



The impact of COVID-19 on property crimes in developing countries: a case study on Bangladesh

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Abstract

This study explored the immediate (lockdown) and long-run (post-lockdown) effects of COVID-19 on property crimes in a developing country, Bangladesh. This investigation separately considered property-related crimes, i.e., dacoity, robbery, extortion, burglary, and theft. The composite measure of ‘total property crimes (TPC)’ was derived by aggregating individual property crimes. This study used the ordinary least square method on static and dynamic models using 2015M01–2021M12 (N=84) officially recorded data throughout the country. The present research found that the TPC increased by about 9% during the post-lockdown period and the lockdown reduced the TPC by about 75%. In a separate property crime analysis, the study found that robbery cases declined by about 10%, but burglary and theft cases increased by about 6% and 14%, respectively, during the post-lockdown period. The effective lockdown reduced all separate property crimes by 68–83%. The findings of this study are essential for future policy implications.

Keywords Property crimes · Pandemic · COVID-19 · Lockdown · Bangladesh

Introduction

The World Health Organization (WHO) declared the COVID-19 pandemic in the second week of March 2020 (WHO 2020). This pandemic still affects humans with different symptoms in 229 countries and states around the globe (Worldometers 2022). The pandemic situation, including the lockdown, has a significant effect on various socioeconomic factors, for example, people’s mobility (Halford et al. 2020), a shift in social and economic activities (Hodgkinson and Andresen 2020), poverty

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(Lata 2022), unemployment, price level, and a crisis of necessary goods (Banerjee et al. 2020; Victor et al. 2021). These socioeconomic deviations caused changes in the trend of crimes globally. Researchers described the fluctuations in the trend of crimes under two broad contexts: one was a criminological analysis based on the exceptional event theory (Hodgkinson and Andresen 2020), mobility and opportunity of crime theories (Halford et al. 2020; Abrams 2021), social distancing theory (Mohler et al. 2020; Bullock and Pellegrino 2021), and another was an economic analysis based on Becker's expected net utility theory (Poblete-Cazenave 2020; Hou et al. 2022).

All studies found a significant impact of the pandemic, especially lockdown, on crimes in various parts of the world (Eisner and Nivette 2020; Hodgkinson and Andresen 2020; Mohler et al. 2020; Poblete-Cazenave 2020; Bullock and Pellegrino 2021; Calderon-Anyosa and Kaufman 2021). Although some research demonstrated the effect of the pandemic on both violent and property crimes around the globe, only four studies demonstrated it in developing countries (Poblete-Cazenave 2020; Bullock and Pellegrino 2021; Calderon-Anyosa and Kaufman 2021; Fondevila et al. 2022). Only a few descriptive studies focused on the effect of lockdown on property crimes, i.e., theft, burglary, extortion, and robbery, in India and Brazil (Poblete-Cazenave 2020; Bullock and Pellegrino 2021). This paper is essential in the current literature because it demonstrated the long-run impact of the pandemic on property crimes during the post-lockdown period in a developing country, Bangladesh, where such evidence was absent. Moreover, this study explored the causal impact of COVID-19 on dacoity, which is new in the literature. This study found that COVID-19 during the post-lockdown period, especially the lockdown, significantly impacted all property crimes in the country, i.e., dacoity, robbery, extortion, burglary, and theft. This study's findings are consistent with criminological and economic theories and are essential for policy implications in developing countries, especially Bangladesh.

Literature review

The exceptional theory defines an unnatural event in a category of three spheres (Tipson 2013). The lithosphere accounts for changes in the earth's crust, such as earthquakes, volcanic eruptions, and tsunamis. The atmosphere accounts for the changes in water and air cause by, for example, hurricanes, droughts, wildfires, tornadoes, and floods. Furthermore, the biosphere accounts for the changes in a micro-organism (Tipson 2013), for example, COVID-19 and the Plague, which were also recognized as pandemics for their devastating, life-threatening nature (Hodgkinson and Andresen 2020; Saifuzzaman 2021). An exceptional event significantly shifts collective human behaviors, and regular activities in society consequently lead to a shift in the trend of crimes, too (Barton 1969; Drabek 1986; Andresen and Tong 2012). Before COVID-19, studies on the relationship between the pandemic,

including lockdown, and crimes were very few in the literature (Abrams 2021). For instance, one report recorded that 35% of overall crimes declined due to a 3 week lockdown in Chicago in 1918 (Robertson 1919).

Social cohesion and altruism, disorganization, or opportunity theory can all explain how a lithosphere, such as a pandemic, affects societies and criminal activity (Hodgkinson and Andresen 2020). Interestingly, the expectations for the effects of social shifts and fluctuations in the trend of crimes are mixed. The social cohesion and altruism theory predicts a declining or stable trend of crimes during an exceptional event (Zahran et al. 2009). This theory was developed mainly based on natural disasters where people help victims altruistically (Barton 1969). Conversely, the disorganization theory predicts an uprising trend of crimes due to the failure of social norms and order during an exceptional event (Curtis et al. 2000; Davila et al. 2005; Prelog 2016). Depending on the shifts in opportunities and types of crime, the opportunity of crime or routine activity theory predicts both upward and downward fluctuations in the trend of crimes during an exceptional event (Leitner et al. 2011). For instance, in 1977, a higher rate of robberies occurred during the blackout in New York City, while higher levels of violent crimes, illegal economic activities, and unemployment also prevailed (Genevie et al. 1987). Another study found a shift in property crimes from flooded to non-flooded neighborhoods in Brisbane in 2011 due to the shift in opportunities (Zahnow et al. 2017). Moreover, some researchers described these crime rate fluctuations during lockdown under the mobility of victims (Halford et al. 2020; Abrams 2021) and social distancing theory (Mohler et al. 2020; Bullcock and Pellegrino 2021).

In addition, some researchers explained fluctuations in the trend of crimes due to the changes in economic conditions during the pandemic, mainly based on Becker's expected net utility theory (Poblete-Cazenave 2020; Hou et al. 2022). They explained that the expected net utility (expected gain minus expense and probable apprehend cost) of an offense to a probable offender might vary depending on the mobility of victims, the opportunity of crimes, crime expense, and probable apprehend cost. Ultimately, criminological and economic analyses showed crime changes depending on probable victim's mobility rates and probable offenders' opportunities during the pandemic and lockdown (Halford et al. 2020). This phenomenon is also explainable under the lifestyle shift and routine activity theories (Hou et al. 2022).

Researchers also indicated that some probable impulses of COVID-19 on crimes, such as stagnant economic growth, may induce more criminal activities in society (Cohen and Felson 1978). Additionally, lockdown and social distancing policies restricted regular policing due to the shift in concentration involved in implementing social distancing among people (Poblete-Cazenave 2020). As a result, probable offenders might commit more crimes with a lower level of surveillance, patrol, and other crime prevention activities. For example, a study demonstrated increased crime by shifting resources from preventing criminal activities to non-criminal

activities in Ecuador (Carrillo et al. 2018). Moreover, disrupting the normal flow of prosecution, investigation, and detection processes during a pandemic might influence offenders to commit more crimes (Melamed and Newall 2020; Abrams 2021).

Conversely, restricting general mobility due to social distance might reduce crime opportunities among probable offenders (Halford et al. 2020; Poblete-Cazenave 2020). One recent study examined whether COVID-19 is a factor in changing crimes or not through the Granger causality test and found COVID-19 is a Granger cause of changing crimes (Hou et al. 2022). So, COVID-19 might have heterogeneous impacts on different crimes in different parts of the world (Farrell and Tilley 2020; Hodgkinson and Andresen 2020). For example, one study forecasted mixed trends in various property crimes but no changes in violent crimes in 16 different large cities in the USA due to the lockdown (Ashby 2020).

One review article summarized the results from 32 studies worldwide. It noted that domestic violence, childhood maltreatment, and abuse cases increased in the first week of the pandemic. Still, police and other social services recorded a declining rate of child abuse and maltreatment (Kourti et al. 2021). Besides, violence against women increased globally during the pandemic (UN Women 2020). On the other hand, some researchers found decreases in overall crime rates (41–60%) as a result of global lockdowns because stay-at-home and social isolation policies reduced people's general activities (Halford et al. 2020; Hodgkinson and Andresen 2020; Poblete-Cazenave 2020).

In a disaggregated analysis of crimes due to the lockdown, researchers found mixed trends in property and violent crimes worldwide. For instance, in the case of property crimes, trends of robbery, extortion, burglary, shoplifting, theft, theft from vehicles, and fraud declined in various cities in the USA, the UK, Canada, Australia, India, and Brazil (Eisner and Nivette 2020; Halford et al. 2020; Hodgkinson and Andresen 2020; Poblete-Cazenave 2020; Abrams 2021; Bullock and Pellegrino 2021; Wang and Weatherburn 2021). However, trends of non-residential burglary and vehicle theft increased in some cities in the USA (Abrams 2021), and no changes were found in the trend of vehicle theft in Vancouver, Canada (Hodgkinson and Andresen 2020). In the case of violent crimes, trends of murder, rape, serious assault, assault, death in a road accident, and domestic abuse decreased (Eisner and Nivette 2020; Halford et al. 2020; Calderon-Anyosa and Kaufman 2021), but the trend of domestic violence increased (Mohler et al. 2020). The trends of overall violent crimes (Ashby 2020; Hodgkinson and Andresen 2020; Bullock and Pellegrino 2021; Wang and Weatherburn 2021), mischief, homicide, and shooting did not change (Hodgkinson and Andresen 2020; Abrams 2021) due to lockdown. Moreover, one recent study found declining trends in fraud, robbery, burglary, theft, and assault cases during the pandemic using daily data up to November 2020 in different cities in the USA (Hou et al. 2022).

Due to the ongoing pandemic, Bangladesh first officially recorded a COVID-19 positive on March 8, 2020, and announced a lockdown on March 26, 2020, for a

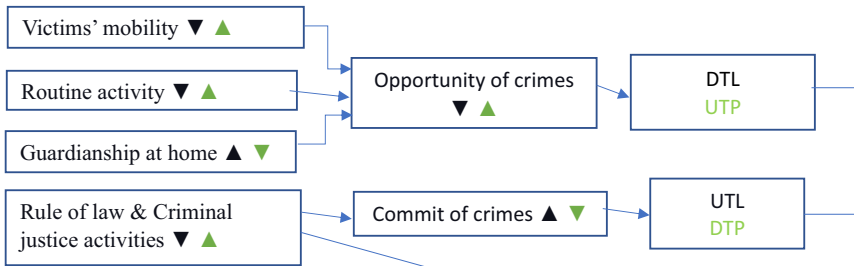
devastating outbreak of the COVID-19 virus among people in the country (Rashid 2021; Saifuzzaman 2021). The first lockdown eased on May 31, 2020; the second lockdown was announced in September 2020 and prolonged to early January 2021; and the third lockdown prevailed between April 14–28, 2021 (Arifuzzaman et al. 2021; Rashid 2021). Researchers have also demonstrated the effect of COVID-19 and lockdown on property and violent crimes in Bangladesh. For instance, it is forecasted based on the observations during COVID-19 and the first lockdown that the arrest rates for vehicle theft and illegal arms dealing were unchanged, but the arrest rate for drug trafficking was steadily high in Dhaka metropolitan city of Bangladesh (Rashid 2021). Gender-based violence, sexual violence, inmate partner violence, rape, and child maltreatment cases increased in Bangladesh during the pandemic (Hamadani et al. 2020; Sifat 2020; Akram and Pervin 2021; Islam and Hossain 2021; King et al. 2021; Rayhan and Akter 2021; Tasnim et al. 2022). Besides, suicidal incidents also increased during the lockdown (Bhuiyan et al. 2021; Kar 2021).

In the long run, COVID-19 may impact other factors, such as poverty, unemployment, and inflation (Eisner and Nivette 2020; Poblete-Cazenave 2020). These changed economic indicators might also influence the number of probable offenders and crime rates in a region or country. Thus, socio-legal and economic factors might change crime trends in the long run. Despite having a COVID-19 short-run (lockdown) impact on various crimes in the global literature, a post-lockdown COVID-19 impact remains to be measured. Empirical evidence regarding the COVID-19 pandemic lockdown (short-run) and post-lockdown (long-run) impacts on property crimes in Bangladesh is not available in the literature. Per available studies, no empirical research in the literature demonstrated the effect of COVID-19 on dacoity as a property crime. Except for the study of Hou and colleagues (Hou et al. 2022), the abovementioned studies examined lockdown's effect on various crimes. However, a long-run post-lockdown COVID-19 impact on property crimes remains to be measured. The study by Hou and colleagues showed the causal impact of COVID-19 on various crimes using the Granger causality test in several cities in the USA (Hou et al. 2022). The Granger causality test is excellent for showing the causation between variables but cannot show the magnitude of the causation (Wan et al. 2012). Thus, this empirical analysis would be the first attempt to show the long-term post-lockdown causal impact of COVID-19 on property crimes and fill a gap in the literature. This study explored the abovementioned causal impact in Bangladesh using nationally recorded data from police stations.

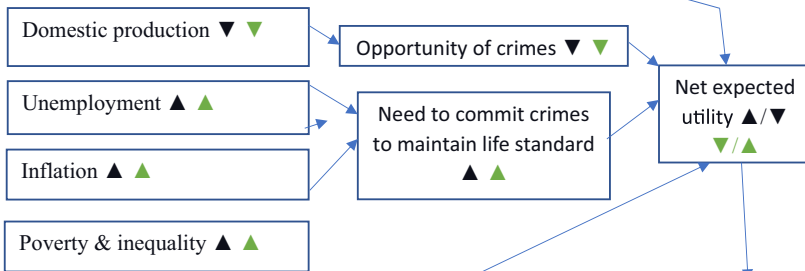
Conceptual framework

Probable impacts on major factors of crime during the lockdown (stay-at-home policy) and post-lockdown periods that might influence the trend of property crimes. The probable changes in crime factors and property crime trends are depicted in the following diagram:

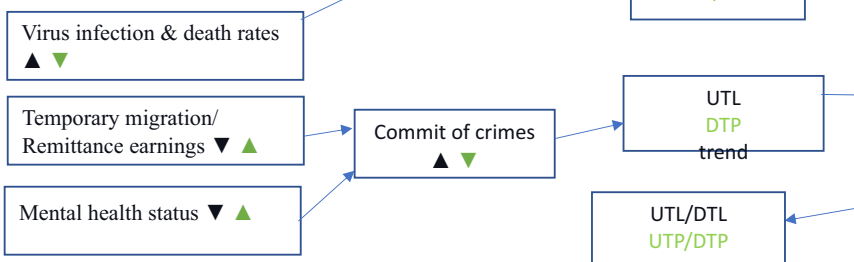
Socio-legal aspects



Economic aspects



Other aspects



Notes: ▼ = decrease during lockdown, ▲ = increase during lockdown, ▼ = decrease during post-lockdown, ▲ = increase during post-lockdown, UTL = upward crime trend during lockdown, DTL = downward crime trend during lockdown, UTP = upward crime trend during post-lockdown, and DTP = downward crime trend during post-lockdown.

Data and method

Data source and sample

The study used monthly time series data in Bangladesh from January 2015 to December 2021 (N=84). This study included only property-related cases, such as

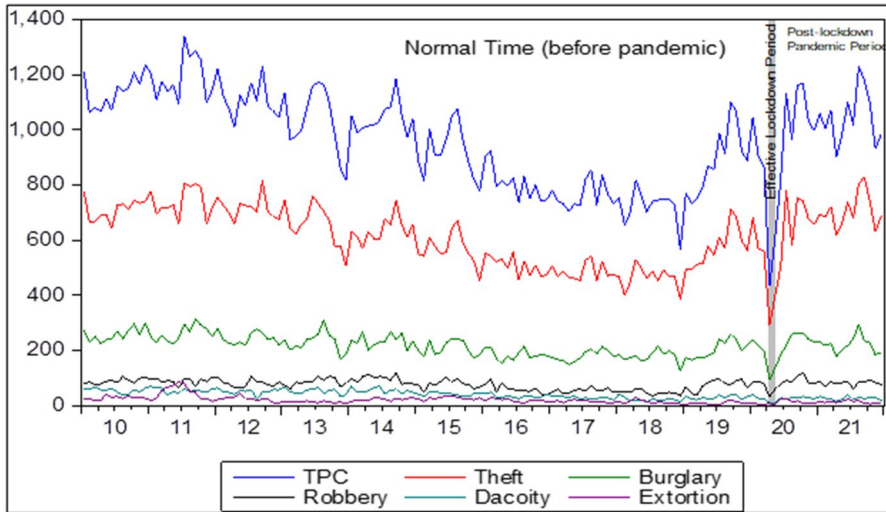


Fig. 1 Trends of property crimes

dacoity, robbery, extortion, burglary, and theft. Additionally, the study measured total property crimes (TPC) by adding all cases related to property crimes to its examination. These cases were recorded in 663 police stations nationwide and are also known as General Register (GR) cases. The GR at every police station is open 24 h a day to record a case if a person is victimized by criminal activity. The officer-in-charge of a police station shall record a GR case whenever a victim, a victim's relative, or a person informs the officer of a criminal event in the area of the respective police station. All lodged cases in the police stations are recorded daily on the criminal data management system (CDMS) software. Bangladesh Police initiated the CDMS in 2008, which is managed by all police sub-units throughout the country and supervised by the Crime Analysis Section of the Police Headquarters (Bangladesh Police 2022). Thus, all criminal events in Bangladesh should be recorded in the CDMS; therefore, the results of this study would reflect the national-level policy implications. Besides, the data on the total population are collected from the World Bank's country-wise online-based dataset (World Bank 2022) and the annual report of the Bangladesh Bureau of Statistics (BBS 2021).

This study used a sample of 84 months (2015M01–2021M12) time series data, where 63 months (2015M01–2020M03) explained crime trends before the pandemic, 2 months (2020M04–2020M05) captured crime trends during the pandemic lockdown, and the rest, 19 months (2020M06–2021M12), explained crime trends during the post-lockdown pandemic period (Fig. 1). Thus, the used sample is capable to show the impact of COVID-19 on property crimes during the lockdown and post-lockdown pandemic periods compared to the crime trends in regular time (before the pandemic period).

Variables and analytic methods

The study used per capita TPC and per capita separated property crimes (dacoity, robbery, extortion, burglary, and theft) as outcome variables. Absolute data values would be biased because the population is unequal every year. So, per capita crime should be logical (Levitt 2002). This study's primary variable of interest is the COVID-19 post-lockdown situation as a dummy variable. The value of the dummy is equal to 1 if the situation is COVID-19; otherwise, it is 0. In addition, the study adopted another independent dummy variable to show the impact of lockdown on property crimes. Regarding people staying at home during the lockdown, the first lockdown was so effective, and subsequent lockdowns were not as effective as expected (Rashid 2021). Thus, this study considered the post-lockdown pandemic period from June 2020 to December 2021 and the lockdown from April 2020 to May 2020. Moreover, this study utilized 11 seasonal (monthly) dummies with the reference of January to address the temporal variations of the crimes.

The study used the logarithmic form of the outcome variables in all models except extortion, which has an observation equal to 0 (2019M06=0). In the case of the extortion model, the study utilized a logarithmic transformation by adding 1 to all observations. This logarithmic transformation will not change the regressed results but can give the benefit of a logarithmic function (Box and Cox 1964). The benefits of a logarithmic form are that it will minimize outliers and eliminate measurement errors because it makes values very small; consequently, errors will also be mitigated (Lin 2009). The 'trend' term was also considered in this study to eliminate any probable measurement error. Thus, seasonal variables, logarithmic form of the outcome variables, and trend terms eliminated any probable measurement errors or errors in the officially recorded data (Lin 2009; Chalfin and McCrary 2013; Dills et al. 2013; Buil-Gil et al. 2022).

Although the study could eliminate probable measurement error but could not address possible endogeneity problems and omitted variable bias, we predict there is less chance of endogeneity problems because COVID-19 and lockdown can influence crime rates. However, crimes cannot affect COVID-19 situation or lockdown. The log-linear functional form is defined below:

$$\ln(TPC)_t = a + b_1 Dummy - COVID - 19 + b_2 Dummy - Lockdown + b_3 Trend_t + Dummy - seasonals + e_t \quad (1)$$

In Eq. 1, t =time (from 2015M01 to 2021M12), TPC is total property crimes, which also applies to all separated property crimes (e.g., dacoity, robbery, extortion, burglary, and theft). *Dummy-COVID-19* and *Dummy-lockdown* are dummies to show the impact of COVID-19 during the post-lockdown and lockdown periods, respectively, on property crimes. The *Dummy-seasonals* are monthly dummies to capture seasonal variations. a is a constant, and e is an error term.

Before selecting a method of estimation, the study first checked variable's order of integration, whether the variables are stationary at level or first difference. Because the condition of stationarity of variables is essential for unbiased, stable,

Table 1 Unit root test and order of integration

Variables	Augmented Dickey-Fuller (ADF) test		Phillips-Perron (PP) Tndndest		Conclusion (Intercept and trend)
	Intercept	Intercept and trend	Intercept	Intercept and trend	
LTPC	- 3.93*	- 4.06*	- 3.85*	- 3.98*	
D(LTPC)	- 11.21*	- 11.15*	- 17.11*	- 17.81*	I (0)
Ldacoity	- 5.03*	- 6.18*	- 5.15*	- 6.35*	
D(Ldacoity)	- 11.34*	- 11.27*	- 14.88*	- 14.75*	I (0)
Lrobbery	- 4.60*	- 4.73*	- 4.68*	- 4.80*	
D(Lrobbery)	- 9.94*	- 9.89*	- 17.21*	- 17.05*	I (0)
Lextortion	- 4.03*	- 4.73*	- 3.84*	- 4.57*	
D(Lextortion)	- 7.88*	- 7.84*	- 29.02*	- 28.89*	I (0)
Lburglary	- 4.60*	- 4.61*	- 4.67*	- 4.69*	
D(Lburglary)	- 10.32*	- 10.26*	- 13.51*	- 13.32*	I (0)
Ltheft	- 3.90*	- 4.27*	- 3.85*	- 4.22*	
D(Ltheft)	- 7.96*	- 7.98*	- 20.09*	- 26.84*	I (0)

Critical value for the ADF and PP tests is - 2.89 (with intercept) and - 3.46 (with intercept and trend) taken as one-sided p values of MacKinnon (1996)

The '**' denotes significance at 5% level

and consistent findings in time series data analysis (Glynn et al. 2007). The Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) unit root tests indicated that the order of integration of outcome variables in every model (either intercept or both intercept and trend) is 0 (Table 1), which means the variables are stationary at level I(0). Besides, the independent variables are dummies. Thus, the ordinary least square (OLS) method on variables at level is sufficient to estimate the models mentioned above.

Results

Table 2 shows descriptive statistics for the outcome variables. Theft is the main driving force behind the TPC, then burglary, extortion, dacoity, and robbery. Although the mean and median of the variables are close, standard deviations are high, which means some observations are spread from the mean; therefore, the possibility of a structural break is present. The possibility of a structural break is due to the pandemic, especially the lockdown, where the rates of property crimes have sharply dropped (shaded area in Fig. 1).

The study checks for unknown structural breakpoints in the trend of the outcome variable because a regression model with a sudden change in the trend can make the model unstable and unreliable (Antoch et al. 2019; Muthuramu and Uma Maheswari 2019). The study finds two structural breaks in every model using the Bai-Perron multiple breakpoints test (Table 3). The breakpoints are not merely for the pandemic and lockdown; some are before the pandemic for unknown reasons. However, every

Table 2 Descriptive statistics of the variables

	TPC	Dacoity	Robbery	Extortion	Burglary	Theft
Mean	868.310	29.250	68.083	13.702	197.952	558.333
Median	835.000	28.500	68.000	13.000	192.000	542.500
Maximum	1232.000	49.000	120.000	36.000	296.000	830.000
Minimum	434.000	10.000	32.000	0.000	93.000	293.000
Standard deviation	152.037	8.842	19.411	8.133	33.817	104.644
Observations	84	84	84	84	84	84

Table 3 Multiple breakpoints using the Bai-Perron test

Variables	L + 1 breaks vs. L sequentially determined breaks	Breakpoints
LTPC	1 vs. 2* (F-statistics = 23.91)	2018M12 and 2020M05
Ldacoity	1 vs. 2* (F-statistics = 11.18)	2018M06 and 2018M12
Lrobbery	1 vs. 2* (F-statistics = 47.62)	2016M03 and 2020M05
Lextortion	1 vs. 2* (F-statistics = 15.33)	2019M05 and 2019M06
Lburglary	1 vs. 2* (F-statistics = 11.57)	2018M12 and 2020M05
Ltheft	1 vs. 2* (F-statistics = 14.89)	2020M05 and 2020M08

Tests are done with trimming 0.15, Maximum breaks 5 and the critical values are taken from Bai and Perron (2003)

L natural logarithm

* denotes significant at 0.05 level

breakpoint has been treated as a dummy variable equal to 1. Otherwise, the values are 0. The breakpoint dummy makes the model stable by changing the constant without affecting the slope (Glynn et al. 2007).

Table 4 shows the estimated results of the TPC model in Panel A and the diagnostic test results in Panel B. The results in column 1 are derived from the simplest model, excluding the trend term. Adding the trend term yields the results in column 2. Although the results in columns 1 and 2 are close and statistically significant (except for the trend), both models suffer from autocorrelation problems. The results in the presence of an autocorrelation or serial correlation problem in the disturbance term are unbiased and consistent but inefficient and suboptimal, and the usual significance is invalid (Greene 2002). Econometricians and researchers suggest using the lag dependent variable (LDV) as a regressor to solve the autocorrelation problem after careful consideration, such as that the sample size should not be small, other independent variables should be exogenous and well-trended, and the coefficient of LDV should not be so high that the suppression of other independent variable's coefficients is sustained at a minimum (Maeshiro 1996; Achen 2000; Cook and Webb 2021). In addition, the LDV should be a relevant regressor (Achen 2000), and the lag of the LDV should be minimal (McKinnish 2005).

The number of observations in this study is not small ($N=84$), and more than one exogenous variable (COVID-19 and Lockdown) is utilized. Besides, the LDV is

Table 4 Estimated results on the TPC model using the ordinary least square (OLS) method

	(1) LTPC	(2) LTPC	(3) LTPC	(4) LTPC	(5) LTPC ^a
Panel-A: variables					
Dummy-COVID-19	0.192* (0.032)	0.245* (0.047)	0.107* (0.034)	0.089* (0.026)	-
Dummy-lockdown	- 0.822* (0.133)	- 0.831* (0.132)	- 0.750* (0.098)	- 0.746* (0.097)	-
LDV ^b	-	-	0.600* (0.080)	0.608* (0.077)	0.758* (0.086)
Trend	-	- 0.001 (0.001)	- 0.000 (0.001)	-	-
Dummy (Breakpoint-1)	- 0.337* (0.131)	- 0.319* (0.130)	- 0.261* (0.096)	- 0.265* (0.096)	- 0.243* (0.093)
Dummy (Breakpoint-2)	- 0.315* (0.185)	- 0.315* (0.183)	- 0.721* (0.146)	- 0.726* (0.145)	-
Seasonal dummies	Yes	Yes	Yes	Yes	Yes
C	- 12.148* (0.046)	- 12.111* (0.052)	- 4.783* (0.968)	- 4.700* (0.952)	- 2.837* (1.062)
Panel-B: diagnostic test results					
Observations (adjusted)	84	84	83	83	61
R ²	0.605	0.618	0.797	0.797	0.700
Adjusted R ²	0.518	0.527	0.744	0.747	0.617
Durbin-Watson statistics	0.681	0.705	2.132	2.140	2.309
Standard error of regression (SER)	0.120	0.120	0.089	0.088	0.083
Normality (Jarque-Bera)	2.393	2.738	0.491	0.511	4.658
LM (Chi-Square)	43.216*	42.241*	2.330	2.081	2.453
Heteroscedasticity (Breusch-Pagan-Godfrey)	18.634	20.028	20.218	20.007	13.739
Ramsey-reset (F-statistics)	0.718	0.807	1.981	2.137	0.176
L natural log					

*, ** denotes significant at 0.05, standard errors are in parentheses

^aEstimated results on the observations before COVID-19 (2015M01–2020M02)

^bLDV = Lag dependent variable (LTPC₍₋₁₎)

relevant as a regressor because the previous experience of successive crimes induces offenders to commit more crimes (Ouimet 2002). The coefficient of LDV is not so high (about 0.6) that it can suppress other regressors (column 3 of Table 4). Importantly, LDV eliminates omitted variable bias and potential endogeneity problems in the estimation (Achen 2000; Cook and Webb 2021). R-square, adjusted R-square, and standard error of regression have improved after taking LDV, but the trend term remained statistically insignificant. Therefore, the study excludes the trend term from the estimation where the R-square is the same but the adjusted R-square has improved slightly (column 4 of Table 4). The goodness-of-fit of the model is improved by excluding the trend term. Thus, the dynamic model (including LDV) has completely developed where the disturbance term is white noise (normally distributed, no autocorrelation, and homoscedastic).

Compared to the normal time coefficients, the unbiased and consistent findings (column 4) indicate that the TPC has increased by 8.9% during the post-lockdown pandemic period in Bangladesh. In contrast, the TPC has remarkably declined by 74.6% due to the lockdown in the country. The elasticity of LDV (one lag of TPC) on total property crimes is 0.61. In other words, one month's previous ten units of successive property crimes induced offenders to commit an additional six units of property crimes in the current month. The elasticity of LDV on TPC before the pandemic was higher at 0.76 (column 5).

Following the estimation strategy of the TPC model, the separated property crime models have also solved the autocorrelation problem by taking the respective LDV. The findings are reported in Table 5, where Panel A shows the estimated results and Panel B shows the diagnostic test results. The diagnostic test results support a white noise disturbance term in every model. So, the estimated results are also unbiased, consistent, and efficient.

Estimated results in Table 5 indicate that the coefficients of dacoity, robbery, and extortion during the post-lockdown pandemic period are negative, but only the result of robbery is significant. Robbery cases have been reduced, but burglary and theft cases have increased by about 10%, 6%, and 14%, respectively, after the effective lockdown. The lockdown during the pandemic decreased dacoity, robbery, extortion, burglary, and theft cases by about 70%, 83%, 71%, 68%, and 75%, respectively. The elasticities of LDV on dacoity, robbery, extortion, burglary, and theft are about 0.39, 0.66, 0.53, 0.53, and 0.57, respectively.

Discussion

The theory explains that crime rates could be changed due to the mobility of victims and the opportunity to commit committable offenses (Halford et al. 2020; Hodgkinson and Andresen 2020; Abrams 2021). Mobility and opportunity might change due to social distancing, collective human behavior swings, and shifts in routine activities during the COVID-19 pandemic, especially during lockdown periods (Mohler et al. 2020; Bullock and Pellegrino 2021). Under the earlier criteria, the probable offender's expected net utility in committing a crime depends on expected gain, expense, probable apprehending, and punishment (Poblete-Cazenave 2020; Hou

Table 5 Estimated results of COVID-19 on separated property crimes using the OLS method

Panel-A: variables	Ldacoity	Lrobbery	Lextortion	Lburglary	Ltheft
Dummy-COVID-19	- 0.112 (0.067)	- 0.102* (0.060)	- 0.058 (0.122)	0.058* (0.022)	0.139* (0.031)
Dummy-Lockdown	- 0.700* (0.196)	- 0.828* (0.188)	- 0.713* (0.371)	- 0.676* (0.089)	- 0.750* (0.105)
LDV ^a	0.394* (0.092)	0.665* (0.094)	0.532* (0.080)	0.533* (0.077)	0.570* (0.084)
Dummy (Breakpoint-1)	- 0.686* (0.189)	- 0.443* (0.105)	- 2.204* (0.512)	0.659* (0.132)	- 0.665* (0.154)
Dummy (Breakpoint-2)	- 0.273* (0.052)	- 0.348* (0.096)	- 1.582* (0.498)	- 0.361* (0.061)	- 0.313* (0.105)
Seasonal dummies	Yes	Yes	Yes	Yes	Yes
C	- 9.112* (1.442)	- 4.798* (7.578)	- 7.810* (1.337)	- 6.318* (1.056)	- 5.366* (1.076)
Panel-B: diagnostic test results					
Observations (adjusted)	83	83	83	83	83
R ²	0.573	0.605	0.645	0.833	0.776
Durbin-Watson statistics	1.994	2.087	2.012	1.994	2.084
SER	0.243	0.207	0.454	0.080	0.095
Normality (Jarque-Bera)	0.502	2.020	0.898	1.031	0.749
LM (Chi-Square)	0.230	0.624	1.655	0.171	3.758
Hetero. (Breusch-Pagan-Godfrey)	14.577	18.899	18.095	20.535	21.875
Heteroscedasticity (ARCH)	0.112	1.700	0.024	0.097	1.217
Ramsey-reset (F-statistics)	0.556	0.800	0.276	0.201	3.394
L natural log					

*, ** denotes significant at 0.05, standard errors are in parentheses

^aOne-lag of models' respective outcome variable (e.g., Ldacoity, Lrobbery, Lextortion, Lburglary, and Ltheft)

et al. 2022). A probable offender committed a crime if the expected net utility of that crime was positive.

As an immediate effect, the lockdown decreased TPC and all separated property crimes by about 75% and 68–83%, respectively. This remarkable decline in property crimes happened due to the effective implementation of stay-at-home orders by both general people and probable offenders. The mobilities of victims and the opportunity for criminal events were reduced during the lockdown to implement social distancing orders and shift routine activity. People kept themselves within their residential houses, reducing their mobility. Thus, the opportunity to commit crimes also declined tremendously. Additionally, the stay-at-home policy increased guardianship in victims' houses, substantially reducing thefts and burglaries. The remarkable decline in property crimes, especially robbery, extortion, burglary, and theft, due to lockdown is consistent with the findings of several studies around the globe (Eisner and Nivette 2020; Halford et al. 2020; Poblete-Cazenave 2020; Bullcock and Pellegrino 2021).

On the other hand, overall property crimes (TPC) increased by about 9% due to the long-run effect of COVID-19 during the post-lockdown period. The findings for separate property crimes are mixed, with burglary and theft cases increasing but robbery cases decreasing. Post-event crime rates generally revert to pre-event levels (Zahnaw et al. 2017). The same scenario is also observed in the case of Bangladesh, where pre- and post-lockdown property crime rates are almost similar (Fig. 1). The main reason behind this reversion of crime rates was the relaxation of social distancing and increased people's mobility, consequently increasing the opportunity for crimes to the pre-lockdown level.

Moreover, an upward trend of property crimes during the post-lockdown period took place due to several probable reasons, i.e., economic meltdown, a long-term shutdown of nonessential businesses, and a rising trend of unemployment, poverty, and inflation (Banerjee et al. 2020; Islam 2020; Victor et al. 2021; Lata 2022). In addition, disrupting the normal flow of the investigation, detection, and prosecution processes due to the shift of resources from criminal to non-criminal activities and non-traditional online-based prosecution might influence offenders to commit more crimes. The mixed results of property crimes during the post-lockdown period are consistent with the trends in different countries after the global financial crisis (SASS 2012). The post-lockdown forecast also showed mixed trends in property crimes in several large cities in the USA (Ashby 2020).

The mechanism of increased property crimes during the pandemic (after the first lockdown) can be explained from various angles, i.e., socioeconomic, psychological, and physical factors (Cohen and Felson 1978). Economic stagnancy during the pandemic might be vital to increasing property crimes. Economic stagnancy reduced general economic activities and increased unemployment (Lata 2022). Besides, supply shocks in national and international markets during pandemics increased inflation; consequently, the purchasing power of the people was reduced, and panic over a scarcity of necessary goods prevailed among people (Banerjee et al. 2020; Islam 2020; Victor et al. 2021; Lata 2022). Therefore, offenders increased property crimes to maintain their living standards.

Moreover, subsistence-level people might be poorer and commit property crimes to maintain their minimum living standards. Conversely, the decreased robbery rate during the post-lockdown period is inconsistent with the opportunity of crimes theory and the expectation of economic stagnancy during the pandemic. The probable explanations for decreased robbery cases are: first, a robbery is committed by more than one offender aware of the threat of spreading the COVID-19 virus to each other, resulting in reduced robbery cases. Second, offenders committed burglary and theft instead of robbery for safety reasons from viruses and because it was easier to commit.

The one-month lag of TPC and separated property crimes was inelastic, roughly at 0.60. This inelastic result indicates that property crimes were inflated by less than unity for successive property crimes. However, the higher pre-pandemic elasticity (0.76) indicates a probable strong effect of economic stagnancy on increasing property crimes in Bangladesh during the post-lockdown pandemic. Because the opportunity for crimes might not be returned to the pre-pandemic situation, the TPC increased by 9% during the post-lockdown period. The increased rates of property crimes happened due to the prevailing higher rates of unemployment, inflation, food insecurity, and poverty during the post-lockdown pandemic in the country (Banerjee et al. 2020; Islam 2020; Lata 2022).

Limitations

This study has some limitations that should be considered regarding policy implications. The findings of this study are based on recorded crimes in police stations throughout the country, but they could not account for property crimes that were not reported to any police station. Besides, the study could not show the results based on the age, level of income, and gender of the offenders due to data constraints.

Policy implications

The present investigation proposes certain policies derived from the obtained results, considering the aforementioned constraints. The research has presented potential strategies for crime prevention in light of the short-term (lockdown) and long-term (post-lockdown) impacts of a pandemic in the future.

Probable responses during a lockdown

During a lockdown period, there is a notable reduction in property crimes. As a result, law enforcement agencies may opt to temporarily reallocate some of their resources from crime prevention initiatives to focus on measures to control the pandemic. For instance, in Bangladesh, police assisted in implementing social distancing measures, distributed food aid, transported sick people to hospitals, and performed funeral ceremonies during the COVID-19 pandemic (UNB 2021).

During the implementation of a stay-at-home policy, commonly referred to as a lockdown, to manage a pandemic, it is imperative that the government ensure the provision of essential basic needs such as food and medications, as well as a resilient public health service-provider system for the populace. The provision of such facilities during a period of lockdown has the potential to mitigate disparities and enhance mental well-being among individuals, thereby potentially reducing the incidence of pandemic-related offences and criminal activities.

Probable responses during a post-lockdown period

Law enforcement agencies can potentially optimize their prevention and detection strategies by reallocating resources towards mitigating post-lockdown property offences, as these types of crimes tend to exhibit higher rates than those observed prior to the lockdown period. It is recommended that pertinent government and non-government personnel utilize various communication channels, such as television, radio, and social media, to disseminate a preventative message regarding potential property crimes. This message should include guidelines outlining appropriate actions and behaviors for individuals to follow.

It is recommended that the government implement measures aimed at mitigating poverty, hunger, and inequalities in the aftermath of the lockdown period. Such measures may include the provision of investment opportunities, the creation of employment-generating initiatives, and the implementation of suitable fiscal and monetary policies. These initiatives aim to prevent individuals living at the subsistence level from committing property crimes by providing them with necessities such as food and healthcare, albeit at a minimum standard. Consequently, the likelihood of criminal activity and potential perpetrators associated with the property will be diminished. It is recommended that the government establish a conducive atmosphere for the private sector to facilitate expeditious economic recuperation in both the public and private domains. Efficient and expeditious prosecution is also imperative to ensure that perpetrators of crime are met with substantial penalties, thereby deterring future criminal activity.

Conclusion

The study explored the impact of COVID-19 during the lockdown and post-lockdown on property crimes in Bangladesh. During the post-lockdown pandemic, COVID-19 increased property crimes in the country, especially theft and burglary. On the other hand, the lockdown reduced property crimes substantially. The findings suggest more prevention and detection policing during the post-lockdown period to reduce property crimes. Police can increase social activities (i.e., social distancing, distribution of necessary goods, and transportation of sick people to hospitals) towards people, especially among poor ones, during the lockdown. The government should take proper measures to reduce poverty, inequality, unemployment, and economic inflation to reduce hunger, which may prevent the country's probable

offenders and property crimes. Besides, people should take the necessary actions to secure their properties during a pandemic. This study suggests further research examining the long-run impact of the pandemic on crimes in developing countries. Various socio-legal and economic factors during the post-lockdown pandemic might influence crime, which should also be considered in future investigations. So relevant policymakers can adopt appropriate policies to curb crimes in their countries.

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Data availability Data is available (upon request) at the Crime Analysis section of Police Headquarters (<https://cdms.police.gov.bd/cdms/f?p=105:101:0>); at ‘World Development Indicators’ of the World Bank (WB) (<https://databank.worldbank.org/reports.aspx?source=2&country=BGD>); and different issues of the ‘Statistical Yearbook of Bangladesh’ published by the Bangladesh Bureau of Statistics (BBS) (https://bbs.portal.gov.bd/sites/default/files/files/bbs.portal.gov.bd/page/5464ccb8_f7a2_4ad2_a1ef_2a44daa0af6f/2022-03-29-06-10-2ed46e9d1b5f9613093b659f51364ca3.pdf).

Declarations

Conflicts of interest The author declares no conflict of interest or competing interests.

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