Crime and economic conditions in Malaysia: An ARDL Bounds Testing Approach

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CRIME AND ECONOMIC CONDITIONS IN MALAYSIA: AN ARDL BOUNDS TESTING APPROACH

by

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ABSTRACT

Economists recognized that economic conditions have an impact on crime activities. In this study we employed the Autoregressive Distributed Lag (ARDL) bounds testing procedure to analyze the impact of economic conditions on various categories of criminal activities in Malaysia for the period 1973-2003. Real gross national product was used as proxy for economic conditions in Malaysia. Our results indicate that murder, armed robbery, rape, assault, daylight burglary and motorcycle theft exhibit long-run relationships with economic conditions, and the causal effect in all cases runs from economic conditions to crime rates and not *vice versa*. In the long-run, strong economic performances have a positive impact on murder, rape, assault, daylight burglary and motorcycle theft, while on the other hand, economic conditions have negative impact on armed robbery.

I. INTRODUCTION

Crime results in the loss of property, lives and misery. In the United States, Freeman (1996) estimates the total cost due to crime in 1995 is about 2 percent of GDP and another 2 percent of GDP is allotted to crime control activities. Recognizing the importance of deterring crime, Freeman (1996) notes that the state of California spent more on prisons than on higher education whereby the budget allocated to spending on prisons rose from 2 percent in 1980 to 9.9 percent in 1995 compared to spending on higher education which shrunk for 12.6 percent in 1980 to 9.5 percent in 1995.

Malaysia is no exception to crime offenders. The phenomenon of crime wave has received an increasing attention and the criminal activity has been given wide coverage in the newspaper and media. Despite this alarming event, Malaysia's criminal activity has received little attention and remains largely neglected by the economics of crime literature originally proposed by Becker (1968) and Ehrlich (1973). Thus, the purpose of the present study is to fill this gap in the literature by providing some empirical evidence on the link between economic conditions and the crime rates in a developing economy, Malaysia.

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The paper is organized as follows. In the next section we discuss some evidence on the effect of economic conditions on criminal activity. In section 3, we present the unit root, cointegration and *Granger* causality tests in the ARDL bounds testing framework used in the study. In section 4, we discuss the empirical results and the last section contains our conclusion.

II. A REVIEW OF RELATED LITERATURE

The seminal paper by Becker (1968) has resulted in the proliferation of numerous studies on the economics of crime. In his theoretical paper, Becker (1968) assumes that criminals are rational and utility maximizing individuals and therefore, contended that an individual will decide whether to engage in crime by comparing the benefits and costs of committing crime. When deciding whether to commit crimes they will compare the expected costs of being caught and punished to the expected rewards of criminal behaviour. Thus, Becker (1968) emphasizes on how changes in the probability and severity of punishment can alter the individual's decisions to commit crime. Later, Ehrlich (1973) extend Becker's crime model by including the role of opportunity cost between illegal and legal work. If legal income opportunities become scarce relative to potential gains from crime, the Becker-Ehrlich model predicts that crime will become more frequent. In other words, when opportunity cost in illegal activity is low, individual will turn into criminal as the payoffs is greater.

In numerous studies on economic factors on crime, economic condition seems to be one of the most important macroeconomic variables affecting crime. Economic adversity as a result of recession would encourage criminal activity. According to the economic models of crime such as Becker (1968), when a nation's economy becomes stronger, improvements in legitimate labour market opportunities make crime relatively less attractive. A study using panel data by Fajnzylber *et al.* (2002) on 15 industrialized, 11 Latin American and the Caribbean, 4 Eastern Europe, 3 Middle East, and 12 Asian countries, found that an increase in GDP per capita is associated with a significant fall in the robbery rate. This result support the view that economic conditions related to the economic cycles, such as employment opportunities and salaries in legal activities, have a strong impact on the incidence of crime. Other studies support that improving economic conditions will result in a fall in the level of criminal activity include Pyle and Deadman (1994), Deadman and Pyle (1997), Hale (1998) and Masih and Masih (1996).

On the other hand, strong economic performances may induce criminal activities. The level and growth of economic activity in a society create attractive opportunities for employment and investment and as a result increase their wealth, but the increase in the size of individual's wealth will portray potential loot from crime will also rises. According to Ehrlich (1973), greater wealth means a higher level of transferable assets in the community and, thus, more lucrative targets for potential criminals. Therefore, a positive coefficient between wealth and crime would support the interpretation of wealth measures as indicators of illegal income opportunities. Study by Scorcu and Cellini (1998) support the positive relationship between financial wealth and crime in Italy, however, the relationship is weak as a result of the dominant impact of unemployment and consumption expenditure.

III. SOME STYLISED FACTS ON CRIME RATES IN MALAYSIA

Table 1 illustrates the crime statistics by twelve categories of crime in Malaysia for the period 1973-2003. In the table we sub-classify the period into 1973-82, 1983-92, and 1993-2003. In columns 2-4, we present the average number of cases, and in columns 5-7 is the average growth rates in crime cases, and the last three columns represent the average share of criminal activities in total crime. Total crime include both violent and property crimes. While murder, attempted murder, armed robbery, robbery, rape and assault constitute violent crime, property crime consisted of daylight burglary, night burglary, lorry-van theft, car theft, motorcycle theft and larceny.

As indicated in Table 1, the average number of all crime cases has been on an increasing trend. For the past three decades, the quantum of crime cases has shown an upward trend for all crime categories except for a brief dropped in number of cases for attempted murder for the period of 1983-92, and armed robbery in the period 1992-2003. In all three periods, property crime represented more than 80 percent of all crime recorded (see columns 8-10). The main contributor to property crime is larceny and followed by motorcycle theft and night burglary. Although the share of larceny and night burglary to total crime is on a decreasing trend, the share of motorcycle thefts is increasing. The share of motorcycle thefts has increased from 8 percent in 1973-82, to 15 percent in 1983-92 and 24 percent in 1993-2003 periods. As for other crime category, the share to total crime has been sustained.

In Table 1, from columns 5-7, we observed that the average percentage growth rate of all crime categories for the period 1983-92 suggests that the growth in the number of cases is slowing down compared to the previous period. Except for murder and lorry-van theft, all category of crime has been slower despite their higher quantum in 1982-93 compared to 1973-82 periods. However, for the period 1992-2003, we experienced higher growth rates in all crime categories except for murder and armed robbery, which show an average growth of 3.2 percent and –1.9 percent respectively.

III. METHODOLOGY

To implement the bounds testing procedure, we estimate the following conditional ARDL unrestricted error-correction model as follows

$$\Delta crime_t = \alpha_0 + \beta_1 crime_{t-1} + \beta_2 rgnp_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta crime_{t-i} + \sum_{j=0}^{q} \theta_j \Delta rgnp_{t-j} + \varepsilon_t \quad (1)$$

where α is a constant term and ε_t is the disturbance term. According to Pesaran et al. (2001), an *F*-test for the joint significance of the coefficients of the lagged levels in the above equation, that is, $H_0: \beta_1 = \beta_2 = 0$, are employed to bounds test for the existence of a long-run relationship between crime and rgnp.

The asymptotic distribution of critical values is obtained for cases in which all regressors are purely *I*(1) as well as when the regressors are purely *I*(0) or mutually cointegrated. Because the critical value of the test depends on the order of integration of the variables, *I*(*d*), where $0 \leq d \leq 1$, the test utilizes a critical range such that values exceeding the range are evidence of rejection, values less than the range are evidence of non-rejection, and values within the range are inconclusive. In other words, if the test statistics exceed their respective upper critical values (assuming purely $I(1)$ regressors) we can conclude that a long-run relationship exists. If the test statistics fall below the lower critical values (assuming the regressors are $I(0)$) we cannot reject the null hypothesis of no cointegration. Inconclusive results achieved when the test statistics fall within their respective bounds. Further, if $\beta_1 < 0$, the long-run relationship between crime and rgnp is stable.

The conditional long-run model for $crime_t$ can be obtained from the reduced form of Equation (1), when $\Delta crime = \Delta rgnp = 0$:

$$crime_t = \Psi_0 + \Psi_1 rgnp_t + \mu_t \tag{2}$$

where $\Psi_0 = -\alpha_0/\beta_1$, $\Psi_1 = -\beta_2/\beta_1$, and μ_t are white noise. In this study we estimate the long-run coefficients, Ψ_1 ,using OLS since the existence of cointegration between the two variables of interest eliminates the problem of spurious regression results, and furthermore the estimates are super-consistent. To check the robustness of the OLS estimates, we also utilized the dynamic OLS (DOLS) procedure proposed by Stock and Watson (1993). According to Stock and Watson, the DOLS is robust in small sample and it is a parametric approach for estimating long-run equilibrium in systems which may involve variables integrated of different orders but still cointegrated. The potential of simultaneity bias and small sample bias among the regressors is dealt with by the inclusion of lagged and led values of the change in the regressors.

In this study, in estimating the long-run parameters of Equation (2), the DOLS involves regressing any $I(1)$ variables on other $I(1)$ variables, any $I(0)$ variables and leads and lags of the first differences of any $I(1)$ variables as follows;

$$crime_t = \alpha_0 + \alpha_1 rgnp_t + \alpha_2 \Delta rgnp_t + \alpha_3 \Delta rgnp_{t-1} + \alpha_4 \Delta rgnp_{t+1} + \mu_t \tag{3}$$

Parameter α_1 is the long-run elasticity.

Sources of Data

Data on crime and their subcategories for the period 1973 to 2003 are collected from the Royal Police of Malaysia (PDRM). The total crime activities are classified into 12 categories: murder, attempted murder, armed robbery, robbery, rape and assault (these comprise the violent crime); daylight burglary, night burglary, lorry-van theft, car theft, motorcycle theft and larceny (comprises the property crime). For the measure of economic conditions in Malaysia, real GNP per capita (rgnp) was used as a proxy. The variable, rgnp was computed by dividing nominal GNP with consumer price index and total population. All data series were collected from various issues of the International Financial Statistics published by the International Monetary Fund. Throughout the analysis, all variables were transformed into natural logarithm.

IV. THE EMPIRICAL RESULTS

Before testing for cointegration by using the ARDL bounds testing procedure, we test for the order of integration for all categories of crime and the economic condition variables. Table 2 show the results of the unit root test for the test of the order of integration of the economic time series under investigation. Clearly the augmented Dickey-Fuller test (Dickey and Fuller, 1981) statistics indicate that all categories of crime and rgnp economic series in Malaysia are difference stationary, in other words, they are $I(1)$ in levels.

Having noted that all series are of the same order of integration, that is they are all $I(1)$ processes, our relevant critical values are the upper bound of purely $I(1)$ regressors. These results are tabulated in Table 3. When crime is used as the dependent variable, the null hypothesis of no cointegration can be rejected in the cases of murder, armed robbery, rape, assault, daylight burglary and motorcycle theft. On the other hand, when economic condition is used as the dependent variable, in all cases the null hypothesis of no cointegration cannot be rejected at least at the 10 percent level. Both these results suggest that there are long-run relationships between rgnp and the crime variable, namely; murder, armed robbery, rape, assault, daylight burglary and motorcycle theft. Further, these results also suggest that the causal direction runs from economic condition to criminal activity and not *vice versa*. This implies that rgnp as a measure of economic condition is exogenous and thus is useful for the purpose as policy variable.

In Table 4 we report the long-run elasticities and the short-run elasticities in Panels A and B respectively. First, in all cases except for armed robbery, the long-run relationship between economic conditions and murder, rape, assault, daylight burglary and motorcycle theft are positive. Results from both estimators, OLS and DOLS give similar size and sign of the parameters. In other words, in a strong economic performances criminal activities with respect to murder, rape, assault, daylight burglary and motorcycle theft will rises in Malaysia. Higher economic growth means higher income and an increase of accumulated wealth of the population. But the increase in the size of individual's wealth will portray potential loot from crime will also rises. As pointed by Ehrlich (1973), greater wealth means a higher level of transferable assets in the community and, thus, more lucrative targets for potential criminals. However, strong economic performance lead to a reduction of crime involving armed robbery in Malaysia in the long-run. On other hand, in the short-run, Panel B in Table 4 indicates that strong economic conditions result only in the reduction of motorcycle theft.

V. CONCLUSION

This study considered a bivariate analysis between the impact of real gross national product per capita as measure of economic conditions on fifteen categories of crime, in Malaysia namely; total crime, violent, murder, attempted murder, armed robbery, robbery, rape, assault, property, daylight burglary, night burglary, lorry-van theft, car theft, motorcycle theft and larceny. In this study we employed the autoregressive distributed lag (ARDL) bounds testing procedure to investigate the long-run relationship between economic conditions variable and criminal activity using annual data for the period 1973 to 2003.

The results suggest that real GNP per capita and all categories of crime are non-stationary variables and achieved stationarity after first differencing. The cointegration analysis using the ARDL bounds testing approach indicate that murder, armed robbery, rape, assault, daylight burglary and motorcycle theft are cointegrated with economic conditions measured by real GNP per capita. The presence of cointegration between these variables tends to suggest they are bound together by common trends or long-run relationships. According to Masih and Masih (1996), although these cointegrated variables will have short-run or transitory deviations (or departures) from their long-run common trends, eventually forces will be set in motion which will drive them together again.

Another important finding of this study is that the causal effect in all cases runs from economic conditions to crime. Important implication of this result is that real GNP per capita is an exogenous variable and it is therefore useful for fiscal policy variable.

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Table 2: Results of ADF unit root test

Crime rate category	Level (Intercept and Trend)	First difference (Intercept)
Crime:	-2.35	-3.24
	[0.39]	[0.02]
Violent:	-2.75	-3.71
	[0.22]	[0]
Murder	-3.56	-4.69
	[0.05]	[0]
Attempted murder	-2.20	-4.49
	[0.46]	[0]
Armed robbery	-2.32	-4.48
	[0.40]	[0]
Robbery	-2.17	-3.47
	[0.48]	[0.01]
Rape	-3.31	-4.97
	[0.08]	[0]
Assault	-2.87	-3.21
	[0.18]	[0.02]
Property:	-2.29	-3.19
	[0.42]	[0.03]
Daylight Burglary	-3.31	-3.20
	[0.08]	[0.03]
Night Burglary	-3.06	-3.71
	[0.13]	[0]
Lorry-van theft	-2.41	-4.25
	[0.36]	[0]
Car theft	-2.01	-3.39
	[0.56]	[0.01]
Motorcycle theft	-2.19	-3.00
	[0.47]	[0.04]
Larceny	-2.38	-3.34
	[0.37]	[0.02]
Rgnp	-2.63	-4.99
	[0.26]	[0.00]

Notes: All unit root estimations were done using Eviews. Eviews select lag 1 as default and were used throughout the analysis. The square brackets. [.].contain the *p-values*.

Table 3: Bounds test results for long-run relationship

Critical value bounds of the *F*-statistic: intercept and no trend						
	90% level		95% level		99% level	
T	*I*(0)	*I*(1)	*I*(0)	*I*(1)	*I*(0)	*I*(1)
29	3.303	3.797	4.090	4.663	6.027	6.760

Calculated *F*-statistic:		
Types of crime	$F_{crime}(Crime\|rgnp)$	$F_{rgnp}(rgnp\|crime)$
Crime:	2.376	0.729
Violent:	3.734	1.048
Murder	5.275**	0.676
Attempted murder	2.161	0.684
Armed robbery	4.040*	0.699
Robbery	2.203	1.088
Rape	7.829***	0.772
Assault	4.235*	0.734
Property:	2.243	0.699
Daylight Burglary	5.170**	1.013
Night Burglary	3.594	1.554
Lorry-van theft	1.889	1.168
Car theft	2.356	0.717
Motorcycle theft	4.404*	0.711
Larceny	2.453	0.503

Notes: Asterisks (*), (**) and (***) denote statistically significant at the 10%, 5% and 15 level. Critical values are taken from Narayanan (2005).

Table 4: Long-run and short-run elasticities

Panel A: Long-run elasticities				
Dependent variable: $crime_t$				
Independent variable:	OLS: Constant	$rgnp_t$	DOLS: Constant	$rgnp_t$
Murder	-0.2860 (1.0400)	0.1478 (3.6292)*	-0.1543 (0.5187)	0.1342 (3.2586)*
Armed robbery	3.9003 (5.4643)*	-0.3679 (3.6198)*	3.9986 (6.1794)*	-3.3532 (3.9431)*
Rape	-2.8302 (8.9776)*	0.5997 (13.357)*	-2.7454 (9.3995)*	0.5977 (14.781)*
Assault	0.8481 (2.2200)*	0.2762 (5.0769)*	1.0738 (2.8748)*	0.2592 (5.0131)*
Daylight burglary	2.9627 (5.6598)*	0.0590 (0.7921)	3.0520 (5.5804)*	0.0607 (0.8019)
Motorcycle theft	-1.7720 (2.2199)*	0.8776 (7.7199)*	-0.5961 (0.9692)	0.7570 (8.8903)*

Panel B: Short-run elasticities			
Dependent variable: $\Delta crime_t$			
Independent variable:	Constant	$\Delta rgnp_t$	ecm_{t-1}
Murder	0.0436 (1.5839)	-0.5808 (1.7643)	-0.6678 (3.8307)*
Armed robbery	0.0290 (0.4586)	-1.1624 (1.5375)	-0.3969 (2.3023)*
Rape	0.0583 (2.2159)*	-0.3803 (1.2054)	-0.4650 (3.0585)*
Assault	0.0104 (0.3168)	0.0601 (0.1484)	-0.3384 (2.0717)*
Daylight burglary	0.0047 (0.1163)	0.1156 (0.2329)	-0.3006 (2.0872)*
Motorcycle theft	0.1126 (3.3185)*	-0.8700 (2.1089)*	-0.2001 (2.5296)*

Notes: Asterisk (*) denotes statistically significant at 5% level. Regression equations in Panel B are run using OLS.

Table 1: Descriptive statistics on criminal activities in Malaysia, 1973-2003

Crime category	Average number of cases			Average growth rates in crime cases in percentage			Average share of criminal activities to total crime		
	1973-82	1983-92	1993-2003	1974-82	1983-92	1993-2003	1973-82	1983-92	1993-2003
Crime:	62638	77262	127550	6.4	1.2	8.2	100	100	100
Violent:	6023	10102	17065	10.1	4.1	8.1	9.49	13.10	13.45
Murder	240	348	514	4.0	7.2	3.2	0.39	0.46	0.42
Attempted murder	64	45	55	4.5	4.2	12.2	0.10	0.06	0.05
Armed robbery	503	817	687	12.6	3.8	-1.9	0.81	1.05	0.61
Robbery	3220	5758	10179	14.6	4.0	10.5	5.01	7.42	7.81
Rape	324	607	1258	8.2	5.5	6.9	0.52	0.80	1.03
Assault	1673	2526	4372	6.4	4.3	5.8	2.66	3.31	3.53
Property:	56616	67160	110485	6.1	0.8	8.2	90.51	86.90	86.55
Daylight Burglary	3634	4445	7062	8.6	3.2	4.9	5.69	5.79	5.76
Night Burglary	12395	16711	20331	10.8	0.5	3.7	19.57	21.58	16.83
Lorry-van theft	167	576	2781	16.4	16.6	18.2	0.26	0.77	2.04
Car theft	1168	2918	5243	15.5	6.1	11.4	1.83	3.77	3.95
Motorcycle theft	5342	11635	32696	15.2	4.4	15.4	8.37	14.99	24.49
Larceny	33911	30876	42372	2.9	-0.7	6.0	54.78	40.00	33.49

Notes: Authors' calculation.