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Business Cycle and Crime: The Case of British Columbia, Canada

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Abstract:

Purpose: *Economic expansions and contractions are among the factors that influence crime as a social phenomenon. Yet, the magnitude of the impact of economic growth and recession has remained largely unexplored in British Columbia (BC). In this study, the reference business cycle variable (GDP) is measured in relation to four crime categories: fraud, robbery, violence, and property crimes.*
Design/methodology/approach: *We collected data from Statistics Canada on various socioeconomic indicators for the period of 1986-2019. We employed ARDL method and dependent tests based on Hamza and Lau (2013) and Oyelade (2019) to estimate the causal effects.*
Findings: *Our results do not support any long-run relationships among various crime categories and business cycles. However, we found statistically significant short-term effects of business cycles on crime categories. Economic prosperity has reduced crime in all four categories in the short term, while the recession has caused crime to increase. Furthermore, increasing the number of police officers during our study did not reduce these types of crimes except for property crimes.*
Practical implications: *The results of the paper can help the policy makers and the BC government determine what types of crime will increase or decrease when there is an economic recession or boom, which can then help the government and justice system plan ahead in order to control crime occurrences.*
Originality value: *This study is noteworthy as the research methodology and time series data used in this research are for the first time in British Columbia.*

Keywords: *Business Cycle, Crime, British Colombia, ARDL.*

JEL Classification Numbers: *E32, K42.*

Paper type: *Research article.*

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1. Introduction

Some researchers such as Blekesaune (2007) and Rosenfeld and Fornango (2007) believe that economic conditions can impact social problems since social welfare can maintain desirable levels by improving economic conditions. Of the numerous social problems linked to economic conditions, this study focuses on crime. Generally, crime refers to an act that violates codified law (Barton-Crosby, 2018). Times of economic prosperity are expected to increase production and employment, while economic recessions generally lead to job losses, falling production, and unemployment (Mukoyama and Sahin, 2006). There are some instances in which crime in a geographical area can be caused by economic prosperity, while in other instances recession leads to an increase in some of crimes. Thus, the relationships among economic growth/recession and crime remain an empirical question.

According to Brand and Price, crime incurs social and economic costs in public and private spheres. For example, loss of property, assets, court costs, and deterrent equipment like closed circuit televisions (CCTV), alarms, and insurance costs are among the private costs, while public costs may include increased monitoring police organizations, courts, and prisons. Therefore, crime is an undesirable social phenomenon that threatens economic and social security (Brand and Price, 2000). Criminal acts such as theft, fraud, robbery, and violence seem like negative social phenomena. Given that these components may not behave the same depending on economic conditions, a greater understanding of the crime's sub-segments is required. Regardless of economic conditions, it is critical to identify whether which types of crime are increased or decreased impacted by the business cycles.

This study investigated the effect of business cycles on crime in British Columbia (BC), Canada, between 1986 and 2019. We estimated the size of the impact of economic expansions and contractions on different crime categories, including fraud, robbery, violence, and property crimes. Moreover, we determined the effect of inflation, unemployment, the number of tourists entering the province, the number of police officers, and the Gini coefficient on the occurrence of these four categories of crime (i.e., fraud, robbery, violence, and property crimes). We analyzed all these effects within short-term and long-term contexts. We collected all data from publicly available crime statistics (i.e., Statics Canada). All time-series were cross checked with Statistics Canada agents to ensure the consistency of reported numbers for the duration of the sample.

The research method in this paper is one of the efficient convergence techniques, known as ARDL model. The models are mainly based on the works of Hamza and Lau (2013) and Oyelade (2019). The number of crimes in the four categories was used as the dependent variable, and the reference cycle variable was used as an independent variable. We also controlled for other socioeconomic variables, such as unemployment, inflation rate, the number of police officers, the number of tourists, and the Gini coefficient. After ensuring that all variables were stationary,[3] we evaluated the models' significance and stability by performing various tests such as the Bound test, the Jarque-Bera test for normality, Breusch-Godfrey for serial correlation, LM Breusch-Pagan-Godfrey for heteroskedasticity, Ramsey reset, and CUSUM test.

Our results show that these models are significant in the short run between 1986 and 2019. Based on the four crime models' evidence, we concluded that economic recessions increase crime in these four categories (fraud, rubbery, property crime and crime of violence), and economic growth has an adverse effect on these crimes. Therefore, based on these results, the initial impression of this relationship has been confirmed. More specifically, our results showed that a one million Canadian dollar increase in BC's Gross Domestic Product (GDP) during the prosperity will reduce property crimes by approximately 5.2 units. This effect, however, is not symmetric. We found that during recession, property crimes increase by approximately 11.4 units for a one million Canadian dollar decrease in BC's GDP.[4]

Our results can help policymakers and the BC government determine what kinds of crimes will increase or decrease during recessions or economic prosperity, which has the potential to help the government and relevant sectors within the criminal justice system develop crime prevention strategies. Among the users of these results are the Planning Institute of British Columbia (PIBC), the British Columbia Police Association (BCPA) to use specialized forces when necessary, and the Prisons Organization in BC for preparing to accept specialized criminals.

The next section describes the theoretical and practical literature review on this field. In the third section, we examine the state of the four categories of crimes and their components in BC, which is followed by an explanation of the study's data in section four. We present the statistical models in section five, and the sixth section shows the study's estimates and empirical results. Finally, we discuss the findings and provide conclusions in section seven.

2. Literature Review

Becker (1968) is one of the earliest studies to show the interconnections among crime and economics with three factors. According to Becker (1968), the probability of arrest and the severity of punishment reduces crime directly, and positive social indicators increase legal activities and work as a controller to crime. Becker (1968) believed that people purchase goods and services based on a cost-benefit analysis. Still, in the pattern of individual behavior, individuals' decisions about committing a crime are different. In his model, he claimed that people do not commit an offense if the costs of committing a crime outweigh their benefits in the United States in 1965.

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[3]*We used Dicky Fuller unit root test for all variables stationary separately.*
[4]*British Columbia's median GDP in our sample is 141932.5 million dollars.*

Accordingly, potential offenders decide by comparing the regular income and the income and risk of committing a crime. If the advantages of the crime outweigh the legal work benefits, they turn to illegal acts (Becker, 1968).

After Becker's examination of the relationships among economic variables and crime, many studies examined the economics index and Crime (for example, see Howsen and Jarrell, 1987). The key findings of these studies at that the main effects of the macroeconomic view on crime were the impact of both unemployment and economic growth on crime (Cantor and Land, 1985; Cohen and Felson, 1970; Kennedy and Forde, 1990) and, in recent years, about unemployment and crime (Andresen and Linning, 2016). Also some researches addressed the subject of economic growth and crime (Burchell and Wilkinson, 1996; Glaeser, 1999; Farmer and Tiefenthaler, 2004; Goulas and Zervoyianni, 2013).

In 2018, Sameem and Sylwester studied the relationship between the crime rate and the unemployment rate (i.e., as a business cycle indicator) during 1990-2013. Their (2018) study showed that the effect of unemployment on home theft, car theft, and violent crime depends on the city or village's size. The results show that, unemployment has a strong effect on domestic crime and theft and a weak effect on violent crime. According to their article, the size of the area was a significant explanatory variable. Most of the time, there is a positive relationship between property crime and unemployment in more populous areas (Sameem and Sylwester, 2018).

Andresen and Linning (2016) examine how unemployment impacts crime specialization in the ten Canadian provinces between 1981 and 2009. Using panel data and a hybrid modeling approach, they find that unemployment affects crime specialization. However, this influence varies in strength and by crime type. They believe that rising unemployment leads to increased specialization of assault and shoplifting, which may be representative of the increased social stress of unemployment. They also believe that with rising unemployment, alcohol consumption may increase and this may increase crime of violence.

In addition, they say, during recessions, people spend more time at home and are better able to protect person and property. In a related paper, Nordin and Almen (2017) study the effects of unemployment on crime. However, instead of using the unemployment variable, they have specifically used long-term unemployment as an independent variable. They believe that the longer duration of unemployment has a more significant impact on crime, especially violent crimes. They believe that long-term unemployment is likely to create a strain that leads to violent behavior. Moreover, in addition to creating direct costs, unemployment also indirectly imposes costs on society due to the costs of crime. Also, they argue that violent crimes usually tend to be more costly than property crimes. Although the Bound test results do not support any long-term relationships in our models, yet, we used unemployment as an independent variable.

Cook and Zarkin (1985) proposed a particular theoretical framework for expressing the relationship between economic contraction and crime. According to them (1985), on the one hand, recession can reduce the opportunity to achieve a desirable life, and therefore offset the proceeds of crime; the reason is recession increases the motivation for criminal activity by reducing the opportunity cost and time spent on illegal activities, including reducing the opportunity cost and time spent in prison.

As for the younger generation, during the recession, the enrollment rate in schools and universities decreases, and this segment of society also has enough time and motivation to join criminal activities. On the other hand, recession can also have a direct impact on the quality of criminal opportunities (Cook and Zarkin, 1985). In the time of recession, property owners spend more time protecting their property; thus, crime and theft numbers may be reducing. For the fundamental theoretical part of our study, after Baker (1968), we took inspiration from this paper about the cause and effect relationship of the recession on crime.

From 25 years of economic and public health research, Cook (2007) concludes that higher indirect taxes on alcohol, as well as other supply constraints, reduce their effects by reducing moderate consumption. Cook (2007) suggested that driving while intoxicated is reduced due to reduced alcohol consumption during a recession. He stated that a specific pattern could not be achieved for drugs. Further, recession can reduce state and local tax revenues, leading to a reduction in regulatory and judicial processes. As a result, the deterrent effects of the criminal justice system on crime can be debilitating.

This article shows that the recession period reduces the percentage of crime due to reduced incomes. The opposite theory is that some kind of crime like smuggling increases during periods of recession due to rising unemployment and falling opportunity costs of crime. In other words, by increasing the unemployment rate, unemployed people seeking to earn money might become smugglers and increase the incidence of this crime (Barone and Masciandaro, 2018).

Regarding experimental studies, we can refer to Oyelade (2019) that examines the determinants of Crime in Nigeria from economic and social perspectives using time series data from 1990 to 2014. The economic variables are: 1) GDP per capita; 2) male unemployment rate; 3) women’s unemployment rate; and 4) the poverty rate (Oyelade, 2019).

Additionally, demographic and social variables include enrollment in higher education, urban population, and rural population. Oyelade’s (2019) long-term results by ARDL methodology show that GDP per capita and female unemployment rate increase Nigeria’s crime rate, while urban and rural population and male unemployment rate have a positive and significant impact on Nigeria’s crime rate. Short-term results also show that GDP per capita and higher education reduce crime rates in Nigeria, while the urban population, male unemployment rate, and poverty rate increase crime in this area. We follow a similar methodology and take advantage of the ARDL method, which we identify as the most appropriate estimation method in this context.

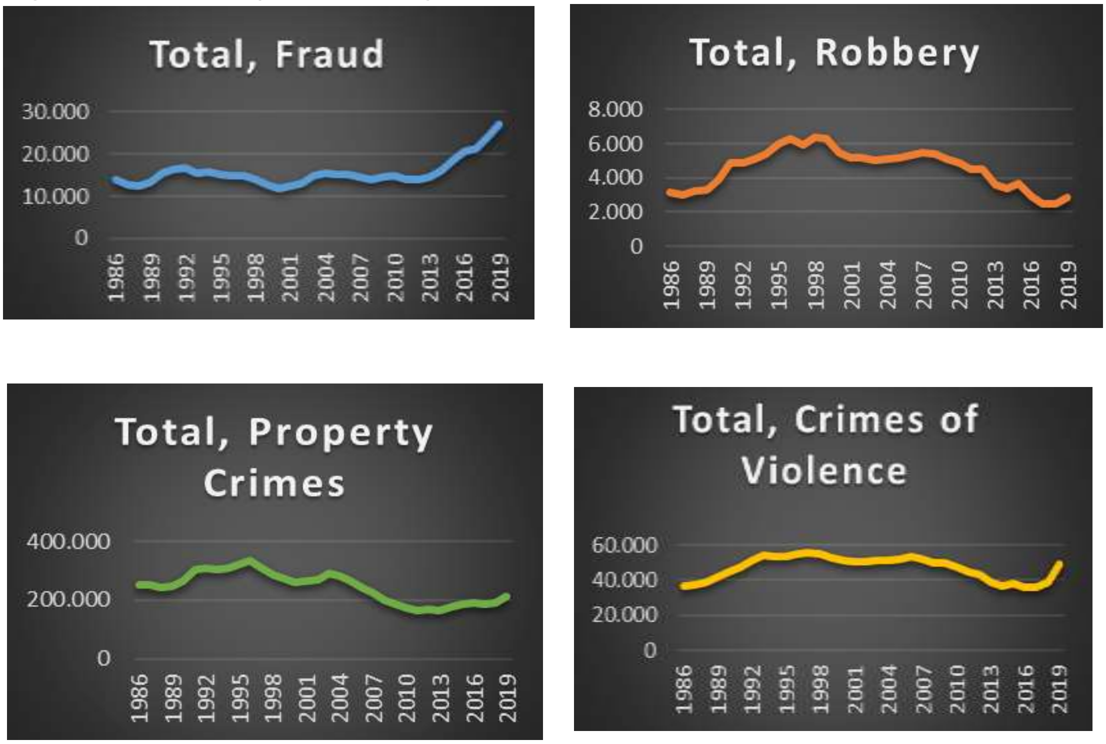
Based on Bushway (2012) and Thrasher's (2018) findings, it is clear that a variable such as economic growth may have different effects on crime in different circumstances. For example, a recession may reduce crime, but at the same time, economic prosperity will increase that crime. In other words, the situation here is asymmetrical, which means that variables may affect crime differently. Bushway (2012) analyzed the thirteen business cycles since 1933 to provide evidence of whether recessions cause crime. The author (2012) used data from the United States to show that recessions are strongly associated with an increase in burglary, robbery, and motor vehicle theft, but that does not have anything to do with the murder. These patterns suggest that economic conditions influence crime in various ways independent of statistical association with homicide.

Thrasher (2018) examined the relationship between crime and Mississippi's business cycle. His (2018) results show that increasing legal income reduces a person's willingness to commit a crime. Thrasher (2018) uses regression models to estimate long-term and short-term revenue relationships, violent crime, theft, vandalism, and vehicle theft. His (2018) long-run model shows how revenue growth increases crime growth, and his short-term empirical model shows how income variable affects criminal change. According to the long-run results, with the increase in revenue, theft, and sabotage decrease, and this variable will increase as income decreases. In the short term, theft decreases as income increases, also as income decrease, theft will be increased. He goes on to explain that recessions can cause law enforcement to have fewer resources available to them and it could be one of the reasons to increase theft. Ultimately, Thrasher does not find a long-term or short-term relationship between violent crime or vehicle theft and the business cycle.

3. Crime in British Columbia

British Columbia is the westernmost province in Canada, with Victoria as the capital and Vancouver as the second-most populous city. As the sixth state, it joined the Canadian Confederation in 1871 (Egan, 2013). Approximately 300,000 people lived in the state in the year 1986. By 2020, the population is about 5,147,000 people. This issue means that the population has grown by over 71.5 percent in the past 34 years (see Appendix 1). An increase in the population may also cause several social problems, such as crime. In this section, we will provide an overview of Crime in British Columbia. In the following diagram, we have shown the changes of four types of crimes including fraud, robbery, property crime, and violence, during the study period from 1986 to 2019. As observed in Figure 1, the general trend of changes in the four crimes of our study is not the same.

Figure 1. *Time trend for crime categories in British Columbia*



Note: *To draw figure 1, we used the final data extracted for the model's estimation.*
Source: *Statistics Canada.*

In a similar fashion to other parts of the country, crime data in BC show the number of crimes reported maybe rapidly increasing over time, like the crime of fraud by a 95% increase during our period. On the other hand, some types of crime decrease such as robbery with about 11% decrease on the same time period. Several factors could be responsible for this; it may be related to the recession, high unemployment, rising poverty rates, or high inflation. Other non-economic factors may also be causal, such as population, number of tourists, and number of police officers. We are using these factors as auxiliary variables in our models to find out the relationship between the business cycle and Crime in BC.

4. Data and Methodology

All data used in these models come from the Statistics Canada website for British Columbia. Changing the crime definition from 1998 posed some challenges in the study process[5], so for earlier data, we get the confirmation from Statistics Canada, and they sent the adjusted data from 1986 till 2019 for all four categories that needed in the article: Crime of Fraud, Crime of Robbery, Property crime, and Crimes of Violence. The final data used in the article are shown in Appendix (2).

In this article, the variables used were defined based on the Bell (2013) report and Statistics Canada website. The Variables identified by the abbreviations CF, CR, CP, CV, GE, UN, INF, PO, TU, and GINI. The definitions of the variables are as follow:

CF: Total fraud is an intentional deception devised to take money or property from an individual or group.
CR: Total robbery, the action of taking property unlawfully from a person or place by force or threat of force.
CP: Property crime is a crime to obtain money, property, or other benefits.
CV: Crime of violence is a crime committed through the using of force or the threat of force.
GE: Business cycle variables, as the reference of GDP we created the business cycle variables, include economic prosperity (GE-POS) and recession (GE-NEG), and we put the income-based gross domestic product in BC (unit to 1,000,000 dollars) in our models.
UN: Unemployment in BC, people whose jobs started within the past four weeks are considered unemployed. Estimates in thousands rounded to the nearest hundred.
INF: The inflation rate (Consumer price index), several items make up the Consumer Price Index (CPI), and the top-level is the "all-items CPI," which we used in our article.
PO: Police personnel in BC, rates are calculated per 100,000 population based on estimations provided by Statistics Canada.
TU: The people who has one or more nights trips as non-resident to British Columbia.
GINI: GINI Coefficient, the Gini coefficient is a measure of how unequal income distribution is between zero and one. In a population with just the same amount of household income received, the coefficient would be zero (minimum inequality). However, a coefficient of one (maximum inequality) occurs if one person receives all the household income while the rest receive none.

In this study, we want to test these hypotheses: Does crime increase during recessions? Does crime decrease during prosperity?

An autoregressive distributed lag model (ARDL) used for decades; however, this model's importance is to examine long-term relationships between variables

[5]*Crime data were available in two categories on the Statistics Canada website: UCR1 (1968-1997) and UCR2 (1998-2019), but due to the changes in the definition of crime variables in these two datasets, we could not use them as the raw data. So, we adjust the data by their definition and got the confirmation from Statistics Canada.*

emphasized in recent years. This approach has been developed by Pesaran and Shin (1999) and Pesaran *et al.* (2001), Ghatak and Siddiki (2001). The regression model with distributive interrupts has many advantages over Engle and Granger (1987) and Johansen and Juselius (1990):

-The ARDL model works better when small samples are involved, whereas the Johansen model is not quite as statistically significant in that situation.
-With the ARDL model, you can explore short-term dynamics as well as long-term relationships.
-Third, in the ARDL approach, selecting a different optimal lag for each variable is possible.
-The ARDL approach is efficient because the endogenous problem does not occur due to the non-correlation of the error terms.

The frame of the ARDL (p, q) model is like equation (1):

$$y_t + \beta_1 y_{t-1} + \cdots + \beta_p y_{t-p} = \lambda + \alpha_0 x_t + \alpha_1 x_{t-1} + \cdots + \alpha_q x_{t-q} + \varepsilon_t \qquad (1)$$

$$\beta(L) y_t = \lambda + \alpha(L) x_t + \varepsilon_t$$

Where consists of **p** lags of dependent variable and **q** lags of independent variables. The process is as follows:

In this paper, we used the ARDL method to estimate the models[6]. In the first step, a unit root test should be performed on the time series variables. We used the standard Dickey-Fuller test for the existence of unit root. In this test, the null hypothesis shows that a unit root is present in an autoregressive model, and the alternative hypothesis shows that the variable is stationarity. The primary purpose is to ensure that the variables are not I (2) to avoid false results, so the condition for using the ARDL method is that all variables must be eider I (0) or I (1) (Kripfganz and Schneider, 2016).

In the second step, the ARDL models show in equation 2. We divided crimes into four categories of Crime (Total Fraud, Total Robbery, Total Property Crimes, Total Crimes of Violence). These variables represent in four different models by one equation as follow:

[6]*We used E-views 10 (Econometrics views) as an software tool for the estimation.*

$$\Delta Y_t = \alpha_0 + \sum_{i=1}^{\rho} \alpha_{1i} \Delta Y_{t-i} + \sum_{i=0}^{q_1} \alpha_{2i} \Delta GE_{t-i} + \sum_{i=0}^{q_2} \alpha_{3i} \Delta UN_{t-i} + \sum_{i=0}^{q_3} \alpha_{4i} \Delta INF_{t-i} + \sum_{i=0}^{q_4} \alpha_{5i} \Delta PO_{t-i} + \sum_{i=0}^{q_5} \alpha_{6i} \Delta TU_{t-i} + \sum_{i=0}^{q_6} \alpha_{7i} \Delta GINI_{t-i} + \delta_{11} CF_{t-1} + \delta_{21} GE_{t-1} + \delta_{31} UN_{t-1} + \delta_{41} INF_{t-1} + \delta_{51} PO_{t-1} + \delta_{61} TU_{t-1} + \delta_{71} GINI_{t-1} + \varepsilon_{1t} \quad (2)$$

Where Y_t is the outcome variable, and it includes CR for the Total Crime of Robbery, CV for the Total Crime of Violence, CP for the Total Crime of Property, CF for the total crime of fraud, and UN refers to the number of unemployed people, INF for the Inflation rate, GE for the Economics Business Cycle[7], GINI for the Gini coefficient, PO for the total number of police officers, TU is international tourist entering or returning, and ε is disruptive sentence residual.

The next step for ARDL analyses is doing Bound Test. The test uses to determine whether a long-term relationship exists or short-term. This test presented by Pesaran *et al.* (2001) and its null hypothesis indicates no long-term relationship in the model. This test is performed separately for each model. If the F-statistic is less than the lower bound for I(0), long - term relationship does not exist, and if the F-statistic is more than the upper bound for I(1), a long-term relationship exists unless the coefficients have spurious regression. In the short-term estimation, if the F be between these two bounds or higher than I(1), the model could estimate as a short-run. Then, we examine the classical hypotheses tests:

Normality test: If the probability is more than 5%, the assumption of normality approves.
Breusch-Godfrey Serial Correlation LM Test: If the probability is more than 5%, there is no correlation problem in our model.
Heteroskedasticity Test: Breusch- Pegan- Godfrey: If the probability is more than 5%, there is no Heteroskedasticity problem in our model.
Ramsey RESET Test[8]: If the probability is more than 5%, then the formulation of the model equation is correct.

Using the Cumulative Sum (CUSUM) test and Cumulative Sum-Quadratic (CUSUMQ) are suitable for assessing the stability of the ARDL model, as suggested by Pesaran *et al.* (2001). So, we use these tests to show the model's stability as a final test. There is no causality test because we accept the function by the basic theory from historical review.

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[7]*The main independent variable in the models is the business cycle, which is defined based on the GDP reference variable. When the model is estimated, two data columns are created for recession and prosperity, which by definition, in the recession variable does not include GDP growth and in the prosperity period, its reduction is not considered. The two variables GE-pos and GE-Neg indicate respectively the state of prosperity and recession in British Columbia during the period under review.*

[8]*Ramsey Regression Equation Specification Error Test (RESET)*

5. Empirical Results

In this study, the number of models analyzes separately for different categories of crime used in the study, namely, Fraud, Robbery, property crime, and violent Crime for British Columbia over the period 1986-2019. Eventually, the authors test the stationary of the variables by Dicky -fuller unit root test as shown in Table 1.

Table 1. *Panel unit root test result*

Symbol	Variables	Probability
CF	Criminal of Fraud	**0.6766**
Δ CF	First difference of CF	**0.0197**
CR	Crime of Robbery	**0.8069**
Δ CR	First difference of CR	**0.0037**
CP	Crimes of Property	**0.0208**
Δ CP	First difference of CP	**-**
CV	Crimes of Violence	**0.0904**
Δ CV	First difference of CV	**-**
GE_NEG	Contraction phase of business cycle	**0.8327**
ΔGE_NEG	First difference of GE-NEG	**0.0000**
GE_POS	Expansion phase of business cycle	**1.0000**
ΔGE_POS	First difference of GE-POS	**0.0218**
UN	Unemployment	**0.6593**
Δ UN	First difference of UN	**0.0046**
INF	Inflation	**0.0337**
Δ INF	First difference of INF	**-**
PO	Number of police	**0.9995**
ΔPO	First difference of PO	**0.0367**
TU	Number of tourists	**0.7377**
ΔTU	First difference of TU	**0.0597**
GINI	Income inequality	**0.3440**
ΔGINI	First difference of GINI	**0.0003**

Notes: *The third column of the table indicates p-value for all variables individually. We take the first difference for each variable that was not significant by at least 90% probability on level (I(0)). CP, CV, and INF are stationary in levels (I(0)), which don't need the first difference. For using ARDL as a method of estimation in this article, the condition is that all variables be stationary in I(0) or I(1). The results show that these data can be used in the ARDL model.*

Source: *The author's calcuations*

As shown in Table 1, all the variables are stationary (at 10% level of significance) by the first difference, except the three variables: CP, CV, and INF, which are stationary (I(0)), and taking the first different is not required for them. Thus, we can use all variables to estimate the model with the ARDL method.

To analyze long-term relationships, we use Bounds tests. Table 2 shows the results for the long-term Bound tests for each crime type separately. Table 2 provides critical value information for all models at three levels of significance for 1%, 5%, and 10% for lower bound (I(0)) and upper bound(I(1)).

Table 2. *Bound test results (Long Run)*

Model specification	F statistic	Critical values						Conclusion
		1% significance		5% significance		10% significance		
		Lower bound (I(0))	Upper bound (I(1))	Lower bound (I(0))	Upper bound (I(1))	Lower bound (I(0))	Upper bound (I(1))	ARDL Long Run Form and Bounds Test
Total, Fraud	1.84	2.73	3.9	2.17	3.21	1.92	2.89	Non Cointegration
Total, Robbery	1.06	2.73	3.9	2.17	3.21	1.92	2.89	Non Cointegration
Total, Property Crimes	1.11	2.54	3.9	1.97	3.18	1.7	2.83	Non Cointegration
Total, Crimes of Violence	1.45	2.54	3.9	1.97	3.18	1.7	2.83	Non Cointegration

Notes: *The results of this table are used to determine whether the relationship is long-term or not. We specify this subject by the amount of F-statistics in the models. The amount of F-statistic in the first model is 1.84, which is lower than the lower bound in all levels of accepted confidence. The F-statistic for the following three models is 1.06, 1.11, and 1.45, respectively, which are all lower than I(0). It shows us that the long-term relationship does not exist, and we need to check the result of table 3 to be sure that there is a short-term relationship or not.*
Source: *The author's calculations*

According to the Bounds test results in all four models, the F-statistic is less than the lower bound for I(0), so long - term relationship does not exist, and we check the bound test in short-run models.

In the next step, we employ the short-term Bounds tests. Table 3 shows the results for the short-term Bound tests for each crime type separately. The table provides critical value information for all models at three levels of significance for 1%, 5%, and 10% for lower bound (I(0)) and upper bound(I(1)). As mentioned before, the model estimates as a short-run if the F-statistic is within these two limits or higher than I(1).

Table 3. *Bound test results (Error Correction Regression)*

Model specification	F-statistic	Critical values						Conclusion
		1% significance		5% significance		10% significance		
		Lower bound (I(0))	Upper bound (I(1))	Lower bound (I(0))	Upper bound (I(1))	Lower bound (I(0))	Upper bound (I(1))	ARDL Error Correction Regression
Total, Fraud	9.60	3.6	4.9	2.87	4	2.53	3.59	Cointegration
Total, Robbery	3.06	2.73	3.9	2.17	3.21	1.92	2.89	Cointegration
Total, Property Crimes	5.55	2.54	3.91	1.97	3.18	1.7	2.83	Cointegration
Total, Crimes of Violence	3.8	3.07	4.23	2.5	3.5	2.22	3.17	Cointegration

Notes: *The results of this table are used to determine whether the relationship is short-term or not. We specify this subject by the amount of F-statistics in the models. The amount of F-statistic in the first model is 9.60, which is higher than the upper bound in all levels of*

accepted confidence. The F-statistic for the following two models is 3.06, 5.55, which are higher than I(1), and the last model's F-statistic is 3.8, which is between two bounds by 1% significant and higher than I(1) in the other levels of significance. Since the F-statistic falls between I(0) and I(1), or higher than I(1), short term relationship is confirmed.
Source: *The author's calculations.*

Thus, according to all test results, Since we have an F-statistic which falls between these two bounds or is higher than I(1), a short-term relationship is confirmed for all models. After the bound test results and the diagnosis of short-term period length for the models, we present data analysis and classical tests in Table 4.

Table 4. *ARDL Error Correction Regression*[9]

Symbol	Variables	Model 1: CF	Model 2: CR	Model 3: CP	Model 4: CV
GE_POS	GDP Prosperity	-0.088433 (0.0486)	-0.086694 (0.0000)	-5.218253 (0.0030)	-0.169603 (0.0432)
GE_NEG	GDP stagnation	0.267687 (0.0136)	0.163752 (0.0034)	11.37231 (0.0102)	0.614437 (0.0484)
UN	Unemployment	-	-	545.6151 (0.0290)	69.03479 (0.0085)
INF	Inflation	-	-	5841.401 (0.0245)	636.4749 (0.0419)
PO	Number of police	-2.128661 (0.0057)	0.950280 (0.0012)	-109.1326 (0.0014)	-2.736427 (0.0521)
TU	Number of tourists	-0.002031 (0.0043)	0.000602 (0.0097)	-0.041570 (0.0070)	0.008125 (0.0012)
GINI	Income inequality	-	19589.93 (0.0122)	1949071 (0.0055)	-
ECM	Error correction model	-0.463530 (0.0000)	-0.030825 (0.0000)	-0.083028 (0.0012)	-0.300118 (0.0001)
SUSUM	Stability	stable	stable	stable	stable
SUSUMQ		stable	stable	stable	stable
Diagnostic Tests					
Heteroskedasticity		0.68	220.	0.10	0.48
Normality		0.60	0.89	0.42	0.40
Ramsey reset		0.93	0.21	0.25	0.057
Serial correlation		0.12	0.12	0.57	0.08

Note: *The p-value for each variable is expressed in parentheses. Those Variables that are not recognized as significant are automatically deleted in the software, such as UN, INF and GINI in model 1, and UN and INF in model 2 and GINI in model 3.*
Source: *The author's calculations.*

According to the table results, the economic expansion shown by GE-POS is significant in all models, also its effect in the third model is more than others. In other words, relative economic expansion plays a greater role in reducing CP among

[9]*For the complete software output see the Appendix 3 to 6.*

four offenses. Economic expansion with a coefficient of -5.2 has the highest decrease in crime on the property and with a coefficient of -0.08, it has the least effect on CF and CR. Symmetrically, the recession shown with GE-NEG has a significant positive relationship in all models with the types of crime in our study, and its effect on CP is still greater than other crimes. The economic expansion coefficient shows that it has a small and uniform negative impact on CF and CR. Also, the contraction has almost the same but positive effect on CF and CR.

Due to the relationship between CF and CR and the small effect of expansion and contraction on them, it can be concluded that these two variables are stable to economic fluctuations. Therefore, if we are to use an economic indicator to control these crimes, economic fluctuations will not be the most appropriate, and employment indicators are much more effective.

The unemployment variable in the first two models CF and CR, are not statistically significant, which in the short-term model automatically excluded from the model by software. This variable in the third model present by a coefficient of approximately 545 and in the fourth model present by a coefficient of approximately 69. It means that by raising the unemployment population in British Columbia for 1000 people, about 545 and 69 numbers are added to CP and CV crimes, respectively. Therefore, job creation policies can help to control CP and CV. The inflation rate affected property crime and crime of violence similar to the unemployment. Police control policies have a stronger effect on reducing CP than other crime types. TU coefficient shows that the number of tourists has almost no effect on four crime types in our study.

Also, Table 4 shows that the GINI coefficient has a significant impact on CR and CP, but policies that reduce income inequality need to reform the tax system and administrative rules, which cannot be easily changed. Furthermore, each of the four models' error correction coefficients has a negative numerical value of less than one and shows that in each period, according to the numerical value, the percentage of imbalances disappears, and the model tends to balance. Finally, the results of heteroskedasticity, normality, and correlation tests also confirm the review and the absence of problems in the research models. Considering the SUSUM and SUSUMQ test results and placing the trend between the two upper and lower edge curves, we conclude that all four models are stable.

6. Discussion, Conclusion, and Recommandation

In this article, using the ARDL model, four models estimate in this research find the relation between four categories of crime and some effective variables that the basic articles confirm the models' causality. In the models, crime is a dependent variable, and the business cycle, unemployment, inflation rate, GINI coefficient, police officer, and tourist number are the independent variable. In this study, the hypothesis was whether contraction increases crime while expansion reduces it. The result proved our original hypothesis. Generally, the study results suggest that the province's crime rates fluctuate only short-term compared to periods of prosperity or recession.

According to the results obtained from estimating the models, we find out that economic prosperity reduces society's crimes. Also, considering its coefficients, this effect is more for property crime than other crimes. Economic prosperity has many benefits, including increasing production, improving public services, reducing unemployment and poverty. It is possible that economic prosperity has increased household welfare and families' ability to provide ancillary products to establish property security like CCTV; it could be one of the reasons that CP reduced more than other crimes in our study.

The contraction has a slightly positive impact on CF and CR, while economic expansion negatively impacts. Because prosperity and recession have such a small impact on them, it seems that they are stable during the economic fluctuation. Hence, other factors must use to control these crimes, such as employment indicators. Generally, the result shows that criminal activity has increased during the economic recession; one of the reasons could be decreasing people's purchasing power during this time or decreasing the aggregate production of British Columbia. The effects of the recession can reduce social welfare as well as increased tensions and psychological pressures for people.

Our results indicate that unemployment affects CP and CV significantly but has no significant effect on CF and CR. Moreover, we find that inflation and the difference between social classes (GINI coefficient) have positively affected crime. The inflation coefficient shows that those who lost their purchasing power, have more committing crimes. According to our results, Class differences can also spiritually divert the lawful man from the right path and lead to corruption. In British Columbia, the number of tourists had little effect on crime, but the number of police had a negative impact on three offenses (CF, CP, CV) and were exceptionally high on property crimes. As a result, we can reduce the amount of property crime with a higher number of police officers.

According to our estimated models, by contributing to the expansion and controlling the recession, increasing job creation policies, police officers' number, inflation's control policies, crime could significantly reduce.

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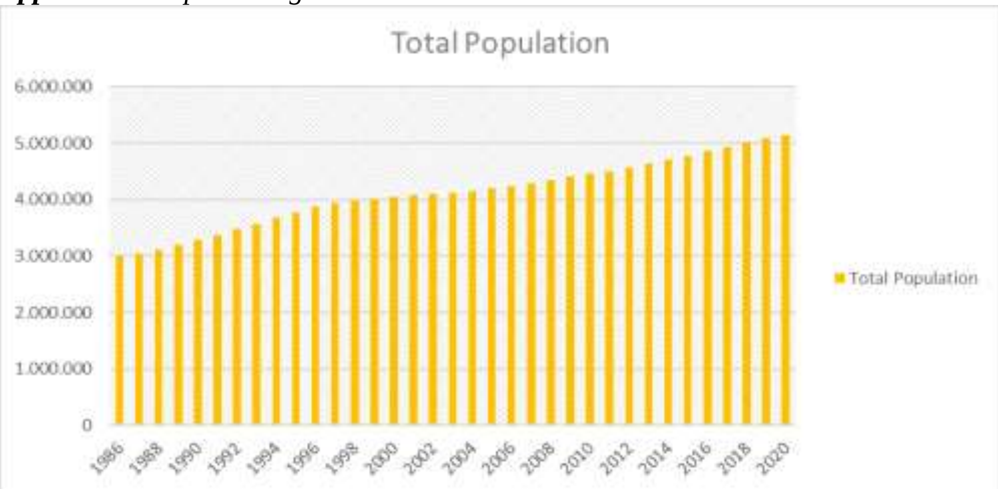
Appendices:

Appendix 1. *Population growth in BC*



Appendix 2. *The adjusted data from 1986 till 2019.*

	UN	PO	INF	GINI	GE	CV	CR	CP	CF	TU
1986	194.5	6770	66.7	0.395	85760	36438	3185	251096	13944	4067807
1987	189.2	6987	68.7	0.395	89353	37205	3005	250351	12703	2699578
1988	164.2	7026	71.2	0.374	93709	38676	3253	244330	12450	2903525
1989	151	7068	74.4	0.362	98058	41530	3342	247384	13318	2982508
1990	143.4	7073	78.4	0.395	102102	44944	3933	266230	15536	3118099
1991	173.3	7393	82.6	0.392	103964	47428	4864	303874	16473	3184511
1992	182.6	7466	84.8	0.411	107469	51523	4851	307698	16796	3208355
1993	179.8	7562	87.8	0.403	110549	53989	5128	304047	15509	3291929
1994	175.2	7726	89.5	0.405	114024	53699	5417	307571	15953	3571092
1995	165.4	7586	91.6	0.404	116111	53300	5999	323747	15280	4050502
1996	172.4	7767	92.4	0.421	120169	54791	6308	336871	14912	4251843
1997	171.7	8073	93.1	0.42	123991	55299	5932	307489	14887	4470473
1998	179.9	8231	93.4	0.423	125726	55112	6399	287816	13943	4681731
1999	170.3	8147	94.4	0.429	128421	52922	6339	272508	12778	4862343
2000	149.2	8087	96.1	0.427	132591	51983	5500	258822	11764	5041684
2001	160.7	8389	97.7	0.439	135724	51068	5204	264461	12314	5021833
2002	182	8464	100	0.454	140099	50973	5150	268979	13065	5134352
2003	173.5	8615	102.2	0.437	143766	51640	5015	289113	14793	4735404
2004	157.6	8667	104.2	0.437	148130	51670	5071	283356	15447	4946863
2005	130	9124	106.3	0.432	153275	52990	5174	264907	15297	4884990
2006	106.5	9584	108.1	0.42	160695	53878	5318	245128	15121	4877322
2007	98.6	10214	110	0.41	169126	52457	5508	226164	14703	4781717
2008	108.2	10341	112.3	0.409	174156	50187	5412	197581	14107	4519871
2009	183.8	11095	112.3	0.424	174870	49575	5136	184837	14524	4105613
2010	183.7	11417	113.8	0.429	180074	47508	4900	174859	13036	4302504
2011	184.1	11600	116.5	0.42	183960	44934	4492	162677	12145	4168373
2012	167.8	11604	117.8	0.418	187489	43224	4521	167534	11956	4221185
2013	162.6	11487	117.7	0.419	191121	38691	3580	163253	12128	4307221
2014	151.2	11308	118.9	0.414	195272	36492	3390	179397	13371	4566166
2015	156.3	11324	120.2	0.416	202331	38231	3644	186217	15749	4926147
2016	158.6	11410	122.4	0.4	208433	35949	2966	192992	17289	5532226
2017	139.1	11608	125	0.411	217014	35672	2484	186692	17863	5693846
2018	129	12203	128.4	0.405	222987	38776	2482	192155	20239	6057835
2019	131.7	12253	131.4	0.403	227602	49041	2855	213171	22816	6361935
2020	244.3	101275	132.4							841854

Appendix 3. *First Model output*

ARDL Long Run Form and Bounds Test
Dependent Variable: D(CF)
Selected Model: ARDL
Case 2: Restricted Constant and No Trend
Date: 04/08/21 Time: 09:50
Sample: 1986 2020
Included observations: 31

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	62522.08	8972.961	6.967831	0.0000
CF(-1)*	-0.176114	0.087026	-2.023692	0.0659
GE_NEG(-1)	-0.475105	0.345164	-1.376464	0.1938
GE_POS(-1)	0.027237	0.040508	0.672377	0.5141
GINI(-1)	-128996.8	36550.22	-3.529304	0.0042
PO(-1)	-3.896067	0.851470	-4.575694	0.0006
TU(-1)	0.000106	0.000530	0.199790	0.8450
UN(-1)	-2.876572	21.99553	-0.130780	0.8981
INF(-1)	283.4872	137.9329	2.055254	0.0623
D(GE_NEG)	0.142448	0.198070	0.719180	0.4858
D(GE_NEG(-1))	0.418871	0.172032	2.434842	0.0315
D(GE_POS)	-0.036670	0.052261	-0.701675	0.4963
D(GINI)	-75910.77	25231.46	-3.008576	0.0109
D(PO)	-0.311212	0.942682	-0.330135	0.7470
D(TU)	-0.000285	0.000991	-0.287891	0.7783
D(TU(-1))	-0.001903	0.000849	-2.241356	0.0447
D(UN)	16.51902	16.86427	0.979528	0.3467
D(UN(-1))	28.00331	13.74514	2.037325	0.0643
D(INF)	-95.81599	194.5520	-0.492496	0.6313

* p-value incompatible with t-Bounds distribution.

Levels Equation
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GE_NEG	-2.697715	2.766631	-0.975090	0.3488
GE_POS	0.154654	0.230376	0.671311	0.5147
GINI	-732462.7	390200.7	-1.877144	0.0850
PO	-22.12243	12.32206	-1.795351	0.0978
TU	0.000602	0.003126	0.192440	0.8506
UN	-16.33359	127.1395	-0.128470	0.8999
INF	1609.681	1100.563	1.462598	0.1693
C	355009.4	172429.1	2.058871	0.0619

EC = CF - (-2.6977*GE_NEG + 0.1547*GE_POS -732462.7135*GINI -22.1224*PO + 0.0006*TU -16.3336*UN + 1609.6813*INF + 355009.3898)

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	1.84933	10%	1.92	2.89
k	7	5%	2.17	3.21
		2.5%	2.43	3.51
		1%	2.73	3.9

ARDL Error Correction Regression
Dependent Variable: D(CF)
Selected Model: ARDL
Case 5: Unrestricted Constant and Unrestricted Trend
Date: 04/08/21 Time: 09:53
Sample: 1986 2020
Included observations: 31

ECM Regression
Case 5: Unrestricted Constant and Unrestricted Trend

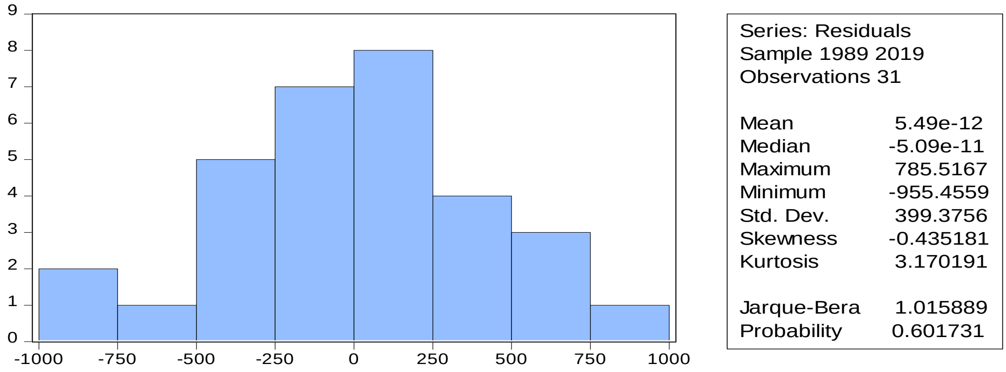
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	43327.82	4473.551	9.685330	0.0000
@TREND	-434.1161	49.79308	-8.718402	0.0000
D(GE_NEG)	0.267687	0.094894	2.820895	0.0136
D(GE_POS)	-0.088433	0.040939	-2.160109	0.0486
D(PO)	-2.128661	0.652289	-3.263370	0.0057
D(TU)	-0.002031	0.000598	-3.398073	0.0043
CointEq(-1)*	-0.463530	0.047291	-9.801651	0.0000

R-squared	0.877952	Mean dependent var	334.3871
Adjusted R-squared	0.816928	S.D. dependent var	1143.185
S.E. of regression	489.1332	Akaike info criterion	15.49457
Sum squared resid	4785027.	Schwarz criterion	16.00340
Log likelihood	-229.1658	Hannan-Quinn criter.	15.66044
F-statistic	14.38703	Durbin-Watson stat	2.307671
Prob(F-statistic)	0.000000		

* p-value incompatible with t-Bounds distribution.

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)

F-statistic	9.607237	10%	2.53	3.59
k	6	5%	2.87	4
		2.5%	3.19	4.38
		1%	3.6	4.9



Breusch-Godfrey Serial Correlation LM Test:

F-statistic	2.521263	Prob. F(2,12)	0.1219

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.780397	Prob. F(16,14)	0.6856
Obs*R-squared	14.61420	Prob. Chi-Square(16)	0.5531

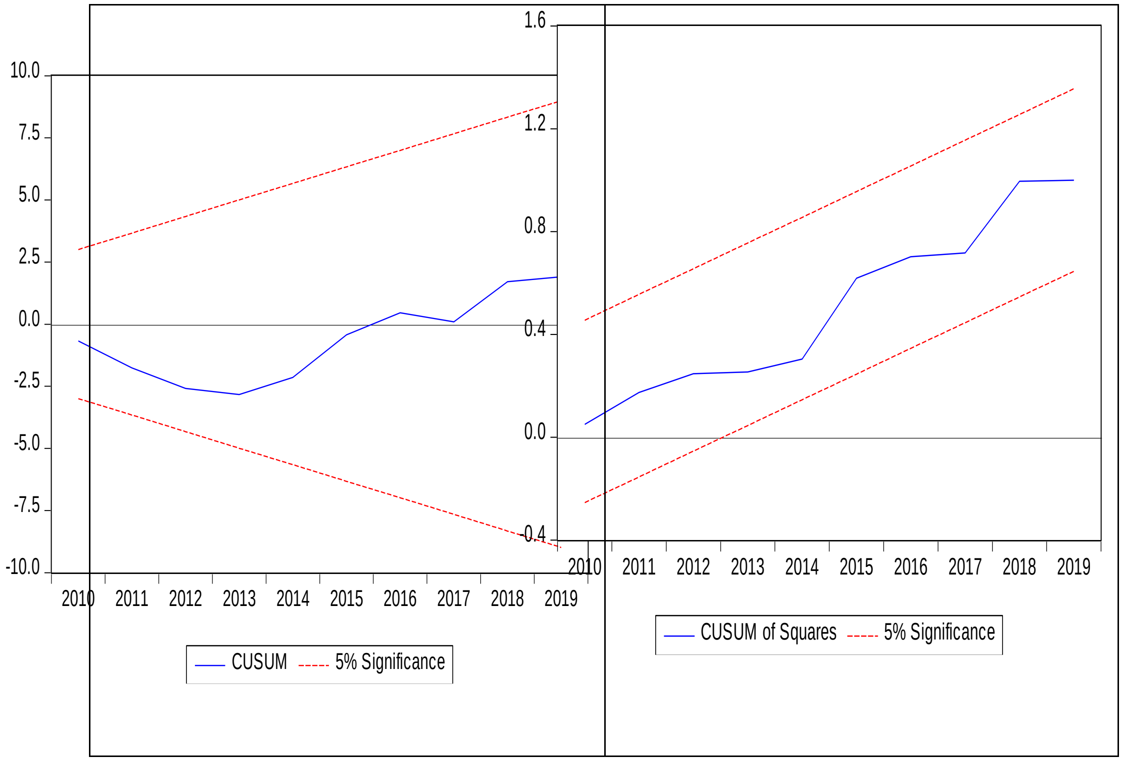
Ramsey RESET Test

Equation: UNTITLED

Specification: CF CF(-1) GE_NEG GE_POS GINI INF PO TU UN C

Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	0.076168	23	0.9399
F-statistic	0.005802	(1, 23)	0.9399



Appendix 4. *Second Model output*

ARDL Long Run Form and Bounds Test
Dependent Variable: D(CR)
Selected Model: ARDL
Case 2: Restricted Constant and No Trend
Date: 04/08/21 Time: 10:30
Sample: 1986 2020
Included observations: 31

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-18730.01	9719.450	-1.927065	0.0802
CR(-1)*	-1.030825	0.323978	-3.181774	0.0087
GE_NEG(-1)	-0.033511	0.144379	-0.232104	0.8207
GE_POS(-1)	-0.082539	0.028437	-2.902532	0.0144
GINI(-1)	5978.439	21656.54	0.276057	0.7876
INF(-1)	230.8353	67.60740	3.414350	0.0058
PO(-1)	0.610029	0.767570	0.794753	0.4436
TU(-1)	0.000411	0.000333	1.234349	0.2428

UN**	-7.910483	9.264784	-0.853823	0.4114
D(CR(-1))	0.608898	0.292348	2.082787	0.0614
D(GE_NEG)	-0.163752	0.124370	-1.316650	0.2147
D(GE_POS)	-0.086694	0.025582	-3.388851	0.0060
D(GE_POS(-1))	0.083379	0.035357	2.358169	0.0379
D(GINI)	19589.93	14042.17	1.395078	0.1905
D(INF)	226.4077	97.77460	2.315608	0.0409
D(INF(-1))	-315.5117	125.6366	-2.511304	0.0289
D(PO)	0.063254	0.564141	0.112124	0.9127
D(PO(-1))	0.950280	0.405371	2.344220	0.0389
D(TU)	0.000602	0.000582	1.034021	0.3233
D(TU(-1))	0.000546	0.000398	1.370091	0.1980

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GE_NEG	-0.032509	0.140532	-0.231326	0.8213
GE_POS	-0.080071	0.015756	-5.082064	0.0004
GINI	5799.666	20061.78	0.289090	0.7779
INF	223.9326	75.47054	2.967153	0.0128
PO	0.591787	0.641480	0.922534	0.3760
TU	0.000399	0.000245	1.626872	0.1320
UN	-7.673936	8.058683	-0.952257	0.3614
C	-18169.93	5139.815	-3.535133	0.0047

EC = CR - (-0.0325*GE_NEG -0.0801*GE_POS + 5799.6662*GINI + 223.9326*INF + 0.5918*PO + 0.0004*TU -7.6739*UN -18169.9326)

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	1.062473	10%	1.92	2.89
k	7	5%	2.17	3.21
		2.5%	2.43	3.51
		1%	2.73	3.9

ARDL Error Correction Regression
Dependent Variable: D(CR)
Selected Model: ARDL
Case 2: Restricted Constant and No Trend
Date: 04/08/21 Time: 10:31

Sample: 1986 2020
Included observations: 31

ECM Regression
Case 2: Restricted Constant and No Trend

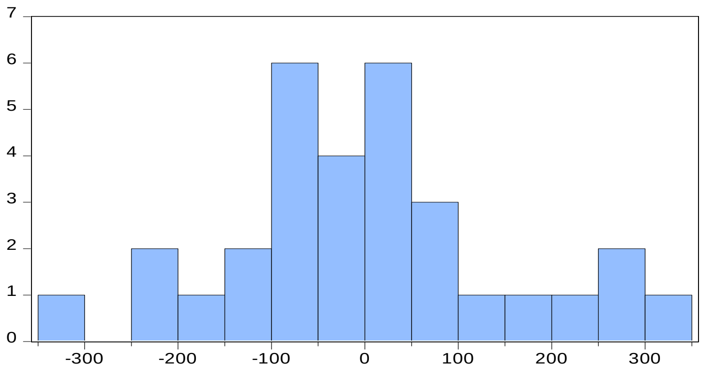
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GE_NEG)	0.163752	0.044130	3.710690	0.0034
D(GE_POS)	-0.086694	0.010235	-8.470740	0.0000
D(GINI)	19589.93	6539.730	2.995525	0.0122
D(INF)	226.4077	50.37202	4.494711	0.0009
D(PO)	0.950280	0.218454	4.350022	0.0012
D(TU)	0.000602	0.000193	3.125047	0.0097
CointEq(-1)*	-0.030825	0.149399	-6.899821	0.0000

R-squared	0.870258	Mean dependent var	-12.83871
Adjusted R-squared	0.795145	S.D. dependent var	415.7496
S.E. of regression	188.1721	Akaike info criterion	13.59724
Sum squared resid	672766.3	Schwarz criterion	14.15233
Log likelihood	-198.7572	Hannan-Quinn criter.	13.77818
Durbin-Watson stat	2.797024		

* p-value incompatible with t-Bounds distribution.

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	3.062473	10%	1.92	2.89
k	7	5%	2.17	3.21
		2.5%	2.43	3.51
		1%	2.73	3.9



Series: Residuals	
Sample 1989 2019	
Observations 31	
Mean	8.45e-12
Median	-4.995308
Maximum	333.8115
Minimum	-345.2953
Std. Dev.	149.7516
Skewness	0.181557
Kurtosis	3.208077
Jarque-Bera	0.226232
Probability	0.893047

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	2.574056	Prob. F(3,8)	0.1267

Heteroskedasticity Test: ARCH

F-statistic	1.532643	Prob. F(1,28)	0.2260
Obs*R-squared	1.556897	Prob. Chi-Square(1)	0.2121

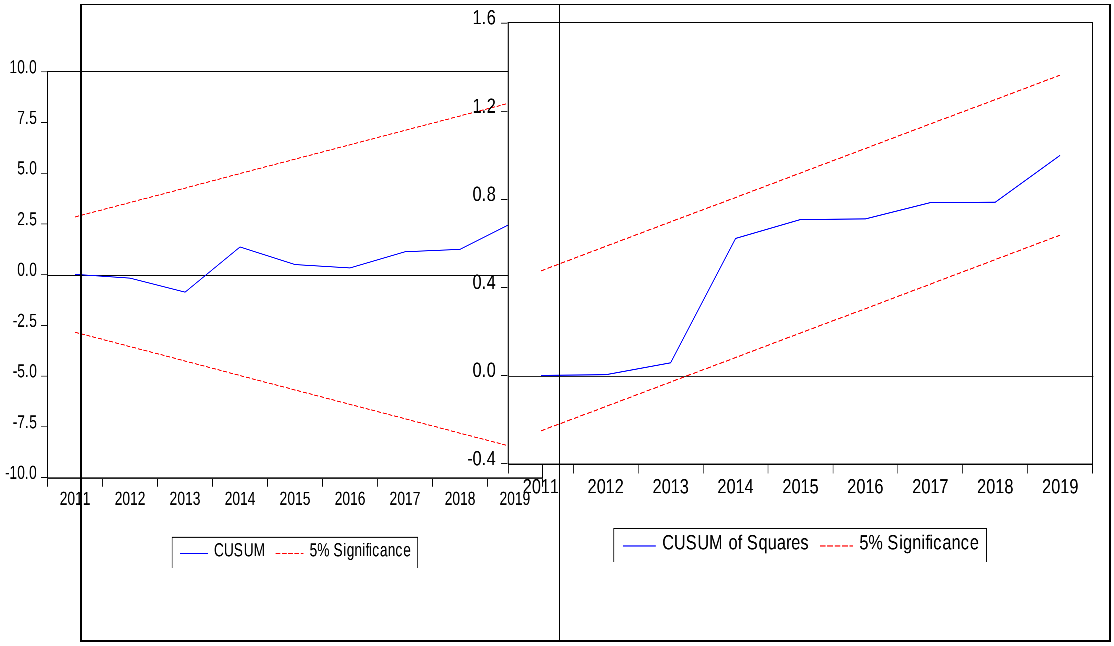
Ramsey RESET Test

Equation: UNTITLED

Specification: CR CR(-1) CR(-2) GE_NEG GE_NEG(-1) GE_POS GE_POS(-1) GE_POS(-2) GINI GINI(-1) INF INF(-1) INF(-2) PO PO(-1) PO(-2) TU TU(-1) TU(-2) UN C

Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	1.309222	10	0.2197
F-statistic	1.714063	(1, 10)	0.2197



Appendix 5. *Third Model output*

ARDL Long Run Form and Bounds Test
Dependent Variable: D(CP)
Selected Model: ARDL
Case 1: No Constant and No Trend
Date: 04/08/21 Time: 11:05
Sample: 1986 2020
Included observations: 32

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CP(-1)*	-0.218028	0.113213	-1.925825	0.0685
GE_NEG(-1)	-8.466111	3.183966	-2.658983	0.0151
GE_POS**	-0.724003	0.461463	-1.568930	0.1324
INF(-1)	3718.808	1575.440	2.360488	0.0285
PO**	-27.52235	8.509834	-3.234181	0.0042
TU**	0.006412	0.007229	0.887043	0.3856
UN(-1)	-235.8035	227.0540	-1.038535	0.3114
GINI**	-54408.78	302257.9	-0.180008	0.8590
D(GE_NEG)	-3.893842	3.188008	-1.221403	0.2361
D(INF)	7022.814	3169.887	2.215478	0.0385
D(INF(-1))	6544.879	2687.704	2.435119	0.0244
D(UN)	9.171572	221.8404	0.041343	0.9674

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation
Case 1: No Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GE_NEG	-38.83046	27.62252	-1.405754	0.1751
GE_POS	-3.320694	2.829193	-1.173725	0.2543
INF	17056.59	11385.48	1.498101	0.1497
PO	-126.2333	63.08776	-2.000916	0.0592
TU	0.029409	0.035555	0.827155	0.4179
UN	-1081.531	1250.108	-0.865150	0.3972
GINI	-249550.0	1437170.	-0.173640	0.8639

EC = CP - (-38.8305*GE_NEG -3.3207*GE_POS + 17056.5939*INF
-126.2333*PO + 0.0294*TU -1081.5306*UN -249549.9775*GINI)

F-Bounds Test	Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	1.117806	10%	1.7	2.83
k	7	5%	1.97	3.18
		2.5%	2.22	3.49
		1%	2.54	3.91

ARDL Error Correction Regression
Dependent Variable: D(CP)
Selected Model: ARDL
Case 1: No Constant and No Trend
Date: 04/08/21 Time: 10:59
Sample: 1986 2020
Included observations: 29

ECM Regression
Case 1: No Constant and No Trend

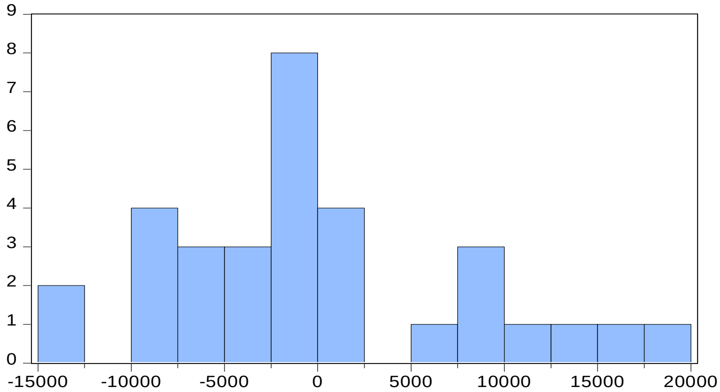
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GE_NEG)	11.37231	1.960446	5.800878	0.0102
D(GE_POS)	-5.218253	0.589761	-8.848080	0.0030
D(INF)	5841.401	1387.548	4.209874	0.0245
D(PO)	-109.1326	9.540759	-11.43856	0.0014
D(TU)	-0.041570	0.006286	-6.613319	0.0070
D(UN)	545.6151	138.2766	3.945825	0.0290
D(GINI(-1))	1949071.	269763.0	7.225123	0.0055
CointEq(-1)*	0.083028	0.006827	12.16105	0.0012

R-squared	0.982166	Mean dependent var	-1829.621
Adjusted R-squared	0.950066	S.D. dependent var	16015.28
S.E. of regression	3578.779	Akaike info criterion	19.44907
Sum squared resid	1.28E+08	Schwarz criterion	20.34488
Log likelihood	-263.0114	Hannan-Quinn criter.	19.72962
Durbin-Watson stat	2.928811		

* p-value incompatible with t-Bounds distribution.

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	5.545917	10%	1.7	2.83
k	7	5%	1.97	3.18
		2.5%	2.22	3.49
		1%	2.54	3.91



Series: Residuals	
Sample 1988 2019	
Observations 32	
Mean	67.64158
Median	-781.7716
Maximum	19908.43
Minimum	-14782.15
Std. Dev.	8283.138
Skewness	0.567030
Kurtosis	2.935466
Jarque-Bera	1.720342
Probability	0.423090

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.578447	Prob. F(2,18)	0.5709
Obs*R-squared	1.932497	Prob. Chi-Square(2)	0.3805

Heteroskedasticity Test: ARCH

F-statistic	2.719540	Prob. F(1,29)	0.1099
Obs*R-squared	2.657848	Prob. Chi-Square(1)	0.1030

Ramsey RESET Test

Equation: UNTITLED

Specification: CP CP(-1) GE_NEG GE_NEG(-1) GE_POS INF INF(-1) INF(
-2) PO TU UN UN(-1) GINI

Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	1.169223	19	0.2568
F-statistic	1.367082	(1, 19)	0.2568

Appendix 6. *Fourth Model output*

ARDL Long Run Form and Bounds Test
Dependent Variable: D(CV)
Selected Model: ARDL
Case 1: No Constant and No Trend
Date: 04/08/21   Time: 11:12
Sample: 1986 2020
Included observations: 31

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CV(-1)*	-0.656787	0.196785	-3.337584	0.0053
GE_NEG(-1)	-2.315546	0.871102	-2.658181	0.0197
GE_POS(-1)	-0.543002	0.162400	-3.343607	0.0053
INF(-1)	1584.132	501.2074	3.160632	0.0075
PO(-1)	-1.502660	3.059741	-0.491107	0.6315
TU(-1)	0.005503	0.001690	3.256738	0.0062
UN(-1)	-145.1792	57.70876	-2.515722	0.0258
GINI**	-164103.3	78911.82	-2.079578	0.0579
D(CV(-1))	1.099476	0.262762	4.184302	0.0011
D(GE_NEG)	-1.532348	0.654040	-2.342898	0.0357
D(GE_POS)	0.070373	0.199964	0.351929	0.7305
D(GE_POS(-1))	0.908162	0.275355	3.298145	0.0058
D(INF)	-472.9024	643.2388	-0.735189	0.4753
D(PO)	-7.151111	2.818709	-2.537016	0.0248

D(PO(-1))	4.811553	3.693876	1.302576	0.2153
D(TU)	0.000113	0.002631	0.042977	0.9664
D(UN)	16.81781	53.47687	0.314487	0.7581
D(UN(-1))	79.14419	47.45874	1.667642	0.1193

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation
Case 1: No Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GE_NEG	-3.525568	1.606060	-2.195167	0.0469
GE_POS	-0.826756	0.217217	-3.806135	0.0022
INF	2411.943	575.2731	4.192692	0.0011
PO	-2.287896	4.716588	-0.485074	0.6357
TU	0.008378	0.003032	2.763422	0.0161
UN	-221.0447	97.30276	-2.271721	0.0407
GINI	-249857.8	106782.8	-2.339868	0.0359

EC = CV - (-3.5256*GE_NEG -0.8268*GE_POS + 2411.9433*INF -2.2879*PO
+ 0.0084*TU -221.0447*UN -249857.7658*GINI)

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	1.458411	10%	1.7	2.83
k	7	5%	1.97	3.18
		2.5%	2.22	3.49
		1%	2.54	3.91

ARDL Error Correction Regression
Dependent Variable: D(CV)
Selected Model: ARDL
Case 4: Unrestricted Constant and Restricted Trend
Date: 04/08/21 Time: 11:14
Sample: 1986 2020
Included observations: 31

ECM Regression
Case 4: Unrestricted Constant and Restricted Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-289330.1	32033.58	-9.032087	0.0001

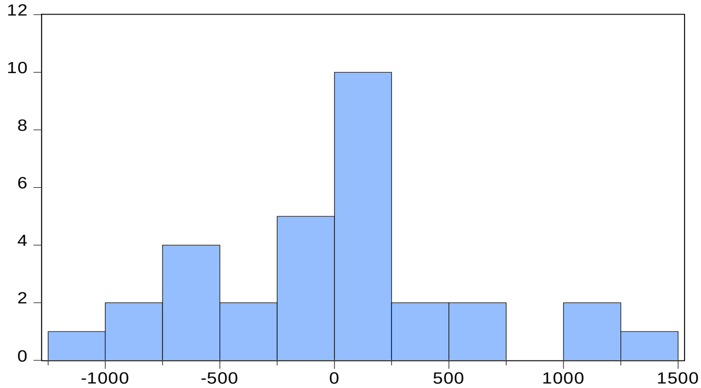
D(GE_NEG)	0.614437	0.248650	2.471093	0.0484
D(GE_POS)	-0.169603	0.066402	-2.554169	0.0432
D(INF)	636.4749	246.9853	2.576975	0.0419
D(PO)	-2.736427	1.132251	-2.416801	0.0521
D(TU)	0.008125	0.001411	5.760042	0.0012
D(UN)	69.03479	17.95916	3.843988	0.0085
CointEq(-1)*	-0.300118	0.257338	-8.938120	0.0001

R-squared	0.956819	Mean dependent var	334.3548
Adjusted R-squared	0.907470	S.D. dependent var	2754.884
S.E. of regression	838.0007	Akaike info criterion	16.60176
Sum squared resid	9831432.	Schwarz criterion	17.38814
Log likelihood	-240.3273	Hannan-Quinn criter.	16.85810
F-statistic	19.38872	Durbin-Watson stat	2.297083
Prob(F-statistic)	0.000001		

* p-value incompatible with t-Bounds distribution.

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	3.804285	10%	2.22	3.17
k	7	5%	2.5	3.5
		2.5%	2.76	3.81
		1%	3.07	4.23



Series: Residuals	
Sample 1989 2019	
Observations 31	
Mean	-1.72e-10
Median	-3.06e-10
Maximum	1471.437
Minimum	-1016.570
Std. Dev.	572.4635
Skewness	0.559856
Kurtosis	3.374380
Jarque-Bera	1.800476
Probability	0.406473

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	6.086272	Prob. F(3,3)	0.0861

Heteroskedasticity Test: ARCH

F-statistic	0.509984	Prob. F(1,28)	0.4811
Obs*R-squared	0.536637	Prob. Chi-Square(1)	0.4638

Ramsey RESET Test
Equation: UNTITLED
Specification: CV CV(-1) CV(-2) GE_NEG GE_NEG(-1) GE_NEG(-2)
GE_POS GE_POS(-1) GE_POS(-2) INF INF(-1) INF(-2) PO PO(-1) PO(
-2) TU TU(-1) TU(-2) UN UN(-1) UN(-2) GINI GINI(-1) GINI(-2) C
@TREND
Omitted Variables: Powers of fitted values from 2 to 4

	Value	df	Probability
F-statistic	8.349421	(3, 3)	0.0574