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An empirical analysis into the dynamic cycle of crime

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This study into the dynamic movement of crime aims to test whether the conversion process of crime leads to an asymmetric response of crime rate. We build a model to test the dynamic relationship between the change in crime rate and the level of it and the effect that exogenous economic and deterrent factors have on crime. We estimate the model using Japanese and American prefecture or state level crime rate data. Our results show that, for a decreasing crime rate, convergence to an equilibrium position is relatively fast but when the crime rate is increasing, convergence to a stable crime rate is slower or does not happen. Our study therefore provides some evidence to suggest that the conversion process of crime causes asymmetry in crime rate response.

Key words: crime, asymmetric response

1. Introduction

Crime is one of the key issues in the world today. Japan, in particular, has experienced an increase in crime rate over the 1990s. Comparing with American crime is quite interesting especially in 1990s because in the United States the crime rate has decreased constantly while it has only increased in Japan over the time.

Many economists study the economics of crime[1] and base their work on the seminal theoretical study by Becker（ 1968） and the empirical study by Ehrlich（ 1973）. It describes the effect that deterrent, such as the number of police or level of punishment, has on criminals. Many studies focus on the behavior of criminals but some concentrate on how much damage crime inflicts on individuals or how much individuals are willing to pay to reduce crime[2]. Therefore, studying crime is also very useful for analyzing household behavior or consumption.

It is said that the contagiousness or conversion process of crime contributes to crime movement. Ludwig et al.（ 2001） states that, “Criminal activity may be “contagious” in high crime areas because the social penalties for committing a crime or the probability of an arrest may be lower than in other neighborhoods.” In addition to this, Fajnzylber et al.（ 2003） presents some empirical evidence for the conversion process of crime over time. Jacob et al.（ 2004） explains that crime contagion happens when

[1] See Freeman（ 1999）.

[2] See Lynch, Rasmussen and Moore（ 2001）, Cohen（ 1990）.

"potential offenders are influenced by the criminal behavior of others."

Most economic studies examine crime as a static phenomenon. However, dynamic aspects are also important, as Imai and Krishna(2004) and Jacob et al.(2004) mention.

In this paper, we investigate the dynamic relationship of crime and the effect that exogenous economic and deterrent shocks have on this relationship. We are particularly interested in discovering whether there is an asymmetric response caused by the persistence of crime. We use Japanese prefecture level data and American state level data to test this.

2. Overview

In this section, we will show some crime statistics in Japan and the United States. Finch(2000) says that the method of Japanese criminal statistics is more reliable than American one[3]. Taking this further, MacDonald(2002) tells us that still American crime statistics are more comprehensive than those from Europe. Thus, it is sensible to assume that using Japanese and American data can provide us a lot of meaningful information.

It is of particular interest to compare the change in American and Japanese crime rates during the 1990s because of the opposing trends that occur. While the United States shows a continual decrease in crime rate over this period, the Japanese rate increases[4].

Firstly looking at Japan, Fig.1 shows the crime rate per 100,000 of population from 1974 to 2003. The figure shows that the Japanese crime rate increases during the 1990s, with particularly significant gains in economic crimes such as robbery and larceny.

It is said that foreign criminals are one of the principal reasons for this trend. In fact, the Crime White Paper in 2001 indeed shows that the total number of cleared criminal cases involving foreign criminals was 867 in 1980, rising to 22,947 in 2000. This represents a 26-fold increase. However, the ratio of foreign criminal offenses to total number of criminal cases in Japan was minimal, standing at about only 4% in 2000. Thus, we need to explore causes for the dramatic increase in Japanese crime rate, aside from foreign criminal offenders.

Now, moving to the American data, Fig. 2 presents the crime rates per 100,000 inhabitants in the United States from 1960 to 2000.

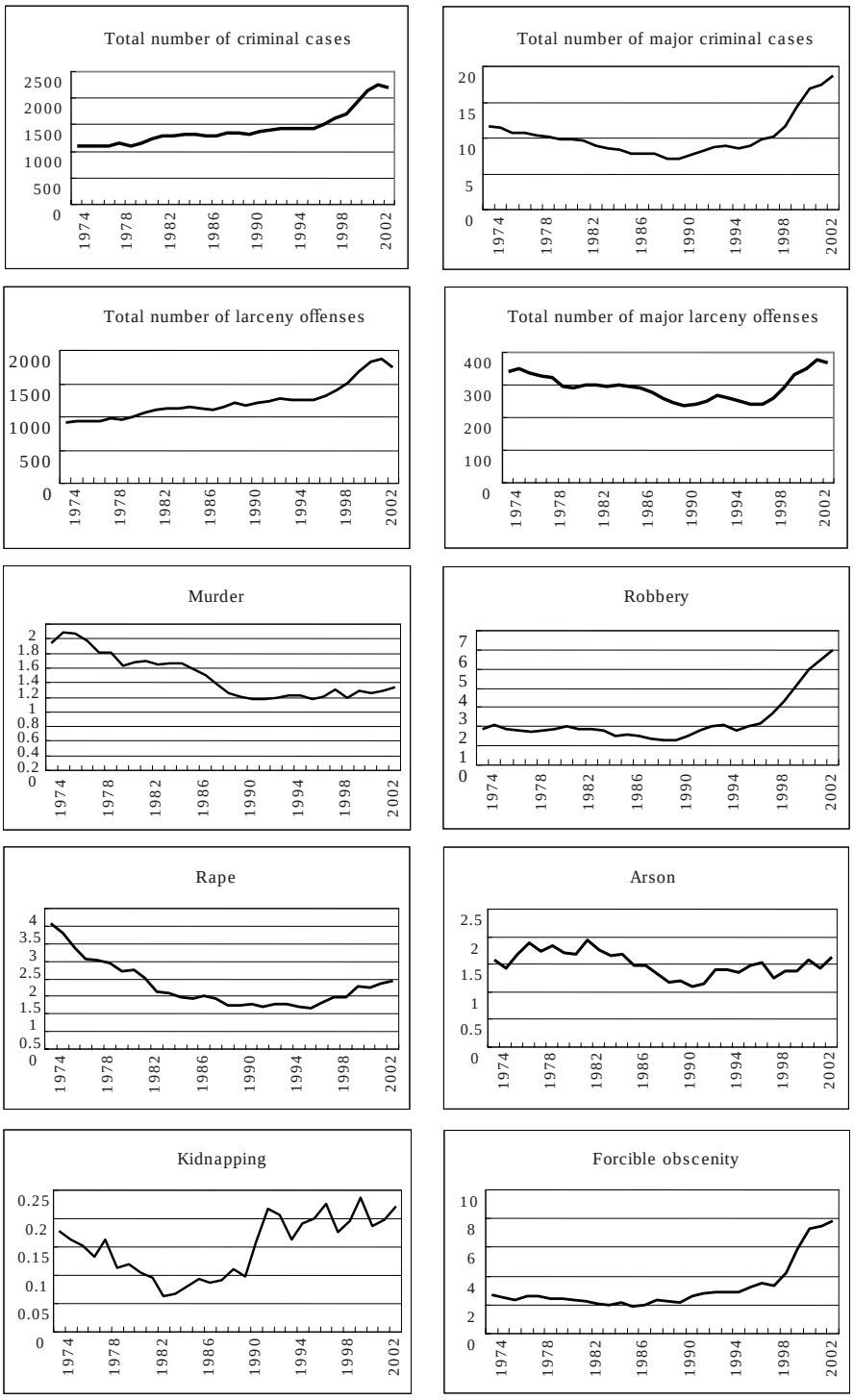
As we can see, crime index shows a steep increase after 1960, reaching 6,000 in 1980. The rate then keeps to the same approximate level for the next ten years. However, after 1991, the crime rate starts falling and eventually reaches two thirds of its peak, about 4,000. All types of crime, but excluding burglary, decrease from around 1991. The burglary rate shows a different trend in that it starts decreasing in the early 80's.

Several empirical studies investigate why the American crime rate decreases during the 1990s. Levitt(2004) concludes that there are four main contributing factors as follows.

[3] However, it is difficult to access Japanese crime statistics, especially prefectural monthly data, as, up until now, there has only been limited availability on the web or in database format.

[4] Many states recorded an increase in crime rate in 2003, while Japanese prefectures decrease.

［ Figure 1］ Crime Rates Per 100,000 populations in Japan



We draw Fig.1 based on the data from National Police Agency

［ Figure 2］ Crime Rates Per 100,000 Inhabitants in the U.S.

We draw Fig.2 based on the data from FBI Uniform Crime Report（ http://www.disastercenter.com/crime/）

1) Increase in the number of policepersons
2) The rising prison population
3) The receding crack epidemic
4) The legalization of abortion

However, in drawing insights, we should be aware of the limitations of the data. Firstly, it is well known that crime statistics are not completely reliable because of the number of crimes that go unreported. This underreported rate can potentially affect the estimation through measurement error. Thus, it is important recognize this. According to Finch(2000), which originally refers Myers(1980), the rate of reported crime in Japan is about 60%, while about 50% in the United States. However, these figures may seem not high for developed countries. In addition to overall underreports' problem MacDonald(2002) warns that researchers should understand the limitation of using official crime statistics since he finds that unemployed people report burglary at a far lower rate than people in employment do.

A second limitation of the data is the differences in definitions and categorization between the Japanese data and the American data. This could impact the accuracy of our international comparison[5].

Thus, we need to be cognizant of limitations, which include the differences of the methodologies of statistic and in definitions, to analyze our results.

3. Evidence

We can capture the dynamic movement of crime by regressing the change of crime on the level of crime.

We use the following estimation model[6]:

$$\begin{aligned}\Delta crime_{it} &= a + b_1 \cdot crime_{it-1} \\ &\quad + b_2 \cdot nd_{it} + b_3 \cdot nd_{it} \cdot crime_{it-1} \\ &\quad + X\beta + nd_{it} \cdot X\gamma \\ &\quad + S_i + T_t + u_{it} \\ nd &= 1 \quad if \quad \Delta crime < 0 \\ nd &= 0 \quad if \quad \Delta crime \geq 0\end{aligned} \qquad (1)$$

Where X represents exogenous shocks, such as deterrent and economic factors. As deterrent and economic factors, we use the changes of police and real gross state(or prefecture) products.

We adopt a model with prefectural(or state)(S_i) and year(T_t) fixed effects[7]. We assume that there are neither omitted factors, which last over time, nor measurement error[8]. We estimate our model using the total number of criminal cases, felonious offenses, violent offenses, larceny offenses, intellectual offenses, and moral offenses as Japanese crime data. We then use crime index, violent crime, property crime, murder, forcible rape, robbery, aggravated assault, burglary, larceny, and vehicle theft for the United States data. The details of these categories are in Appendix which is placed in the end of this paper.

To measure the impact of deterrent factors we use different data for Japan and the United States. For Japan, we employ the number of policepersons

[5] Finch(2000) shows some differences between Japanese and American crime statistics.

[6] Mocan et al.(2005) and Imai and Krishna(2004) estimate the dynamic asymmetric impact of independent variables.

[7] Tella and Schargrodsky(2004) uses this fixed model.

[8] Jacob et al.(2004) points out that lagged crime rate would be affected by auto correlated error term if omitted factors last over time when we use the level of crime rate as the dependent variable.

deployed(per capita). In the case of the United States we use the real per capita expenditure on local state police enforcement, a value deflated by the implicit deflator for consumption, instead of the number of policepersons deployed. An endogeneity problem could present in using the policepersons deployed variable because increasing crime causes larger police numbers. To avoid this, we use the one period lagged variable.

For the economic factor data, we employ the real per capita gross product of prefectures or states.

For the United States, we use state level data from between the years 1978 - 2002 and for Japan, we use prefecture level data from 1976 - 2001. We source the American crime rate data primarily from the Uniform Crime Reports of the Federal Bureau of Investigation. All American data are available on the web[9]. We take the Japanese crime data from the National Police Agency[10]. GSP(Gross State Products) figures and the population figures for Japan come from the Annual Report on Prefectural Accounts. The number of policepersons is from a survey for local officer's salary(Chihou Koumuin Kyuyo no Jittai).

We require the coefficients b1 and b1+b3 to be negative to maintain a stable state. As the size of the coefficient implies the speed of convergence or movement, if b3 is negative, then the convergence speed for a declining process is faster than for a rising one. Table 1 and 2 show our results.

Our main results are as follows: Firstly, we are not able to demonstrate either deterrent or economic effects on crime rate in either Japan or the United States. It might not be surprising without some treatment: Levitt(1997) shows the significant result by using the timing of elections.

Secondly, the estimates of b1+b3 in all categories are significant and negative in both countries. All estimates of b3, except for larceny in the United States, are significant and negative. Thus, the speed of convergence is lower when crime rate is increasing than when it is decreasing. This result is consistent with Levitt(2004). In addition, most estimates of b1 are not significant.

These results allow us to describe the relationship between crime rate and the change of crime rate in our society as shown in Fig.3. Suppose that our initial crime rate is at "A" and stable. If there is a negative exogenous shock which causes a downward shift in the dynamic relationship curve, then our society moves from "A" to "A' ". At A', there is negative movement along this new dynamic relationship curve to "B". Therefore, convergence to a new equilibrium occurs.

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[9] Data sources:
Crime, Population(annual "FBI Crime in the United States" reports from Florida department of law enforcement)
http://www.fdle.state.fl.us/FSAC/Crime_Trends/download/excel/fed_ucr72-02.xls) 1972-2002
Unemployment(U.S. Department of Labor - Bureau of Labor Statistics http://www.bls.gov/lau/) 1978-2002
GSP, Retail,(U.S. Department of Commerce Bureau of Economic Analysis,
http://www.bea.doc.gov/bea/regional/gsp/) 1977-2001
Police Protection(Government Finance, Police protection Direct Expenditure of State Government)
http://ftp2.census.gov/pub/outgoing/govs/Finance/ 1977-2000

[10] Crime(National Police Agency) http://www.pdc.npa.go.jp/hakusyo/index.htm(1972-2001)

［Table 1］Japan

	Total number of criminal cases	Felonious offenses	Violent offenses	Larceny	Intellectual offenses	Moral offenses
b1	0.00378 （0.0232）	0.0330 （0.0899）	0.00982 （0.0374）	0.00431 （0.0213）	−0.0384 （0.143）	−0.0866 （0.0588）
b3	−0.112 （0.0287）**	−0.447 （0.106）**	−0.204 （0.0430）**	0.124 （0.0281）**	−0.689 （0.280）**	−0.344 （0.0731）**
△police $_{t-1}$	−0.0129 （0.129）	0.00187 （0.00151）	−0.00608 （0.00789）	−0.0528 （0.117）	0.0665 （0.0407）	−0.00213 （0.00219）
nd *△police $_{t-1}$	−0.104 （0.0324）**	0.00100 （0.000480）**	0.000697 （0.00211）	−0.0434 （0.0300）	−0.00231 （0.0170）	0.00101 （0.000694）
△GSP	0.000130 （0.000114）	0.00000128 （0.00000148）	0.00000831 （0.00000877）	0.0000538 （0.0000973）	0.000132 （0.000136）	−0.000000130 （0.00000277）
nd *△ GSP	−0.000188 （0.000147）	0.00000124 （0.00000194）	−0.0000120 （0.00000101）	−0.000158 （0.000128）	−0.000107 （0.000136）	0.00000139 （0.00000295）
R2	0.64	0.73	0.74	0.63	0.60	0.68
b1+b3	−0.108 （0.0177）**	−0.414 （0.0595）**	−0.194 （0.0212）**	−0.120 （0.0188）**	−0.727 （0.241）**	−0.431 （0.0446）**
△police $_{t-1}$ （nagative）	−0.117 （0.124）	0.00287 （0.00156）	−0.00538 （0.00743）	−0.00962 （0.115）	0.0642 （0.0483）	−0.00112 （0.00221）
△GSP （negative）	−0.0000577 （0.000111）	0.00000252 （0.00000161）	−0.00000369 （0.00000605）	−0.000104 （0.000103）	0.0000248 （0.0000464）	0.00000126 （0.00000178）

The numbers in the parentheses show White heteroscedasticity consistent standard errors
** and *significant with 5% and 10% level

［Table 2］US

	Crime Index	Violent Crime	Property Crime
b1	−0.0589 （0.0207）**	−0.0348 （0.0253）	−0.0535 （0.0210）**
b3	−0.00382 （0.0260）	−0.0432 （0.0303）	−0.0207 （0.0264）
△police $_{t-1}$	0.00782 （0.0124）	0.0000516 （0.000470）	0.00635 （0.0121）
nd *△police $_{t-1}$	−0.0101 （0.0154）	0.000000657 （0.00209）	−0.0103 （0.0147）
△GSP	−0.0258 （0.165）	−0.0171 （0.0201）	−0.0290 （0.154）
nd *△ GSP	0.341 （0.230）	0.0330 （0.0274）	0.278 （0.213）
R2	0.76	0.74	0.76
b1+b3	−0.0627 （0.0158）**	−0.0780 （0.0167）**	−0.0742 （0.0161）**
△police $_{t-1}$ （nagative）	−0.00228 （0.00881）	0.0000523 （0.00209）	−0.00395 （0.00812）
△GSP（negative）	0.315 （0.161）	0.0159 （0.0187）	0.250 （0.148）

The numbers in the parentheses show White heteroscedasticity consistent standard errors
** and *significant with 5% and 10% level

［Table 2］(cont')

	Murder	Forcible rape	Robbery	Aggravated assault	Burglary	Larceny	Motor vehicle theft
b1	−0.0445 (0.0386)	−0.0417 (0.0268)	−0.0392 (0.0351)	−0.0372 (0.0261)	−0.00874 (0.0207)	−0.0789 (0.0235)**	0.0373 (0.0232)
b3	−0.186 (0.0484)**	−0.124 (0.0365)**	−0.0510 (0.0401)	−0.113 (0.0331)**	−0.117 (0.0258)**	−0.000169 (0.0292)	−0.153 (0.0296)**
△police t−1	−0.00000544 (0.0000149)	−0.0000175 (0.0000692) (	0.00100 0.000308)**	0.00121 (0.000916)	0.00121 (0.00115)	0.00484 (0.0110)	−0.00207 (0.00236)
nd *△police t−1	0.0000111 (0.0000222)	0.000400 (0.000284)	−0.000354 (0.00186)	0.0000534 (0.00102)	0.000593 (0.00234)	−0.00852 (0.0131)	0.00155 (0.00334)
△GSP	0.0000782 (0.000423)	−0.00101 (0.00127)	0.00676 (0.00572)	−0.0216 (0.0189)	−0.0616 (0.0622)	−0.0366 (0.0753)	0.00359 (0.0190)
nd *△GSP	0.000142 (0.000626)	0.000768 (0.00216)	−0.0150 (0.00855)*	0.0124 (0.0251)	0.113 (0.0751)	0.284 (0.133)**	0.00155 (0.0233)
R2	0.70	0.69	0.74	0.68	0.77	0.74	0.71
b1+b3	−0.231 (0.0291)**	−0.166 (0.0247)**	−0.0902 (0.0192)**	−0.150 (0.0205)**	−0.126 (0.0155)**	−0.0791 (0.0174)**	−0.116 (0.0183)**
△police t−1 (negative)	0.00000566 (0.0000177)	0.000383 (0.000298)	0.000646 (0.00182) (	0.00126 0.000470)**	0.00180 (0.00189)	−0.00368 (0.00683)	−0.000518 (0.00235)
△GSP (negative)	0.000220 (0.000459)	−0.000246 (0.00174)	−0.00824 (0.00677)	−0.0092 (.0.0164)	0.0514 (0.0421)	0.247 (0.110)**	0.00514 (0.0137)

The numbers in the parentheses show White heteroscedasticity consistent standard errors
** and *significant with 5% and 10% level

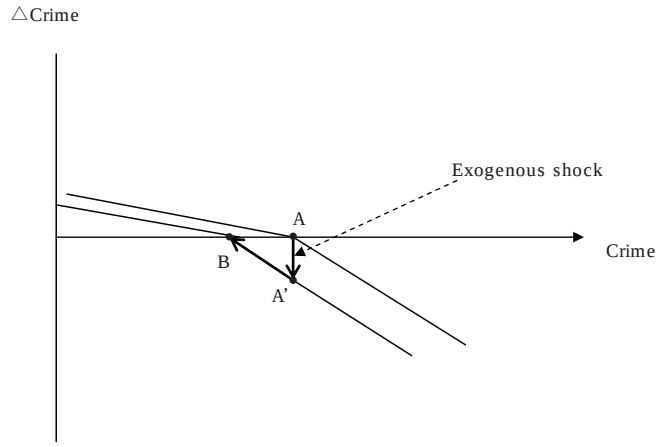
4. Conclusion

This study into the dynamic movement of crime aims to test whether the conversion process of crime leads to an asymmetric response of crime rate. We build a model to test the dynamic relationship between the change in crime rate and the level of crime rate and the effect that exogenous economic and deterrent factors have on crime. We estimate the model using Japanese and American prefecture or state level data. Our results show that, for a decreasing crime rate, convergence to an equilibrium position is relatively fast but when the crime rate is increasing, convergence to a stable crime rate is slower or does not happen. Our study therefore provides some evidence to suggest that the conversion process of crime causes asymmetry in crime rate response. From these results, we conclude that the exogenous shocks induce convergence as crime decreases, but no strong evidence of the dynamic cycle by the contagiousness or conversion process as crime increases.

We previously expected that economic factors might have explained the difference between the crime rate trends in Japan and the United States, especially the trend during the 1990s where Japan experienced a severe recession while the United States went through an economic boom. However, we cannot confirm this with our data set since could not show any significant results of economic factors. We recommend that this problem be further examined in future studies by using a different data set.

We also recommend that this study is extended

［ Figure 3］



to formulate a consistent theory with the study of quantitative comparative criminology, and to include the effect of crime committed by foreign offenders, which might affect the estimation results.

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来原先生紀要論文の役割分担について

来原：データ収集及び考察

林　：データ収集、推定及び考察

[Appendix] Definition of Crime Statistics

JAPAN(Criminal Statistics)	US(Uniform Crime Reporting Program)
Total number of criminal cases Composition of six categories: felonious and violet offences, larceny, intellectual and moral offences, and others	**Crime Index** Composition of selected offenses, the violent crime and property crime
Felonious offences murder, robbery, arson, rape	**Violent Crime** Composition of four offenses: murder and non negligent manslaughter, forcible rape, robbery, and aggravated assault
Violent offences violence, bodily injury, intimidation, extortion unlawful assembly with dangerous weapons	**Property Crime** Composition of four offenses: burglary, larceny-theft, motor vehicle theft, and arson *Arson is not included in any estimated volume data
Larceny larceny	**Murder and non-negligent manslaughter** The willful(non negligent) killing of one human being by another
Intellectual offences fraud, embezzlement, counterfeiting, official corruption, breach of trust	**Forcible Rape** The carnal knowledge of a female forcibly and against her will
Moral offences gambling, indecency	**Robbery** The taking or attempting to take anything of value from the care, custody, or control of a person or persons by force or threat of force or violence and/or by putting the victim in fear
Others	**Aggravated assault** An unlawful attack by one person upon another for the purpose of inflicting severe or aggravated bodily injury
	Burglary The unlawful entry of a structure to commit a felony or theft *Sub classifications: forcible entry, unlawful entry where no force is used, and attempted forcible entry
	Larceny-theft The unlawful taking, carrying, leading, or riding away of property from the possession or constructive possession of another
	Motor vehicle theft The theft or attempted theft of a motor vehicle
Alternative Classification	
Total number of major criminal cases The number of felonious offenses plus the number of kidnapping and forcible obscenity	
Total number of severe larceny offences The number of theft through breaking and entering, automobile theft, snatch, and pickpocket	