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Crime and Inflation Rates in the Philippines: A Co-integration Analysis

[1] Adrian M. Tamayo, [2] Carmelita Chavez, [3] Nestor Nabe
[1] PhD, Research and Publication Center, University of Mindanao, Davao, Philippines
[2] PhD, College of Criminal Justice, University of Mindanao, Davao, Philippines
[3] PhD, College of Criminal Justice Education, University of Mindanao, Davao, Philippines

ABSTRACT

The test of relationships of variables has been used to provide policy tool a foundation for forecast interactions. If variables were empirically determined to have close association, then a control of one variable then it will show significant effect on the other variable, thus a forecast relationship. This study aimed to establish long-run relationship between crime volume and the inflation rates. This will address the chicken-egg question, poverty leading to crime, or crime causes poverty? Or statistically, will crime rates lead to increased prices or high prices cause crime from period 2003 to 2007? The test of unit root was conducted to establish stationarity of the time-data, then a Granger-causality test for cointegration was conducted. Data were found to be stationary when integrated at order 2, I(2) as the $a_1 = 0$ for both series , the cointegration was conducted at Mixed Process of the Augmented Dickey Fuller (ADF) test of unit root with a computed value of -4.25 with an R^2=0.5237 and Durbin – Watson (DW) was 1.214. Also, findings revealed that the highest crime rate was recorded at the period the inflation rates was at the highest. Crime rates and increasing prices are cointegrated. This finding would lend support to peace and development policies. The paradigm of peace first before development or the reverse would not make any difference; it is on what the government is good at must be the first. Either peace and security first, development follows; development first, peace follows.

Keywords: *crime volume, infloation rate, development policies, co-integration*

1. INTRODUCTION

The test for relationships of variables has been used to provide policy tool a foundation for forecast interactions. Test for relationships is employed to determine whether the variables move at almost the same variation and direction. If two interest variables were empirically determined to have a close association, then, control of one variable will show significant effect on the other, thus a forecast relationship. Co-integration relationship was prevalent in showing the long run and short-run relationship of two variables. A long – run relationship suggest that the variables are co-integrated.

The use of showing relationship of two variables employs the use of co-integration. The co-integration technique which was introduced by Johansenn has attracted many economist, policy makers and financial analysts to narrow the risk of ventures or for policy control in the economy. The works of Keho (2009) [1] revealed relationship between inflation and financial development which determined the long run relationship of inflation and financial development for countries in West Africa and the Monetary Union using the autoregressive distributed lag. This is a type of test where the number or the rank of co-integration becomes trivial and making misspecification of the order of the integration not significant in the test.

An empirical test was conducted by Boulila and Trabelsi (2002) [2] using the time series of financial development and the macroeconomic development of Tunisa which included a two-period time series analysis for which a financial control was in place and when the liberalization regime occurred. Boubakari and Jin (2010) [3] used stock market and economic growth of 5 European countries to show causal relationship. The ability of the co-integration as an empirical tool was peculiarly used by Kitov, Kitov and Svetlana (2007) [4] to prove deviation from the mainstream development economic theory. They used the personal income distribution (PID) and the real per capita income as interacting variables to show the internal growth dynamic of the economy from 1960 to 1992 USA economy. Their study highlighted the erstwhile theoretical thought of the need to increase population in order to accelerate economic development.

Furthermore, as pointed out by Granger (1986) [5] and Engle and Granger (1987)[6], knowledge of co-integration is also important in view of the fact that if two economic time series are co-integrated, there must be a causal relationship in at least one direction. Co-integration is important because of the existence of co-integration which can be exploited to predict the variables in the co-integrated system with which a short-run and long-run analysis can be employed. The granger causality measures whether one thing happens before another thing and helps predict it - and nothing else. This means that the interpretation of the result of causality rest on the validity and consistency of the statistical estimates with the empirical outcome. Cheng (1999) [7] highlight the need to define causation an correlation that is, given that two variables tend to be closely associated and move together does not necessarily mean that one causes the behavior of the other variable.

Causality studies were dominantly conducted in the field of finance. The study of Cho and Ogwang (2002) [8] used the test for co-integration and granger causality between two Canadian indexes: Toronto Stock Exchange and the Canadian Venture Exchange Incorporate, which revealed that the two indexes do not have long run relationships but have a unidirectional causal relationship. A causality study was also used by Lee and Yang (2006)

[9] using the granger causality to show relation of money and income where which the money has causal relationship to income. This finding is a support to monetary economist's theory to achieve economic growth. Granger causality as tool of relationship was also employed as a forecast tool (Sorensen, 2005) [10].

The knowledge on how two variables are affected by the other, such that relationship is useful to predict likely outcome of the variables. In this case, the information that can be derived on the cointegration (co-movement) can be used by the policy – makers to tighten up system of control to stabilize economic fundamentals. The prediction that is place on the causality did not come in the same effect as ordinary forecast function, it is instead showing that the variable which was cointegrated can be helpful in prediction on the

With so many literatures showing the relationship of economic growth with other macroeconomic variables such as population, money, stocks, income index, this paper will determine the relation.

The Philippine crime rate was said to be affected by the growing population, poverty and hunger. The urbanization of cities had created slums where poverty is the highest and petty crimes nest. The communist and Muslim insurgencies compounded the problem of proliferating guns and violence. Piracy and smuggling also were thriving criminal industries, especially in the southern portions of the archipelago in addition to the Philippines being the center of drugs transshipment and trafficking. It was noted that evaluating the motive of the crime perpetrators lead into conclusion that petty crimes such as robbery, shoplifting, theft were because they cannot afford to purchase the product. Mark Easton in one of his BBC news theorizes that a 1% inflation will increase criminality by 0.02%. This is quite a very heroic assumption; after all, the relationship of increase in the prices of commodities in the economy doesn't always lead someone to commit crime. This was a supported by Coomer (2002)[11] who hypothesized that the crime causes increase in the prices of the goods (inflation due to theft). When the quality of an individual's life is increased, the marginal benefit of crime can be expected to decrease thus decreasing that individual's willingness to participate in criminal activity. Putting this, an increase in the price of goods in the market while keeping the ability of the consumer to purchase the goods being held fixed, the willingness to participate in crime increases that is, the worst effect of the high rocketing of prices of the basic needs might increase the crime rate (Camion, 2008) [12]. Thus poor people are attracted to criminal activities. A large gap in wealth indicates that there are more people with a lower income and thus more people who could possibly gain from criminal activity; the greater the disparity the more likely people are to participate in the criminal activities.

Though there were observed causal relationship between criminality and inflation, no empirical study was conducted to validate the claims using advance statistical technique like co-integration.

2. THEORETICAL FRAMEWORK

The increasing price of goods in the market causes a decrease in the purchasing ability of the consumers in the market. Less goods combination in the consumers' basket of goods is a major setback for welfare objective of an individual. It was theorized that some people might be tempted to do evil things just to survive, that is, there is a possible increase of the crime rate due to poverty today due to the continued increase of rice prices and other basic needs (Camion, 2008).

Mark Easton theorizes that a 1 percent increase in the inflation, crime rises by 0.026 percent.

This study will show relationship between inflation and crime rate, and determine.

The increase in the price of goods in the market will cause crime, that is, more people will be into robbery, theft in order to obtain the food that will keep them survive. When there is a rampant criminal activities in the market, and many individual are becoming victims of the criminals, the business will decrease their economic activity. Business will reduce their business hours, reduce production, and might lead into contracting the labor force. That is, crime causes inflation.

3. METHOD

3.1 Unit Root Test

The test for unit root is necessary in order to determine whether the series that is subject for estimate and inferences were stationary. There is suspicion that there exists a non-stationary of the time series data, caution on handling the data is necessary in order to rule out spurious regression of the series. Regression analysis can only be reliable when series are stationary. Co-integration analysis confronts spurious regression by attempting to identify conditions for which relationships are not spurious. The most common test for order of cointegration is the Augmented Dickey Fuller (ADF) test which is based on the regression given as

$$\Delta x_t = \phi_0 + \delta x_{t-1} + \sum_{i=1}^{n} \phi \Delta_{t-1} + e_t$$

Where Δ is the first – difference and, e_t is the stationary random error. The Dickey-Fuller (DF) test is based on the above equation when the right – hand side summation is deleted. The null hypothesis is that x_t is non-stationary series and is rejected when σ is significantly negative. The non-stationarity cannot be rejected for the levels of all variables except 5-percent

level based on the conventional DF and ADF test. When the data are differenced, non-stationarity can be rejected in all cases based on the DF and ADF test at 5-percent level. Therefore the estimate of co-integration equations with undifferenced data and the Granger causality and error-correction equations with first –differenced data. Some authors were saying that co-integration is achieved at the first differencing[10].

3.2 Cointegration

Co-integration theory is an innovation in theoretical econometrics that shows the relationship of economic series. The statistical theory for cointegration model indicates that the economic series behaved an I(1) processes, that is, the series seem to drift all over, then, the series seem not to drift from each other.

Co-integration was introduced by Granger and Engle [6]. The concept of co-integration is an statistical equivalent of economic equilibrium, that is defined, the components of the vector $x_t = (x_{1t} +,...,+x_{nt})'$ are said to be cointegrated of order d, b, denoted by $x_t \approx CI(d,b)$ if

a. All components of x_t are integrated of order b or d (b and d>0)
b. There exists a vector $\beta=(\beta_1, \beta_2,\ldots, \beta_n)$ such that a linear combination $\beta' x_t = \beta_1 x_{1t} + \beta_2 x_{2t} + \ldots + \beta_n x_{nt}$ is integrated of order (d,b).

The two main methodologies to test co-integration are Engle – Granger, which is base on testing the residuals of the estimated equilibrium for a unit root, and Johansen which based testing of co-integration for the rank of the π matrix.

Simple correlations help only in predicting relations between variables but to analyze the causality issue between the variables chosen in the econometric model one needs to carry out the causality tests.

3.3 Data

The crime volume data were taken from the Philippine National Police (PNP) web portal and the National Statistics Office for period January 2003 to September 2007. The inflation rate for the same period was compiled by the National Statistical Coordination Board (NSCB).

4. RESULTS AND FINDINGS

This section presents the results of the estimation.

4.1 Crime rates and Inflation Rates

Table 1 shows that the minimum occurrence of crime from January 2003 to September 2007 reported monthly was 559 which occurred on August of 2007, while the highest occurrence of crime was 1074 which occurred on February of 2005, the mean occurrence of crime over 57 months is 836 with the standard deviation of 113.59.

Inflation rate's lowest value was 2.20 which occurred on March of 2007, while the highest reported inflation value was 8.6 which occurred on June of 2005, with the mean of 5.34 with standard deviation of 2.09.

It is good to note that the lowest crime volume corresponds to the year on which the inflation rate's lowest value occurred, in the same manner that the highest occurrence of crime occurred on the year when the inflation rate was high, though there was an observed lag period of occurrence. This leads into suspicion that the two are integrated in the long – run.

Table 1: Descriptive Statistics of Crime Volume and Inflation for period January 2003 to September 2007

Variables	Number of Observations	Minimum	Maximum	Mean	Standard Deviation
Crime volume	57	559	1074	836.42	113.95
	57	2.20	8.6	5.34	2.09

4.2 Relationship of Crime Volume and Inflation Rate

Table 2 shows the relationship of crime volume and inflation rate employing the correlation test Pearson r. The test revealed a strong positive correlation between crime volume and inflation rate, 0.724 correlation value. This implies that an increase in the inflation value will also change the crime volume in the same direction.

Table 2: Relationship of crime volume and inflation

Variables	Inflation rate
Crime volume	.724(**)

4.3 Test for Cointegration

Test for integration of the two series reveal that there is a presence for unit root. The test proceeded ton vert the series stationary and revealed that the series was integrated at order 2, I(2). Table 3 reveals the test for unit root using the Dickey Fuller (DF) test.

Since the $a_1 = 0$ for both series, there is no unit root (see red values on table 3), then test for co-integration is done on "No constant, No Trend" model that is a "Mixed Process of the Augmented Dickey Fuller (ADF) to test the unit root.

The R^2 value is 0.5237 indicating a moderate relationship of co-integration, while the Durbin – Watson (DW) is 1.214. It was said that when series are co-integrated the R^2 is high and the DW is farther from zero.

Comparing the R^2 when series was not differenced (table 1) and when the series was differenced revealed a significant difference. The undifferenced test revealed a high relationship (R^2=0.72) of the two series while the differenced test revealed a moderate relationship (R^2=0.52).

5. CONCLUSION

The study able to establish the serial relationship of crime and inflation rate as when the lowest of crime incidence recorded, the smallest inflation rate was also observed. Also, it was also observed that the highest crime occurred when the inflation rate was high.

The time-series test revealed that crime rates and inflation rates are stationary in order of differencing equal to two. This is interesting because although the two series were observed to be correlated, yet the order of co-integration is established at a higher differencing order indicating gradual impact of one variable to the other. Thus, any effort to reduce crime incidence does not immediately lead to an increased confidence in peace and security, and thus slower market activities. On the other hand, efforts to improve market activities do not necessarily lead to increased criminal activities. But note, that over time, both will integrate.

Then test for co-integration was done on the ADF test on "No constant, No Trend which revealed a computed value of -4.2490 which was lower than the critical value of -3.50, therefore, the null hypothesis is rejected and conclude that the two series are co-integrated. This suggests that the inflation rate is useful to predict the changes occurring in the crime volume.

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Table 3: Dickey – Fuller (DF) test for unit root at Integrated Order 2, I (2)

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              2
VARIABLE : (1-B)  LCRIME
DICKEY-FULLER TESTS - NO.LAGS =   2   NO.OBS =   51

   NULL            TEST      ASY. CRITICAL
 HYPOTHESIS        STATISTIC     VALUE 10%
-------------------------------------------------------------------------
CONSTANT, NO TREND
A(1)=0  T-TEST      -7.0689     -2.57
A(0)=A(1)=0         24.985      3.78
                              AIC =    -4.003
                               SC =    -3.851
-------------------------------------------------------------------------
CONSTANT, TREND
A(1)=0  T-TEST      -6.9900     -3.13
A(0)=A(1)=A(2)=0     16.333      4.03
A(1)=A(2)=0         24.498      5.34                    No Constant, No trend
                              AIC =    -3.965
                               SC =    -3.775
-------------------------------------------------------------------------

              2
VARIABLE : (1-B)  INF
DICKEY-FULLER TESTS - NO.LAGS =   4   NO.OBS =   49

   NULL            TEST      ASY. CRITICAL
 HYPOTHESIS        STATISTIC     VALUE 10%
-------------------------------------------------------------------------
CONSTANT, NO TREND
A(1)=0  T-TEST      -4.0988     -2.57
A(0)=A(1)=0         8.4247      3.78
                              AIC =    -1.704
                               SC =    -1.472
-------------------------------------------------------------------------
CONSTANT, TREND
A(1)=0  T-TEST      -4.0621     -3.13
A(0)=A(1)=A(2)=0     5.5169      4.03
A(1)=A(2)=0         8.2513      5.34 No Constant, No trend
                              AIC =    -1.665
                               SC =    -1.395
-------------------------------------------------------------------------
```

Table 4: Test for Cointegration Using Engle-Granger Test of Residuals

REGRESSAND : CRIME

R-SQUARE = 0.5237 DURBIN-WATSON = 1.214

DICKEY-FULLER TESTS ON RESIDUALS - NO.LAGS = 4 M = 2

	TEST STATISTIC	ASY. CRITICAL VALUE 10%
NO CONSTANT, NO TREND		
T-TEST	-2.0645	-3.04
	AIC =	8.691
	SC =	8.881

COINTEGRATING REGRESSION - CONSTANT, TREND NO.OBS = 56

REGRESSAND : CRIME

R-SQUARE = 0.6541 DURBIN-WATSON = 1.668

DICKEY-FULLER TESTS ON RESIDUALS - NO.LAGS = 4 M = 2

	TEST STATISTIC	ASY. CRITICAL VALUE 10%
NO CONSTANT, NO TREND		
T-TEST	-4.2490	-3.50
	AIC =	8.439
	SC =	8.628