ce1         |
lcr |         1          .       .       .            .           .
INI         | -1.116166    .346521    -3.22   0.001    -1.795335   -.4369975
unrate |  -.1770789   .0375174    -4.72   0.000    -.2506117   -.1035461
defexpgdp |   .2950243   .0479709     6.15   0.000     .2010031    .3890455
dirtaxgdp |   .6964574   .1209223     5.76   0.000     .4594542    .9334607
      _cons |   23.06969          .       .       .            .           .
------------------------------------------------------------------------------
```

$$LCr = 23.070 + 1.116\,INI + 0.177\,Unrate - 0.295\,DefX - 0.696\,DirT$$

Diagnostic testing

Autocorrelation

Lagrange-multiplier test

lag	chi2	dfProb> chi2
1	15.5299	25	0.92811
2	20.2444	25	0.73389
3	26.6857	25	0.37177
4	16.8262	25	0.88800
5	15.3348	25	0.93320
6	26.0325	25	0.40587

H0: no autocorrelation at lag order

Normality Test for Residuals

Jarque-Bera test

Equation	chi2	dfProb> chi2
D_lcr	0.600	2	0.74063
D_INI	1.581	2	0.45362
D_unrate	0.976	2	0.61376
D_defexpgdp	2.895	2	0.23518
D_dirtaxgdp	0.316	2	0.85379
ALL	6.369	10	0.78339

Skewness Test for Residuals

Skewness test

Equation	Skewness	chi2	df	Prob> chi2
D_lcr	-.30456	0.587	1	0.44341
D_INI	.45	1.282	1	0.25744
D_unrate	.32155	0.655	1	0.41839
D_defexpgdp	-.67538	2.889	1	0.08919
D_dirtaxgdp	.0125	0.001	1	0.97490
ALL		5.415	5	0.36740

Kurtosis Test for Residuals

Kurtosis test

Equation	Kurtosis	chi2	df	Prob> chi2
D_lcr	2.9092	0.013	1	0.90905
D_INI	2.5658	0.299	1	0.58482
D_unrate	3.4506	0.321	1	0.57071
D_defexpgdp	2.9388	0.006	1	0.93861
D_dirtaxgdp	2.5539	0.315	1	0.57453
ALL		0.954	5	0.96618

Impulse Response Function (IRF)

Results from crime

Step	(1) irf	(2) irf	(3) irf	(4) irf
0	0	0	0	0
1	.000768	.000122	-.000203	-.000479
2	.001246	.000198	-.000329	-.000777
3	.001543	.000245	-.000408	-.000963
4	.001727	.000274	-.000457	-.001078
5	.001842	.000292	-.000487	-.00115
6	.001914	.000304	-.000506	-.001194
7	.001958	.000311	-.000518	-.001222
8	.001986	.000315	-.000525	-.001239
9	.002003	.000318	-.000529	-.00125
10	.002014	.000319	-.000532	-.001257

(1) irfname = crime, impulse = INI, and response = lcr.
(2) irfname = crime, impulse = unrate, and response = lcr.
(3) irfname = crime, impulse = defexpgdp, and response = lcr.
(4) irfname = crime, impulse = dirtaxgdp, and response = lcr.

Equations Showing no Long Run Relationships (Tries that have not revealed significant but as a reference given in appendix
Trail 1 (adding indirect taxes replacing direct taxes)
. varsoclcrINIunratedefexpgdpindtaxgdp

Lag-order selection criteria

Sample: 1984 thru 2020 Number of obs = 37

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-136.929				.001477	7.67182	7.74857	7.88951
1	41.5514	356.96	25	0.000	3.7e-07*	-.624399	-.16392*	.681751*
2	55.2023	27.302	25	0.341	7.5e-07	-.010933	.833278	2.38367
3	77.6641	44.924	25	0.009	1.1e-06	.126267	1.35421	3.60933
4	116.662	77.996*	25	0.000	7.9e-07	-.630377*	.981299	3.94115

* optimal lag
Endogenous: lcrINIunratedefexpgdpindtaxgdp
Exogenous: _cons

Rank of VECM (Zero revealed: no long run relationship exists)
. vecranklcrINIunratedefexpgdpindtaxgdp, trend(constant) lags(1) max

Johansen tests for cointegration
Trend: Constant Number of obs = 40
Sample: 1981 thru 2020 Number of lags = 1

Maximum rank	Params	LL	Eigenvalue	Trace statistic	Critical value 5%
0	5	21.726155	.	44.9672*	68.52
1	14	31.228878	0.37820	25.9618	47.21
2	21	38.224912	0.29517	11.9697	29.68
3	26	41.40865	0.14716	5.6022	15.41
4	29	43.685796	0.10761	1.0479	3.76
5	30	44.209768	0.02586		

Maximum rank	Params	LL	------Eigenvalue----- Maximum	Critical value 5%
0	5	21.726155	.	19.0054	33.46
1	14	31.228878	0.37820	13.9921	27.07
2	21	38.224912	0.29517	6.3675	20.97
3	26	41.40865	0.14716	4.5543	14.07
4	29	43.685796	0.10761	1.0479	3.76
5	30	44.209768	0.02586		

* selected rank

Trail 2(adding loans and grants replacing direct taxes)
. varsoclcrINIunratedefexpgdploansgdp

Lag-order selection criteria

```
  Sample: 1984 thru 2020                          Number of obs = 37
 +---------------------------------------------------------------------------+
 | Lag |    LL      LR      df    p     FPE       AIC      HQIC      SBIC    |
 |-----+---------------------------------------------------------------------|
 |   0 | -31.4832                    4.9e-06   1.97206   2.04881   2.18976  |
 |   1 | 141.459  345.89   25  0.000 1.7e-09* -6.02484  -5.56436* -4.71869* |
 |   2 | 163.822  44.725   25  0.009 2.1e-09  -5.88226  -5.03805  -3.48765  |
 |   3 | 192.274  56.904   25  0.000 2.2e-09  -6.06886  -4.84092   -2.5858  |
 |   4 | 225.719  66.891*  25  0.000 2.2e-09  -6.52536* -4.91369  -1.95384  |
 +---------------------------------------------------------------------------+
  * optimal lag
  Endogenous: lcrINIunratedefexpgdploansgdp
   Exogenous: _cons
```

Rank of VECM (Zero revealed: no long run relationship exists)

. vecranklcrINIunratedefexpgdploansgdp, trend(constant) lags(1) max

Johansen tests for cointegration

```
Trend: Constant                         Number of obs  = 40
Sample: 1981 thru 2020                       Number of lags =  1
------------------------------------------------------------------
                                                Critical
Maximum                                          Trace     value
rank  Params         LL  Eigenvalue  statistic       5%
    0     5   104.89108         .    62.9586*    68.52
    1    14   121.83709     0.57143    29.0666     47.21
    2    21   130.63669     0.35595    11.4674     29.68
    3    26   134.03659     0.15633     4.6676     15.41
    4    29   136.03081     0.09490     0.6792      3.76
    5    30   136.37038     0.01684
------------------------------------------------------------------
                                                Critical
Maximum                                 ------Eigenvalue-----     value
rank  Params         LL                       Maximum       5%
    0     5   104.89108         .    33.8920     33.46
    1    14   121.83709     0.57143    17.5992     27.07
    2    21   130.63669     0.35595     6.7998     20.97
    3    26   134.03659     0.15633     3.9884     14.07
    4    29   136.03081     0.09490     0.6792      3.76
    5    30   136.37038     0.01684
------------------------------------------------------------------
* selected rank
```

Trail 3 (adding development expenditures replacing defence expenditures)

. varsoclcrINIunratedevexpgdpdirtaxgdp

Lag-order selection criteria

```
  Sample: 1984 thru 2020                          Number of obs = 37
 +---------------------------------------------------------------------------+
 | Lag |    LL      LR      df    p     FPE       AIC      HQIC      SBIC    |
 |-----+---------------------------------------------------------------------|
 |   0 | -151.751                    .003292   8.47302   8.54976   8.69071  |
 |   1 | 23.3548  350.21   25  0.000 1.0e-06*  .359201*   .81968*  1.66535* |
```

```
|  2 | 41.3429  35.976   25  0.072 1.6e-06   .738224   1.58244   3.13283 |
|  3 | 70.9497  59.214   25  0.000 1.5e-06   .489204   1.71715   3.97227 |
|  4 | 96.7225  51.546*  25  0.001 2.3e-06   .447433   2.05911   5.01896 |
+-------------------------------------------------------------------------+
 * optimal lag
Endogenous: lcrINIunratedevexpgdpdirtaxgdp
 Exogenous: _cons
```

Rank of VECM (Zero revealed: no long run relationship exists)

. vecranklcrINIunratedevexpgdpdirtaxgdp, trend(constant) lags(1) max

Johansen tests for cointegration

Trend: Constant Number of obs = 40
Sample: 1981 thru 2020 Number of lags = 1

Maximum rank	Params	LL	Eigenvalue	Trace statistic	Critical value 5%
0	5	-1.4238468	.	54.2631*	68.52
1	14	10.464877	0.44813	30.4856	47.21
2	21	17.231853	0.28705	16.9516	29.68
3	26	21.850598	0.20621	7.7142	15.41
4	29	25.686647	0.17453	0.0421	3.76
5	30	25.707678	0.00105		

Maximum rank	Params	LL	Eigenvalue	Maximum	Critical value 5%
0	5	-1.4238468	.	23.7774	33.46
1	14	10.464877	0.44813	13.5340	27.07
2	21	17.231853	0.28705	9.2375	20.97
3	26	21.850598	0.20621	7.6721	14.07
4	29	25.686647	0.17453	0.0421	3.76
5	30	25.707678	0.00105		

* selected rank

Corresponding author: Ramona Birau, University of Craiova, Doctoral School of Economic Sciences, Craiova, Romania, Email: ramona.f.birau@gmail.com.

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