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ABSTRACT

This study used panel data of index crime rates for the 13 regions of the Philippines over the period 1983-2000 to analyze the determinants of crime rates in the country using the *constant coefficient model*. As different types of index crimes are likely to be influenced by different factors, the total index crime rate was disaggregated into three parts: (a) crimes against person (murder, homicide, and physical injury); (b) crimes against property (robbery and theft); and (c) rape. The data reveal that, of the potential factors used to associate the fluctuations of the recorded crime rates (social, economic, criminal justice, and demographic factors), the economic factors are the robust determinants of crime rates. That is, the more stable the economy is, the lesser the crime. The study highlighted the following findings: The determinant to explain the variation of crimes against person per 100,000 inhabitants are: (1) per capita gross regional domestic product; (2) average income of the people in urban and rural; (3) consumer price index; (4) cohort survival rate in elementary education. For the crimes against property, the determinants are: (1) per capita gross regional domestic product; (2) income inequality proxied by gini coefficient; (4) cohort survival rate in secondary education. There are only two significant determinants of crime rate on rape incidence: unemployment rate ad population density.

I. Introduction

Crime is as old as mankind itself. Since the biblical crime at the Garden of Eden, societies have emerged, laws have been created, and prohibitions have been declared but violations of forbiddances have continued. Crime has been with us from the very beginning; it has never ceased to disturb men's living together. Moreover, it has become a common societal phenomenon, viewed by some as a normal symptom, as if it was a functional component of the organization of human groupings (Schafer, 1976).

The study on crimes has generated a substantial volume of literature. Since the path-breaking work of Becker (1968) nearly thirty five years ago, the economics profession has analyzed the determinants of criminal behavior from both the theoretical and the empirical points of view. Theoretical and empirical researches have provided a richer understanding of the crime once primarily viewed through the lenses of sociologists like Emile Durkhiem and Max Weber. Much has been learned about this critical topic; however many questions remain unanswered.

The Philippines, being a developing country, is not exempted from occurrences of crimes. Newspapers and television news updates are loaded with all sorts of "misbehavior": murder, rape, theft, robbery and others. For this study, the author classifies crimes into three: crimes against property (e.g. theft), crimes against person (e.g. murder), and rape. Though the latter could be considered crime against person, it was decided that it should be separated from the rest because it is believed that it has different influencing factor.

However, it is noted that crime rates plunged over the past two decades. In fact, rates declined almost yearly. Between 1981 and 2000, crime rates for the crimes against property and crimes against person declined by approximately 80% and 61% respectively. On the regional picture, in the year 2001, statistics from Philippine National Police (PNP) showed that for crimes against person, Southern Tagalog (Region 4) has the highest crime volume recorded, followed by the National Capital Region, Central Visayas (Region 7), Western Visayas (Region 6), then Bicol Region (Region 5). For crimes against property, National Capital Region was ranked as first, followed by Central Visayas, Southern Tagalog, Central Luzon (Region 3), Western Mindanao (Region 9), then Northern Mindanao (Region 10). What may be the key factors behind these declining trends?

1.1 Objectives

The general objective of the study is to present an over-all picture of the crime trends in the Philippines (considering 13 regions) within a period of eighteen years (1983-2000), without necessarily looking for root causes nor hoping to offer solutions to these crimes.

Specifically, the study aims:

1. to identify social, economic and criminal justice factors associated with fluctuations in the recorded crime rates;
2. to measure the magnitude of change in the crime rate per unit change of each of the significant explanatory variables; and
3. to use important outputs for policy making or assessment purposes.

1.2 Scope of the Study

The study focuses on the index crimes over the period 1983-2000 expressed in crime rate (crime per 100,000 population). Index crimes are those violations of the penal code. They are considered to have socioeconomic significance, and they occur with sufficient regularity. These include crimes against person (murder, homicide, physical injury and rape), and crimes against property (robbery and theft). All other crimes are classified as non-index.

Only a limited number of potential influences on crime can be quantified, so that not all-influencing factors can be assessed since the study formulated a statistical model.

II. Data, and Model Specification

2.1 Data

The study makes use of panel data consisting of time–series observations over a period of eighteen years (1983–2000), and 13 cross–sections (one for each of the 13 regions of the country). Most of the secondary data were taken from the Philippine Statistical Yearbook and Philippine Yearbook, both

publications of the National Statistical Coordination Board and the National Statistics Office, respectively.

Panel data were used because they permit a rich model specification and have more advantages since they allow the researcher to sort out economic effects that cannot be distinguished with the use of either cross-section or time-series data alone. Some of the advantages are: (1) Panel data provide an increased number of data points, which in turn generate additional degrees of freedom; (2) Panel data incorporate information relating to both cross-section and time-series variables, thereby substantially diminishing the omitted-variable problems; (3) Panel data eliminate some of the statistical inference problems which may arise from a probable correlation between some of the explanatory variable (problems such as multicollinearity, heteroscedasticity and autocorrelation) and the extent of under-reporting of crime rates; (4) Panel data have the ability to control heterogeneity and the likely joint endogeniety of some of the explanatory variables and the bias due to under-reporting.

2.2 The Statistical Models

The more common model used to determine the relationship between crime rate and its determinants is multiple regression analysis. It is a statistical technique that shows the individual effects of several explanatory variables on a single dependent variable. The most important explanatory variables are those that account for a significant proportion of the variation on the recorded crime rates between years and across regions. The joint effect of several variables can be considered in the same model, giving a much more powerful conclusion than simple correlation between recorded crime rate and one other variable. The direction of magnitude of the specific effect of any variable is given by the coefficient estimate. This estimate gives the impact of each variable on the recorded crime rate if all other variables are held constant.

As different types of index crimes are likely to be influenced by different factors, there were three models. The total index crime rate was disaggregated into three parts: (a) crimes against person (rape is excluded); (b) crime against property (robbery and theft); and (c) rape. The implicit forms of the three models take on the following forms:

$$\text{(a) } CR_{it}\text{ (Person)} = \beta 0_{it} + \beta_{1it}DPC_{it} + \beta_{2it}UI_{it} + \beta_{3it}RI_{it} + \beta_{4it}SS_{it} + \beta_{5it}CI_{it} + \beta_{6it}PP_{it} + \beta_{7it}PD_{it} + \beta_{8it}AC_{i} + \beta_{9it}GC_{it} + \beta_{10it}UR_{it} + \varepsilon_{it}$$

$$\text{(b) } CR_{it}\text{ (Property)} = \beta 0_{it} + \beta_{1it}DPC_{it} + \beta_{2it}UI_{it} + \beta_{3it}RI_{it} + \beta_{4it}SS_{it} + \beta_{5it}SE_{it} + \beta_{6it}CI_{it} + \beta_{7it}PP_{it} + \beta_{8it}PD_{it} + \beta_{9it}GC_{it} + \beta_{10it}UR_{it} + \beta_{11it}CPI_{it} + \varepsilon_{it}$$

$$\text{(c) } CR_{it}\text{ (Rape)} = \beta 0_{it} + \beta_{1it}UR_{it} + \beta_{2it}UI_{it} + \beta_{3it}RI_{it} + \beta_{4it}ALC_{it} + \beta_{5it}PD_{it} + \beta_{6it}PP_{it} + \varepsilon_{it}$$

where,

CR = crime rate
DPC = per capita regional domestic product
UI = average income of people in urban
RI = average income of people in rural
SS= cohort survival rate in secondary education
SE = cohort survival rate in elementary education
CI = corruption index

PP = police population
PD= population density
AC = alcohol consumption
GC = gini coefficient
UR = unemployment rate
CPI = consumer price index (1985=100)

β_i = the parameters which measure the change in value of dependent variable (crime rate) given a unit change in an explanatory variable granting other variables constant.

β_0= the value of crime rate when all explanatory variables are equal to zero. In many cases, β_0 has no clear economic interpretation, but it is almost always included in the model because it helps in the overall estimation of the model and in prediction.

The explanatory variables that were included in the models above are not based on the judgment of the researcher; they are suggested by past studies and theories. The use of the multiple regression technique requires that the variables chosen to explain changes in the recorded crime rates are theoretically valid or causal agents. The selection of appropriate variables prior to the development of the model decreases the chances of getting spurious relationships; that is, a good fit by chance.

In the models presented above, the intercepts and response parameters are permitted to differ for each region in each time period. There is a problem with these models because they cannot be estimated in their current form, as there are more unknown parameters than data points; however, there are many types of simplifying assumptions that can be made to make the models operational. Econometricians have provided several models for pooling time-series and cross-sectional data, one of which is the constant coefficients model, which was used in this study.

2.2.1 The Constant Coefficient Model

One of the simplifications of the general statistical models presented above which yields what is called a constant coefficient model is:

$\beta_{0it} = \beta_0$, $\beta_{1it} = \beta_1$, $\beta_{2it} = \beta_2$, $\beta_{3it} = \beta_3$, …, $\beta_{kit} = \beta_k$

that is, the parameters of crime functions did not differ across regions and are constant over time (note that "i" and "t" subscripts were dropped). These assumptions mean the general statistical models become:

(a) CR_{it} (Person) = $\beta 0 + \beta_1 DPC_{it} + \beta_2 UI_{it} + \beta_3 RI_{it} + \beta_4 SS_{it} + \beta_5 CI_{it} + \beta_6 PP_{it} + \beta_7 PD_{it} + \beta_8 AC_{it} + \beta_9 GC_{it} + \beta_{10} UR_{it} + \varepsilon_{it}$

(b) CR_{it} (Property) = $\beta_0 + \beta_1 DPC_{it} + \beta_2 UI_{it} + \beta_3 RI_{it} + \beta_4 SS_{it} + \beta_5 SE_{it} + \beta_6 CI_{it} + \beta_7 PP_{it} + \beta_8 PD_{it} + \beta_9 GC_{it} + \beta_{10} UR_{it} + \beta_{11} CPI_{it} + \varepsilon_{it}$

(c) CR_{it} (Rape) = $\beta_0 + \beta_1 UR_{it} + \beta_2 UI_{it} + \beta_3 RI_{it} + \beta_4 ALC_{it} + \beta_5 PD_{it} + \beta_6 DP_{it} + \beta_7 PP_{it} + \varepsilon_{it}$

Before estimating the parameters of these models, there are assumptions concerning the properties of the error term. Since there are cross-section and time-series data, the usual cross-section assumptions concerning heteroscedasticity and the usual time-series assumptions concerning serial correlation might be considered. Specifically, the assumptions are:

(1) $E(\varepsilon_{it}) = 0$

(2) $E(\varepsilon^2_{it}) = \sigma_i^2$

Heteroscedasticity; different variances over cross-sectional units but uniform over time.

(3) $E(\varepsilon_{it} \ \varepsilon_{jt}) = 0$ for $i \neq j$

Cross-sectional independence; two different cross-sections are independent at same time period.

(4) $\varepsilon_{it} = \rho_i \varepsilon_{it, t-1} + u_{it}$

ρ could be different for each cross-sectional unit; ε_{it} and u_{it} are correlated.

(5) $E(u_{it}) = 0$

(6) $E(u^2_{it}) = \sigma_{ui}^2$

(7) $E(u_{it} \ u_{jt}) = 0$ for $i \neq j$

u_{it} uncorrelated over cross-sections.

(8) $E(u_{it} \ u_{is}) = 0$ for $t \neq s$

u_{it} uncorrelated over time.

(9) $E(\varepsilon_{it, t-l} \ u_{jt}) = 0$ for all i,j

Under these assumptions, the models are known as the Cross-sectionally Heteroscedastic and Timewise Autoregressive Model (CHTA). CHTA under assumptions (1) to (9) can be demonstrated that:

$E(\varepsilon_{it} \ \varepsilon_{is}) = \rho_i^{t-s} \ \sigma_i^2$ for $t \geq s$

and

$E(\varepsilon_{it} \ \varepsilon_{js}) = 0$ for $i \neq j$

These results, together with assumptions (2) and (3), completely describe the variance-covariance properties of the ε_{it}.

For all estimations, the econometrics package SHAZAM Version 9.0 was used.

III. Results and discussions

A) For crimes against person

The estimated model is:

$$\hat{CR} = -0.00091DPC + 0.28770CPI - 0.51368UI - 0.63221RI - 1.7350\ SE$$

$$R^2 = 0.81 \qquad \hat{\sigma}^2 = 0.55$$

Among the chosen variables that were presented in the previous chapter to explain the fluctuations of the recorded crime rate for crimes against person, only the per capita gross regional domestic product at constant prices (DPC), average income of the people in urban and in rural (UI and RI), consumer price index (1985=100), and cohort survival rate in elementary education (SE) were found to be significant. By examining their signs, shown in Table 1, the per capita gross domestic product, average income of the people in rural and urban and cohort survival rate in elementary education are all negatively related to crime rate. That is, the higher they are the lower are the crime rates. On the other hand, consumer price index has a positive relationship to crime rate, that is, if the former increases, the latter also increases. These findings are not quite surprising because they generally coincide with the results of studies on criminal behavior conducted by Becker (1968), Ehrlich (1993), Fleisher (1966) and others.

Table 1. Coefficient estimates for the crimes against person model.

Variable Name	Estimated Coefficient	Standard Error	T-ratio 213 DF	P – value
DPC	**-0.00091**	**0.000171**	**5.3225**	**0.0000**
CPI	**0.28770**	**-0.043213**	**-6.6576**	**0.0000**
UI	**-0.51368**	**0.16817**	**-3.0546**	**0.0025**
RI	**-0.63221**	**0.14748**	**4.2867**	**0.0000**
SE	**-1.7350**	**0.22738**	**7.6303**	**0.0000**
$R^2 = 0.81$		**$\sigma^2 = 0.55$**		

To assess the individual impact of the significant variables, on the average, crime rate will decrease by about 0.91 in every 1000-peso increase in per capita gross regional domestic product holding other variables constant. In the same way that crime will also decrease by about 1.74, 0.63 and 0.51 per unit increase in cohort survival rate in elementary education, average income of the people in rural and urban respectively. On the other hand, crime rate will increase by about 0.29 per unit increase in consumer price index. As shown by the value of R^2, 81% of the variation of crime rate is explained by the five statistically significant explanatory variables.

B) For crimes against property

The estimated model is:

$$\hat{CR} = 252.11 + 0.00324DPC + 73.714GC + 0.000057UR - 4.4850SS$$

$$R^2 = 0.87 \qquad \hat{\sigma}^2 = 0.51$$

The explanatory variables that were included in the model to explain the variation of crime rate on crime against property were per capita gross regional domestic product, consumer price index (1985=100), income inequality proxied by the gini coefficient, cohort survival rate for secondary and elementary education, average income of people in rural and urban, population density, unemployment rate and corruption index. Of these, only the per capita gross regional domestic product, income inequality, unemployment rate and cohort

survival rate in secondary education are significant. By looking on their signs as shown in Table 2, per capita gross regional domestic product, income inequality and unemployment rate behave along the same direction with crime rate. That is, the higher they are, the higher are the crime rates. On the other hand, as expected, cohort survival rate in secondary education is inversely related to crime rate. Analyzing their relationships, there is one relationship that is surprising, it is the relationship of per capita gross regional domestic product and crime rate. This unexpected relationship however, agrees with the study of Field (1990). He found out that during economic growth, property crimes were high. He argued that a buoyant economy is associated with the increase in social activities outside home, which would somehow increase the motivation of the robbers to commit crime. Furthermore, he also stressed that if the economy rises, there will be more available property to be stolen.

Table 2. Coefficient estimates for the crimes against property model

Variable Name	Estimated Coefficient	Standard Error	T-ratio 213 DF	P – value
DPC	0.00324	0.000367	8.8211	0.0000
GC	73.714	15.132	4.8713	0.0000
UR	0.000057	0.0000086	-6.6005	0.0000
SS	-4.4850	0.68117	-6.5843	0.0000
constant	252.11	26.924	9.3643	0.0000
$R^2 = 0.87$		$\sigma^2 = 0.51$		

The incremental impact of the significant variables as given in the estimated coefficient column indicates that on the average, in every 1000-peso increase in per capita gross regional domestic product and 0.1 increase in gini coefficient there is an increase in crime rate of about 3.2 and 7.37 respectively. The impact of unemployment rate to the crime rate is not quite sensitive because crime rate will only increase by about 0.0005 per unit increase in unemployment rate. On the other hand, crime rate will decrease by about 4.5 for every unit change in cohort survival rate in secondary education. The four significant explanatory variables explained 87% of the variation of crime rate on crimes against property, as shown by the value of R^2.

(c) For Rape

The estimated model is:

$$\hat{CR} = -4.1016 + 0.0000016UR + 0.00115PD$$

$$R^2 = 0.85 \qquad \hat{\sigma}^2 = 0.52$$

Population density, unemployment rate, average income of people in urban and rural, alcohol consumption, implementation of death penalty were the variables considered to explain the variation of crime rate on rape incidence. The significant variables were only the population density and unemployment rate. With regards to their relationship to crime rate, they are positively related. That is, if the population density and unemployment rate increase, crime rate will also increase.

Table 3. Coefficient estimates for the rape model.

Variable Name	Estimated Coefficient	Standard Error	T-ratio 213 DF	P – value
UR	0.0000016	0.00000043	3.7467	0.0002
PD	0.000115	0.0000318	3.6123	0.0004
constant	-4.3601	1.0630	-4.1016	0.0001
$R^2 = 0.85$		$\sigma^2 = 0.52$		

The marginal impact of every unit increase in population density and unemployment rate to the rape incidence per 100,000 population are 0.00012

and 0.0000016 respectively. The two significant explanatory variables explained 85% of the variation of crime rate on rape incidence per 100,000 inhabitants.

IV. Recommendations

The results show that the economic factors are the robust determinants of crime rates. This implies that generally, the more the stable the economy is, the lower the crime rates. Thus, it is recommended that policy makers should focus on the stabilization of the economy because it has a significant influence on the variation of crime rates.

One disturbing result of the study is that there is only a little support between the relationship of the number of policemen and crime rates; that is, the number of policemen is not statistically significant for the three models. There are two opposing implications for this: first, the number of policemen is not just really enough to influence crime rates; second, policemen are just inefficient on their job that is why they cannot simply influence the crime rates. There is also a big possibility to have both. It is recommended that the government should: hire additional policemen; conduct more extensive training, seminars, and re-educating for the old and new policemen; provide enough and advance facilities because policemen might not be effective even with their number if their facilities are outmoded or outdated.

A caution must be addressed to the findings because statistical significance between crime rates and to their explanatory variables does not mean, nor does it mean to imply that the derived relevant explanatory variables cause crime. Furthermore, the results should also be interpreted with caution because crime *per se* is complex since it involves factors beyond law enforcement, economic, social and demographic conditions such as the strength of the family, relationship with the neighborhoods, schools and churches. This study could be considered as benchmark information on crime rates and factors influencing them.

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