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The Linkages among Inflation, Unemployment and Crime Rates in Malaysia

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ABSTRACT

This paper attempts to examine the linkages among inflation, unemployment and crime rates in Malaysia. The sample period covered annual data from 1970 to 2006. The Bartlett corrected trace test proposed by Johansen (2002) was employed as being appropriate for small sample study. The corrected trace test affirmed the existence of long run equilibrium relationship between crime rate and its determinants. The estimated cointegrating vector revealed that inflation and unemployment are positively related to crime rate. However, inflation is not significant in the short run. Finally, the empirical evidence suggests that the causality direction is running from inflation and unemployment to crime, but there is no evidence of reverse causality.

Keywords: Bartlett Corrected Trace Test, Crime, Inflation and Unemployment.

INTRODUCTION

In a world of increasing crime, the policymakers and the criminologists have focused much on crime prevention. Furthermore, the Association of Southeast Asia Nations (ASEAN) has been fostering international cooperation to combat transnational crime in the region (Pushpanathan, 1999). UNODC (2005) report stated that crime was both the cause and consequence of poverty, insecurity and under-development, thus crime has been a major concern for many country's policymakers including Malaysia. Over the past decades, crime rates in Malaysia increased tremendously. In view of crime statistics in Table 1, the violent crime and property crime showed

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an increasing trend since 1970. In addition, the statistics compiled by the Royal Malaysian Police (RMP) department indicate that Malaysia had more than 167,000 cases of crime occurred in 2000 and approximately 70 per cent of the cases are still pending in that particular year. The criminal cases in Malaysia further increased to 198,622 cases in 2006 (see Table 1). In other words, 22 criminal cases occurred at every hour in Malaysia at year 2006.

Table 1 Case of crime in Malaysia (1970 to 2006)

Year	Violent Crime	Property Crime	Total Crime
1970	2,701	24,106	26,807
1975	5,467	57,695	63,162
1980	7,474	66,221	73,695
1985	11,476	82,481	93,957
1990	9,696	68,566	78,262
1995	15,252	87,007	102,259
2000	21,604	145,569	167,173
2005	22,133	135,326	157,459
2006	42,343	156,279	198,622

Source: The figures are obtained from Social Statistics Bulletin Malaysia, United Nation Survey on Crime Trends and the Operations of Criminal Justice Systems[2] and Royal Malaysian Police[3]. Total crime is the violent crime added to the property crime.

With respect to the question of increasing crime trend, Ohashi (2004) reports that the RMP department is under-staffed and under-equipped. Moreover, the police forces are also inappropriately distributed among the States in Malaysia. Therefore, even more police officers they still fail to manage the criminal cases in Malaysia. This is consistent with the findings of Meera and Jayakumar (1995), who find that more police force will lead to more crime. Of course, from the international standard the criminal cases in Malaysia is relatively low and still manageable compared to high crime economies like Colombia, Mexico and Estonia. However, the increasing trend of crime in Malaysia has heightened the public awareness and has created an urgency to tackle this problem.

Therefore, it is of paramount importance for this study to shed some light to the policymakers in formulating policies to reduce crime rate in Malaysia. In the literatures, the issue of increasing crime rates is often linked to unemployment. However, unemployment can have both positive and negative effects on crime

[2] https://www2.unodc.org/unodc/en/data-and-analysis/United-Nations-Surveys-on-Crime-Trends-and-the-Operations-of-Criminal-Justice-Systems.html

[3] http://www.rmp.gov.my

through the increasing criminal motivations (Becker, 1968), and the reducing criminal opportunities effects (Cantor and Land, 1985), respectively. Becker (1968) postulates that unemployment is positively related to crime because when individual is unemployed, the marginal return from legitimate earning activities is lower than before and hence one is more likely to engage in criminal activities. On the other hand, Cantor and Land (1985) argue that unemployment is negatively related to crime because when people are unemployed, the expenditure on property and luxury goods reduced. Furthermore, they prefer to be at home or close neighbourhood. As a result, they may have more protection to their property and hence the crime incidence will reduce. In addition to that, Cantor and Land (1985; 2001), and Greenberg (2001) show that the opportunity effect should be instantaneous or short run phenomenon while the motivational effects are likely to be a long run criminal effect because most workers have savings and welfare benefit to sustain them for a time after they loss their job (see also Paternoster and Bushway, 2001).

Masih and Masih (1996), and Narayan and Smyth (2004) argue that unemployment rate is not an important determinant of crime in Australia because the Granger causality test tends to show neutrality causal effect results. Carmichael and Ward (2001) examine the relationship between male (i.e. adult and young) unemployment and crime in Britain from 1989 to 1996. They find that male unemployment is the most influencing factor to the crime rate in Britain. Furthermore, they claim that most of the crimes in Britain are positively related to male unemployment regardless of age structure. On the contrary, Messner *et al.* (2001) find that unemployment rate is negatively related to crime in the United States and the coefficients are statistically significant at the conventional level (1 and 5 per cents, respectively). Recently, Tang and Lean (2007a) conduct a study with the United States data from 1960 to 2006. They find that inflation and unemployment rates are two important determinants of crime in the United States. They demonstrate that both the positive motivation effect and the negative opportunity effect exist in the United States. The study also shows that, in the short run unemployment rate is negatively related to crime rate and this is consistent with the finding of Messner *et al.* (2001); but the relationship has shifted to positive in the long run. Besides, their study indicates that inflation rate is positively related to crime rate in both the short run and the long run.

As far as Malaysia is concerned, empirical study on crime rate is relatively few. Meera and Jayakumar (1995) employ the simultaneous equation approach to estimate the crime function for Malaysia. They find that crimes in Malaysia are influenced by three categories of determinants; namely (1) deterrence and punishment; (2) economic or incentive of crime; and (3) socio-demographic. Consistent with the notions of criminal motivational effect, they find that the effect of unemployment on crime rates in Malaysia is positive and statistically significant at 5 per cent level. Nevertheless, this study does not take into consideration of the time series properties, thus the regression results produced by Meera and Jayakumar

(1995) may be spurious if the estimated variables are non-stationary (see Granger and Newbold, 1974; Phillips, 1986). Next, Habibullah and Law (2007) examine the linkages between crime rates and financial determinants (e.g. real per capita income, financial wealth and lending rate) in Malaysia over the period of 1973 to 2003. They find that crime rate and its determinants are cointegrated. However, the variance decomposition analysis result suggests that criminal activity in Malaysia is not explained by the macro-financial determinants incorporated. This contrary evidence may due to the omission of relevant variables such as inflation and unemployment. Thus, their empirical results should be accepted with caution.

Additionally, many studies on crime have merely focused on the effect of unemployment (Masih and Masih, 1996; Carmichael and Ward, 2001; Narayan and Smyth, 2004 etc.), but omitted the relevant variable – inflation that played an important role in explaining the change of crime rate. Consequently, these studies may lose valuable information and cause the mis-specification problem. Several studies have observed the crucial effect of inflation on crime (e.g. Curtis, 1981; Ralston, 1999; Teles, 2004; Tang and Lean, 2007a), they find that inflation reduces the purchasing power and increases the cost of living. Hence, crime rate may increase when an individual is unable to maintain their standard of living as before. Moreover, Tang and Lean (2007a) added that this is not an immediate phenomenon because it takes time for inflation to gradually 'reduce' the purchasing power.

The motivation of this study is initiated by the need for a further empirical work to overcome the shortcoming from the above studies. The objective of this study is to examine the linkages among inflation, unemployment and crime rates in Malaysia. This study extends the famous unemployment-crime (U-C) model specification by introducing a variable – inflation that has not been considered by the previous studies in Malaysia. The introduction of inflation into the determinants of unemployment-crime specification may avoid the mis-specification problem and may shed some light on the implication of using inflation and unemployment rate as a policy instrument to reduce crime rate in Malaysia. Moreover, this study also addresses the issue of small sample by using the Johansen (2002) cointegration test to avoid the small sample biased or the size distortion problem. Furthermore, the modified Wald (MWALD) test proposed by Toda and Yamamoto (1995), and Dolado and Lütkepohl (1996) is used to ascertain the causal links between crime rate and its determinants.

The remainder of this paper is organised as follows. In Section 2, we briefly discuss the data and methodology used in this study. The empirical results are reported in Section 3 and Section 4 concludes.

DATA AND METHODOLOGY

This study uses annual data of crime rate, consumer price index (CPI = 2000) and unemployment rate from 1970 to 2006 in Malaysia. The data were extracted

from *International Financial Statistics* (IFS), Malaysian Economic Report, United Nations Crime and Justice Information Network (UNCJIN), Euromonitor International, and the Royal Malaysian Police reports.

The time series property of the series is crucial for cointegration and causality analyses. Nelson and Plosser (1982) argue that most of the macroeconomic series are non-stationary at level, but stationary after first differencing. If the estimated variables are non-stationary, the regression results with these non-stationary variables will be spurious (see Granger & Newbold, 1974). Therefore, it is essential to determine the stationarity and the order of integration, $I(d)$ of each series to avoid the spurious regression phenomenon. In this study, we employed both Augmented Dickey-Fuller (ADF) and Phillips-Perrons (PP) procedures to test for stationarity. Both tests will use the model that allows for a constant and deterministic trend. The results of these unit root tests are presented in Table 2.

Table 2 The results of unit root tests

Variables	Test statistics	
	ADF	**PP**
Level:		
ln CR_t	–2.943 (2)	–1.911 (3)
ln CPI_t	–3.142 (1)	–1.658 (9)
UR_t	–1.828 (0)	–2.188 (3)
First Difference:		
Δ ln CR_t	–2.193 (1)	–4.656 (2)*
Δ ln CPI_t	–3.364 (4)***	–4.017 (3)**
Δ UR_t	–5.219 (0)*	–5.175 (3)*

Note: The asterisks *, ** and *** denote the significance at 1 per cent, 5 per cent and 10 per cent levels, respectively. ADF is the augmented Dickey-Fuller test (Dickey and Fuller, 1979) and PP is the Phillips-Perron test (Phillips and Perron, 1988). ln denotes as natural logarithm. Both tests will use the model that allows for a constant and deterministic trend. Figure in the parentheses indicate the optimal lag length for ADF test and bandwidth for PP test. The optimal lag length and bandwidth are selected by Akaike's information criterion (AIC) and Newey-West Bartlett kernel. The critical values are obtained from MacKinnon (1996) for the ADF and the PP tests. Both the ADF and the PP tests examine the null hypothesis of a unit root against the alternative hypothesis stationarity.

The ADF test shows that all the variables are integrated of order one, $I(1)$, except is non-stationary after first differencing. On the other hand, PP test show that all variables are non-stationary at level, but is stationary after first differencing, $I(1)$. Thus, the ADF and the PP tests results are not consistent. According to Hallam and Zanoli (1993), and Obben (1998) when there is inconsistency between the ADF and the PP results, the conclusion from the PP test is preferred because the PP test is more powerful than ADF test especially for small sample study. Therefore, we conclude

that all the estimated variables are integrated of order one, $I(1)$. With these findings, we can proceed to the Johansen's cointegration test to examine the potential long run equilibrium relationship. In order to implement the Johansen's cointegration test, the following vector error-correction model (VECM) is estimated.

$$\Delta Z_t = \Phi D_t + \sum_{i=1}^{k-1} \Gamma_i \Delta Z_{t-i} + \Pi Z_{t-1} + \varepsilon_t \quad (1)$$

where Δ is the first difference operator. Z_t is a vector of endogenous variables ($\ln CR_t$, $\ln CPI_t$ and UR_t). D_t is the deterministic vector (constant and trend, etc); Φ is a matrix of parameters D_t. The matrix Π contains information about the long run relationship between Z_t variables in the vector. If all the variables in Z_t are integrated of order one, the cointegrating rank, r, is given by the rank of $\Pi = \alpha\beta'$ where α is the matrix of parameters denoting the speed of convergence to the long run equilibrium and β is the matrix of parameters of cointegrating vector. To determine the number of cointegrating rank, we use the likelihood ratio (LR) trace test statistic $LR(\lambda_{\text{trace}}) = -T\sum_{i=r+1}^{k} \ln(1-\lambda_i)$, where λ are the eigenvalues $\lambda_1 \geq \lambda_2 \ldots \geq \lambda_k$ and T is the numbers of observations (see Johansen, 1991). We aware that the Johansen's LR tests (e.g. Johansen, 1988; Johansen and Juselius, 1990) for cointegration are biased when the sample size is small (see Ahn & Reinsel, 1990; Cheung & Lai, 1993; Toda, 1995). Therefore, this study uses Bartlett's (1937) correction procedure for the trace test proposed by Johansen (2002) to overcome the problem. The advantage of using Bartlett corrected trace test is that it can be applied even when the test distribution behaviour is non-standard (see Nielsen, 1997). However, Omtzigt and Fachin (2006) simulation results showed that the Bartlett corrected trace test may have some size distortion problem. As an improvement strategy, this study also computes the bootstrap p-values for the Bartlett corrected trace test.

EMPIRICAL RESULTS

Given the unit root tests results (see Table 2) shows that each of the series are integrated of order one, $I(1)$, we carry out the Johansen's cointegration test to determine the existence of long run equilibrium relationship. The first step in applying Johansen's cointegration procedure is to determine the optimal lag structure for the vector autoregression (VAR) system. The Schwarz Bayesian Criterion (SBC) is used to choose an appropriate lag structure for the VAR system. The SBC suggests that lag one of VAR is the best and this is consistent with the usual empirical studies practices that the maximum lag structure for annual data analysis should not exceed 3 years (see Enders, 2004). Thus, the results for Johansen trace tests for total crime rate are reported in Table 3, Panel A.

The results of Bartlett corrected trace test and the bootstrap *p*-values clearly indicates that the null hypothesis of no cointegrating vector is rejected at 1 per cent significant level. Furthermore, both the Bartlett corrected trace test and the bootstrap *p*-values fail to reject the null hypothesis of one cointegrating vector at 10 per cent significant level. Hence, we conclude that there exists one cointegrating vector among [ln *CR*, ln *CPI*, ln UR_t]. Since the variables are cointegrated and this study tends to evaluate the responses of crime rate to inflation and unemployment the cointegrating vectors are normalised by crime rate. These normalised coefficients (see Table 3, Panel B) support our views that inflation will lead crime rate to increase in the long run. Moreover, the unemployment, rate appears to have a positive effect on crime rate and this evidence supports the presence of criminal motivation effect and furthermore consistent with the findings of Meera and Jayakumar (1995) for the case of Malaysia.

On the other hand, the impact of inflation and unemployment in the short run are determined by VECM. The results are reported in Table 3, Panel C. The negative sign of lagged error-correction terms (ECT_{t-1}) is statistically significant at 1 per cent level. This affirmed that the finding from Johansen (2002) test that a long run relationship exists is valid (see Kremers *et al.,* 1992) and there is also a long run causality running from inflation and unemployment to crime rates in Malaysia. Furthermore, the coefficient on the lagged error-correction term is small (–0.034), which means that the speed of convergence to the long run equilibrium is slow once the system is exposed to a shock. Besides, this study finds that in the short run inflation does not play any role on crime rate in Malaysia. A plausible explanation is the point raised by Tang and Lean (2007a) that inflation is not an immediate effect because it takes time for inflation to gradually 'reduce' the purchasing power. Therefore, the coefficient for inflation is not significant in the short run is not that unexpected. Contrary to Tang and Lean (2007a) the results in Table 3, Panel C reveals that the unemployment rate is statistically significant at 1 per cent level and positively related to crime rate in the short run. This implied that unemployment rate will lead crime rate in Malaysia to increase in both the short and the long run. Obviously, for the case of Malaysia, the crime rate is driven by the motivation effect (Becker, 1968) rather than the opportunity effect (Cantor & Land, 1985).

Table 3 The results of cointegration analysis

Panel A: Cointegration test			
Eigenvalues	0.5438	0.1915	0.0978
Null hypothesis, H_0	$r = 0$	$r \leq 1$	$r \leq 2$
LR (λ_{trace})	39.614	11.356	3.705
Asymptotic p-value	0.0028*	0.1903	0.0543***

Table 3 (*Continued*)

Bootstrap p-value	0.0050*	0.3433	0.1962	
LR (λ_{trace}) (Bartlett correction)	37.175	6.872	2.325	
Asymptotic *p*-value	0.0147**	0.5926	0.1274	
Bootstrap *p*-value	0.0060*	0.4815	0.1972	
Bartlett correction factor	1.0656	1.6525	1.5935	
Panel B: Normalised cointegrating vectors				
Variables	ln CR_t	ln CPI_t	UR_t	*Constant*
Cointegration coefficients	1.000	4.790*	0.921*	–17.566
Panel C: Short run coefficients – VECM				
Dependent variable: Δ ln CR_t				
Variables	Δ ln CPI_t	Δ UR_t	*Constant*	ECT_{t-1}
Coefficients	–0.800	0.103*	0.118*	–0.034*
Dependent variable: Δ ln CPI_t				
Variables	Δ ln CR_t	Δ UR_t	*Constant*	ECT_{t-1}
Coefficients	0.024	–0.006	0.028*	–0.004**
Dependent variable: Δ ln UR_t				
Variables	Δ ln CR_t	Δ ln CPI_t	*Constant*	ECT_{t-1}
Coefficients	1.438	2.157	–0.184	–0.022

Note: The asterisks *, ** and *** denotes statistically significant at 1, 5 and 10 per cent level, respectively. The optimal lag order is determined by using SBC. The bootstrap *p*-values and trace test with Bartlett correction have been performed in Structural VAR, version 0.45. The rests of the information are computed in STATA, version 10.

According to the Granger Representation Theorem, if the variables are cointegrated there must be Granger causality in at least one direction to hold the long run relationship. In this respect, we employed modified Wald (MWALD) causality test (Toda & Yamamoto, 1995; Dolado & Lütkepohl, 1996) to determine the causality direction between crime rate and its determinants. The causality test is compelled because the presence of cointegration does not imply causation and the causality direction is vital to envisage some useful policy implication for the Malaysian economy. To implement the MWALD test, we estimate the augmented VAR model as shows in equation (2).

$$\begin{bmatrix} \ln CR_t \\ \ln CPI_t \\ UR_t \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \end{bmatrix} + \begin{bmatrix} A_{11,1} & A_{12,1} & A_{13,1} \\ A_{21,1} & A_{22,1} & A_{23,1} \\ A_{31,1} & A_{32,1} & A_{33,1} \end{bmatrix} \times \begin{bmatrix} \ln CR_{t-1} \\ \ln CPI_{t-1} \\ UR_{t-1} \end{bmatrix} + \cdots + \begin{bmatrix} A_{11,k} & A_{12,k} & A_{13,k} \\ A_{21,k} & A_{22,k} & A_{23,k} \\ A_{31,k} & A_{32,k} & A_{33,k} \end{bmatrix}$$
$$\times \begin{bmatrix} \ln CR_{t-k} \\ \ln CPI_{t-k} \\ UR_{t-k} \end{bmatrix} + \begin{bmatrix} A_{11,p} & A_{12,p} & A_{13,p} \\ A_{21,p} & A_{22,p} & A_{23,p} \\ A_{31,p} & A_{32,p} & A_{33,p} \end{bmatrix} \times \begin{bmatrix} \ln CR_{t-p} \\ \ln CPI_{t-p} \\ UR_{t-p} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \end{bmatrix} \quad (2)$$

where k is the optimal lag orders and p represents $k + 1$ lag orders. For example, from equation (2), $A_{12,k} \neq 0\forall_k$ and/or $A_{13,k} \neq 0\forall_k$ implies that inflation and/or unemployment Granger cause crime rate; whereas if $A_{21,k} \neq 0\forall_k$ and/or $A_{31,k} \neq 0\forall_k$ means crime rate Granger causes inflation and/or unemployment. However, it should be pointed out here that the parameters for the extra lag, i.e. $d_{\max} = 1$, in equation (2) is unrestricted because the inclusion of extra lag is to ensure that the asymptotic χ^2 distribution critical value can be applied when the test for causality between the integrated variables are conducted.

The causality results are reported in Table 4. The optimal lag orders (k) for VAR was determined by using Akaike's Information Criterion (AIC). The statistic suggests that lag structure 3 is the best and hence we estimate the augmented VAR with 4 lags for causality test. The results imply that the causality direction is running from inflation and unemployment to crime, but there is no evidence of reverse causality from crime. This result is consistent with the long run causality evidence indicates by the significant of the lagged error-correction term (ECT_{t-1}) when the $\Delta \ln CR_t$ is the dependent variable in the VECM. Furthermore, this study also found that the unemployment rate Granger cause inflation. The empirical evidence of this study has highlighted that crime rate in Malaysia is significantly affected by inflation and unemployment.

Table 4 The results of modified WALD test

Dependent Variables	χ^2 – statistics		
	ln CR_t	**ln CPI_t**	**UR_t**
ln CR_t	–	15.204*	34.487*
ln CPI_t	1.555	–	12.057*
UR_t	0.806	2.237	–

Note: The χ^2 – statistics tests joint significance of the lagged values of the independent variables. The asterisk * denote the significance at 1 per cent level. The optimal lag orders (k) is 3 and was determined by using AIC.

CONCLUSION

This study investigates the linkages among inflation, unemployment and crime rates in Malaysia through cointegration and causality analyses. The Johansen's test reveals that the macroeconomic variables, inflation and unemployment were coalescing with crime rate to achieve their steady-state equilibrium in the long run, although deviations may occur in the short run. In this study, the normalised coefficients for inflation and unemployment rate are positively related to crime rate in Malaysia over the sample period of 1970 to 2006. This implied that inflation and unemployment are two importance criminal motivation factors in Malaysia. Furthermore, the empirical evidence implies that Malaysia's crime rate is Granger caused by inflation and unemployment. This empirical evidence may throw some

light that the policymaker could reduce the crime rate Malaysia by controlling the two macroeconomics evils – inflation and unemployment. In addition, supply-side economy may be a good policy to simultaneously reduce both inflation and unemployment rates and ultimately, reduces the crime rate in Malaysia.

Nothing is perfect; this study has no exception too. There are few limitations that confined to this study and will be presented as follow. First, as inflation and unemployment rate are the only the variables employed in this study, the results may not thoroughly capture the criminal behaviour in Malaysia. There are some other potential variables such as the proportion of government spending on internal security and the benefit or cost of commit crime. However, the use of inflation and unemployment rate is in line to the purpose of this study and thus they should not be discarded as an irrelevant policy instrument in curbing crime rate. Second, the disaggregate analysis on crime rate such as property and violent crimes may be more comprehensive and interesting.[4] Nevertheless, this is beyond the scope of this study, thus the future study can be extended by analysing the effect of inflation and unemployment rates on different categories of crime rates – property and violent crimes. Third, according to economic theory, there is a strong trade-off relationship between inflation and unemployment rates (see Tang and Lean, 2007b for the case of Malaysia). This is also known as the Phillips curve phenomenon. Therefore, the inclusion of both inflation and unemployment variables into the crime function may cause the multicolinearity problem. For this reason, Tang and Lean (2009) suggest to employ the misery index to overcome this problem.

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