Offline crime may go back to normal, cyber won’t: Interrupted time-series analysis during COVID-19

Contributions should be fewer than 5,000 words, not including references, endnotes, figures or tables.

Ideas

Interrupted time series analysis + counterfactuals: https://ds4ps.org/pe4ps-textbook/docs/p-020-time-series.html#the-counterfactual

Focus in Northern Ireland

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# Acknowledgements

# Abstract

# Keywords

Coronavirus; Fraud; Counterfactuals; Temporal; Routine activities; Cyber-enabled

# Introduction

The COVID-19 pandemic and the associated stay-at-home orders imposed by national and regional governments to prevent the spread of the virus caused unprecedented changes in the everyday lives of millions worldwide. Due to the quick spread and high mortality of the virus (on 24th June 2021, the World Health Organization has recorded more than 179 million cases and almost 4 million deaths), many countries established and enforced lockdown and social distancing measures to control the virus, which had severe short- and medium-term effects on multiple social domains, including psychological wellbeing (Krendl and Perry, 2021; Rajkumar, 2020), inequality (Abedi et al., 2021; Czymara et al., 2021), the subsistence of small and medium businesses (Bartik et al., 2020) and crime rates (Nivette et al., 2021).

Many researchers and public organisations observed important decreases in some types of violent and property crime immediately after the first national and regional lockdowns in the United States (Abrams, 2021; Ashby, 2020; Mohler et al., 2020), the United Kingdom (Halford et al., 2020), Australia (Payne et al., 2021) and many other countries (Nivette et al., 2021). Simultaneously, others indicated that while street crimes decreased during the first months of the pandemic, other offences that occur in physical and digital places less affected by lockdown mobility restriction, such as domestic violence (Piquero et al., 2021), cyber-enabled fraud (Kemp et al., 2021), online hate speech (Stechemesser et al., 2020) and cyber-dependent crime (Buil-Gil et al., 2020), increased. After the first months of COVID pandemic, researchers noted that rates of traditional, offline crime started to bounce back to pre-COVID levels (Langton et al., 2021; Nix and Richards, 2021), but there is a lack of research about the medium-term impact, and the potential long-term impact, of stay-at-home order on cybercrime. More importantly, crime research has yet to understand whether the peak in cyber-enabled and cyber-dependent crime seen immediately after the first lockdown orders returns to pre-COVID levels after the ease of stay-at-home restrictions or remains well above pre-pandemic trends, thus indicating a potential long-term upward trend in cybercrime. This research analyses changes in crime, including both offline and online crime, in Northern Ireland during COVID-19 up until May 2021, and investigates the short- and medium-term impact of lockdown restrictions on crime.

The timeline of the COVID-19 pandemic in Northern Ireland was similar to that of other parts of the UK and Europe. The first case was detected in the town of Antrim on February 27th 2020, and the number of cases rose steeply throughout March. In order to control the spread of the virus, the UK Government announced the first COVID national lockdown on March 23rd, which came into force three days later on March 26th. All non-essential social and business activity was restricted for weeks, and non-essential shops, schools and universities, businesses, pubs and other venues were closed. The first lockdown was gradually eased during June and July 2020. Due to the steep rise in COVID infections during late September and early October 2020, the Northern Ireland Government announced a second lockdown on October 14th 2020, which officially began on October 16th and was mostly lifted by the second week of December. This second lockdown involved the closure of schools, universities and the hospitality sector, but it was less strict than the first national lockdown and did not involve a stay-at-home order as such. A third lockdown was announced on December 17th to begin on December 26th, and mobility restrictions were hardened on the 8th January 2021, when a stay-at-home order came into force due to the spread of a new variant of the virus. This last lockdown meant that people were only allowed to leave home for medical reasons, to buy food, exercise and work that cannot be done from home. Stay-at-home orders were progressively lifted during March and April 2021, following the increase in the proportions of persons vaccinated against COVID.

Aims of paper

Distribution of paper

# Rapid social changes and crime: The COVID-19 case

Changes in mobility

Changes in street crime

Changes in cyber

Increase in romance fraud suffered by young people in the UK (Buil-Gil and Zeng, 2021)

Reduction in successful deliveries of drugs bought in cryptomarkets (Bergeron et al., 2020)

# The present study

# Methodology

## Data

Data recorded and published by the Police Service of Northern Ireland between April 2015 and May 2021 in the crime open data portal (<https://www.psni.police.uk/inside-psni/Statistics/police-recorded-crime-statistics/>). Historical crime data can also be downloaded from the online portal of Open Data Northern Ireland (<https://www.opendatani.gov.uk/dataset/police-recorded-crime-in-northern-ireland>).

## Analytical approach

Interrupted time series analysis and counterfactuals

represents time in months, , and correspond to the first, second and third lockdowns, respectively, and , and are the number of months since the first, second and third lockdowns, respectively.

Counterfactual predicted from

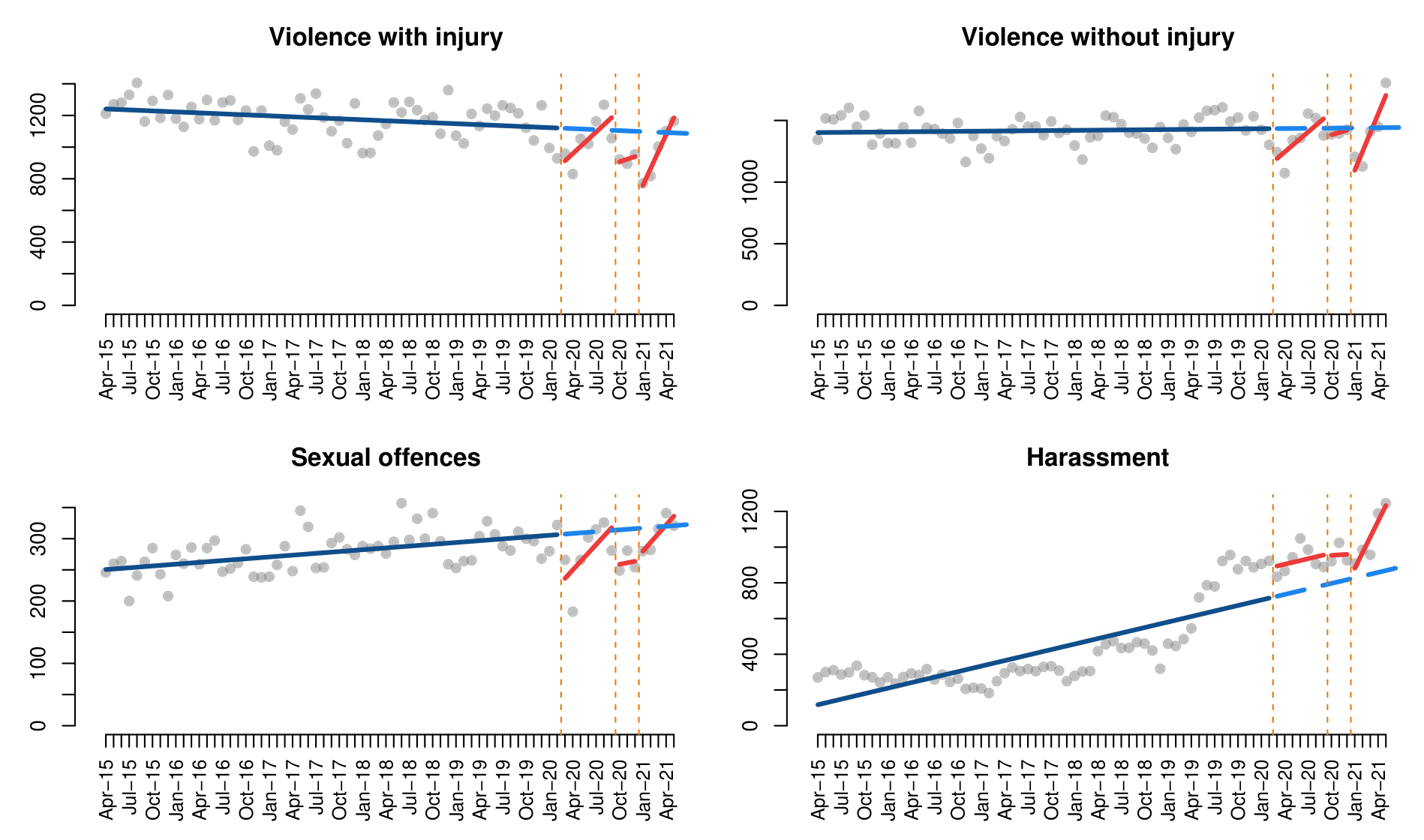
The analysis has been conducted in R software (R Core Team, 2021), and all data and codes are available from a Github repository ().

# Results



***Figure 1.*** *Interrupted time series analysis of all crime*

## Violent and sexual crime



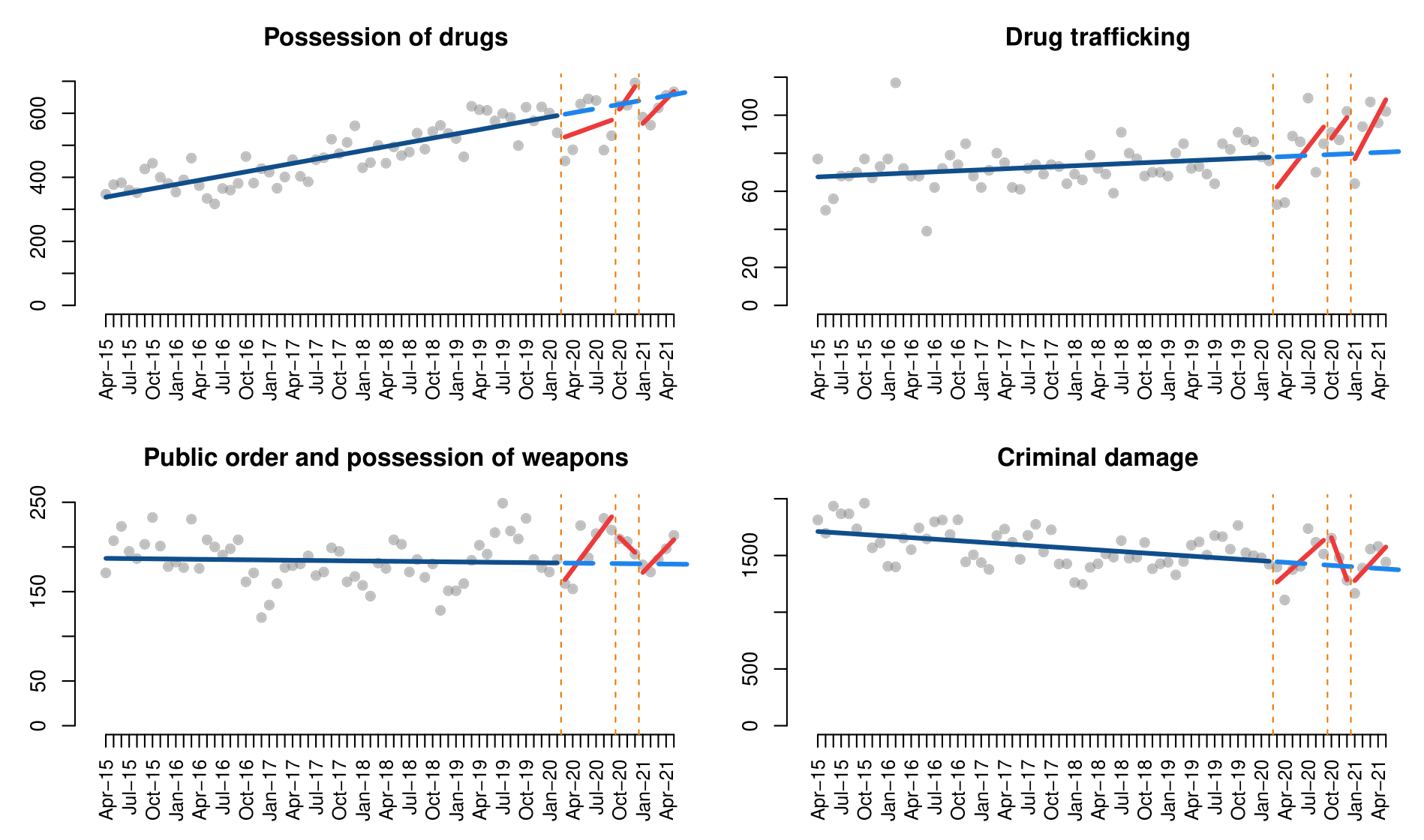
***Figure 2.*** *Interrupted time series analysis of violent and sexual crimes*

***Table 1.*** *Interrupted time series models of violent and sexual crimes*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Violence with injury | Violence without injury | Sexual offences | Harassment |
| (Intercept) | 1243.3\*\*\* | 1401.2\*\*\* | 249.5\*\*\* | 107.0\*\* |
| Time | -2.1\* | 0.5 | 1.0\*\*\* | 10.3\*\*\* |
| First lockdown | -253.5\*\* | -297.1\*\* | -83.7\*\* | 169.3 |
| Time since first lockdown | 47.7\* | 53.4\* | 12.6\* | -0.0 |
| Second lockdown | -215.5 | -73.0 | -56.9 | 164.3 |
| Time since second lockdown | 18.6 | 18.5 | 1.5 | -7.3 |
| Third lockdown | -450.0\*\*\* | -496.3\*\*\* | -50.4 | -24.2 |
| Time since third lockdown | 109.1\*\* | 151.8\*\*\* | 13.13 | 77.7+ |
| Adjusted R2 | 0.42 | 0.24 | 0.28 | 0.82 |

\*\*\*p-value<0.001, \*\*p-value<0.01, \*p-value<0.05, +p-value<0.1

## Drug crimes, damage and public order



***Figure 3.*** *Interrupted time series analysis of drug crimes, damage and public order*

***Table 2.*** *Interrupted time series models of drug crimes, damage and public order*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Possession of drugs | Drug trafficking | Public order and possession of weapons | Criminal damage |
| (Intercept) | 333.8\*\*\* | 67.4\*\*\* | 187.3\*\*\* | 1715.9\*\*\* |
| Time | 4.4\*\*\* | 0.2\* | -0.1 | -4.5\*\*\* |
| First lockdown | -75.5+ | -21.0\* | -30.5 | -245.2+ |
| Time since first lockdown | 4.4 | 5.1\* | 11.8\* | 66.1\* |
| Second lockdown | -46.4 | 3.2 | 37.8 | 426.3+ |
| Time since second lockdown | 31.1 | 5.3 | -8.4 | -181.5+ |
| Third lockdown | -93.7+ | -10.5 | -19.0 | -200.1 |
| Time since third lockdown | 20.7 | 7.6\* | 9.3 | 78.8+ |
| Adjusted R2 | 0.76 | 0.29 | 0.05 | 0.28 |

\*\*\*p-value<0.001, \*\*p-value<0.01, \*p-value<0.05, +p-value<0.1

## Burglary



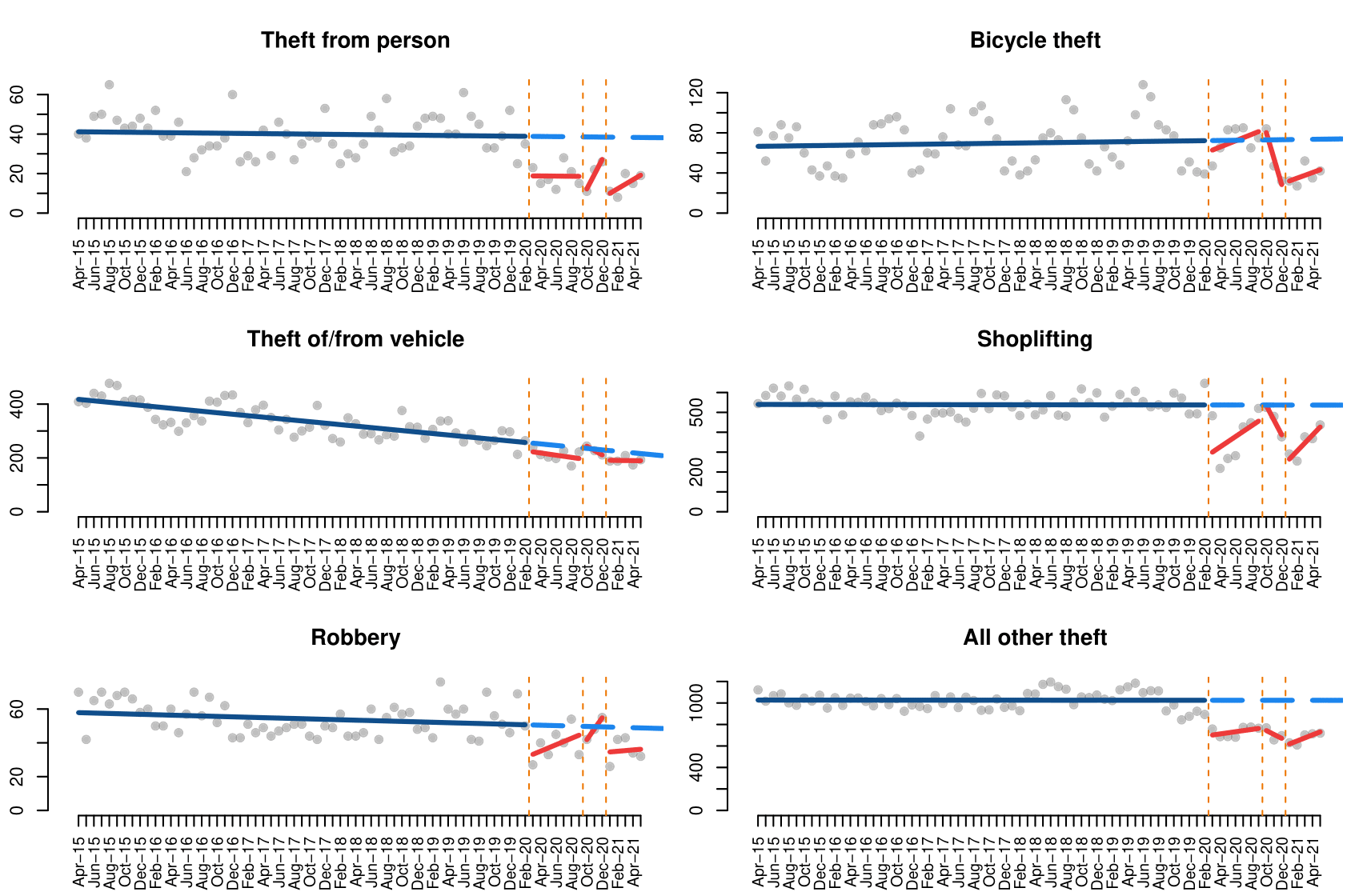
***Figure 4.*** *Interrupted time series analysis of burglary*

***Table 3.*** *Interrupted time series models of burglary*

|  |  |  |
| --- | --- | --- |
|  | Residential burglary | Non-residential burglary |
| (Intercept) | 465.2\*\*\* | 248.9\*\*\* |
| Time | -1.7\*\*\* | -2.6\*\*\* |
| First lockdown | -98.3\* | 4.4 |
| Time since first lockdown | 2.9 | -1.8 |
| Second lockdown | -11.5 | 18.1 |
| Time since second lockdown | -15.3 | -3.9 |
| Third lockdown | -124.1\* | -7.4 |
| Time since third lockdown | 2.7 | 2.0 |
| Adjusted R2 | 0.62 | 0.83 |

\*\*\*p-value<0.001, \*\*p-value<0.01, \*p-value<0.05, +p-value<0.1

## Theft and robbery



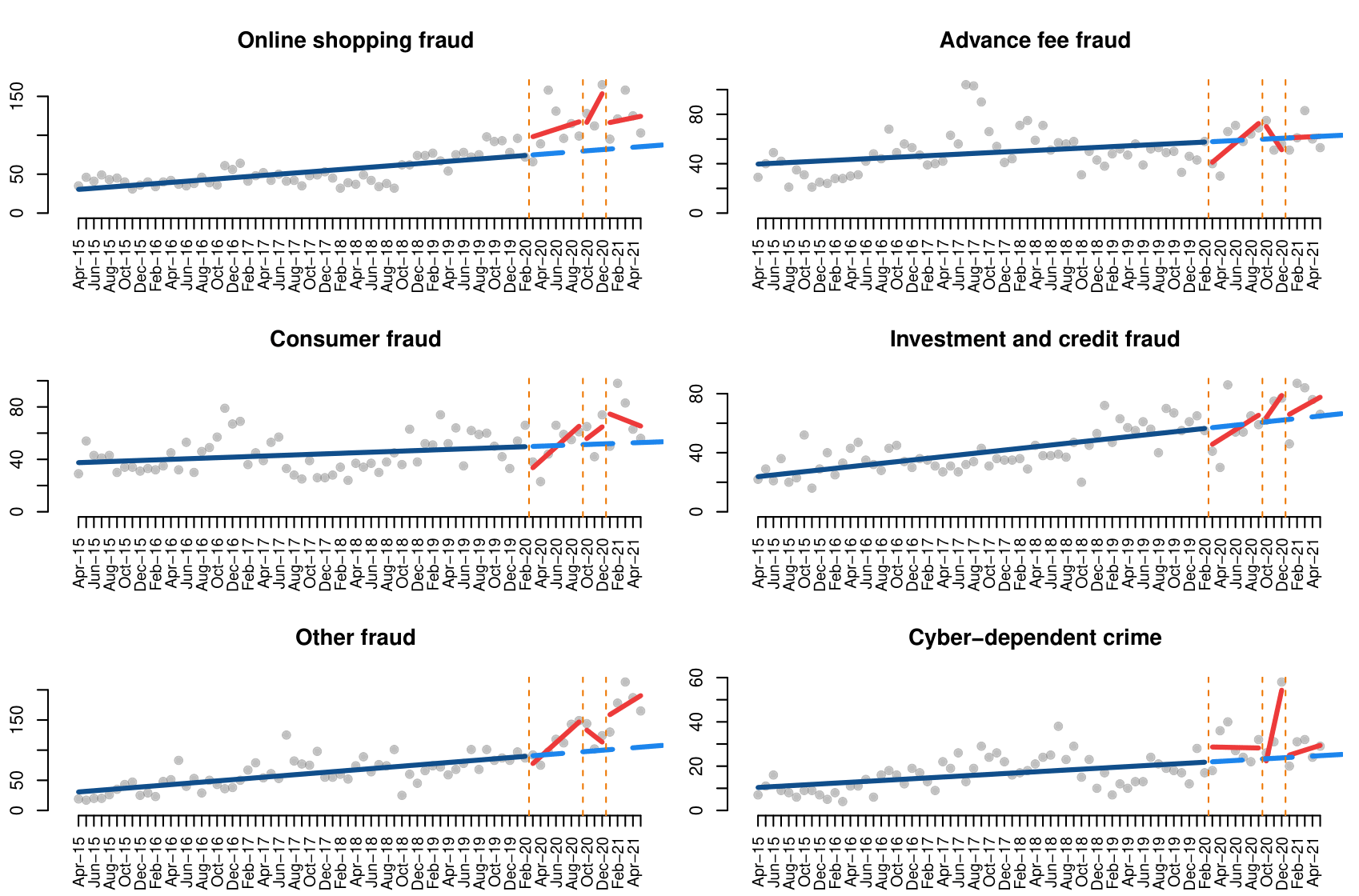
***Figure 5.*** *Interrupted time series analysis of theft and robbery*

***Table 4.*** *Interrupted time series models of theft and robbery*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Theft from person | Bicycle theft | Theft of/ from vehicle | Shoplifting | Robbery | All other theft |
| (Intercept) | 41.2\*\*\* | 66.5\*\*\* | 420.3\*\*\* | 540.0\*\*\* | 58.0\*\*\* | 1026.8\*\*\* |
| Time | -0.0 | 0.1 | -2.7\*\*\* | -0.0 | -0.1+ | -0.0 |
| First lockdown | -20.0\* | -12.5 | -30.9 | -263.6\*\*\* | -19.4\* | -333.9\*\*\* |
| Time since first lockdown | 0.0 | 3.0 | -1.3 | 26.1\* | 2.0 | 10.3 |
| Second lockdown | -33.9\* | 33.5 | 22.1 | 71.7 | -14.5 | -245.0\* |
| Time since second lockdown | 7.5 | -26.1 | -13.7 | -74.0+ | 6.6 | -36.5 |
| Third lockdown | -30.8\*\* | -44.0+ | -38.3 | -312.7\*\*\* | -15.3 | -434.7\*\*\* |
| Time since third lockdown | 2.3 | 2.7 | 2.4 | 40.5\* | 0.5 | 28.2 |
| Adjusted R2 | 0.46 | 0.09 | 0.76 | 0.57 | 0.31 | 0.74 |

\*\*\*p-value<0.001, \*\*p-value<0.01, \*p-value<0.05, +p-value<0.1

## Fraud and cybercrime



***Figure 6.*** *Interrupted time series analysis of fraud and cybercrime*

***Table 5.*** *Interrupted time series model of fraud and cybercrime*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Online shopping fraud | Advance fee fraud | Consumer fraud | Investment and credit fraud | Other fraud | Cyber-dependent crime |
| (Intercept) | 29.7\*\*\* | 39.4\*\*\* | 37.3\*\*\* | 23.2\*\*\* | 29.6\*\*\* | 10.2\*\*\* |
| Time | 0.8\*\*\* | 0.3\* | 0.2+ | 0.6\*\*\* | 1.0\*\*\* | 0.2\*\*\* |
| First lockdown | 21.0 | -21.7 | -21.4+ | -14.0 | -23.4 | 6.9 |
| Time since first lockdown | 2.4 | 4.9 | 5.1+ | 2.7 | 10.5\*\* | -0.3 |
| Second lockdown | 18.7 | 20.0 | 0.2 | -4.0 | 46.5 | -16.8 |
| Time since second lockdown | 17.7 | -9.8 | 4.3 | 6.9 | -11.0 | 15.8\*\* |
| Third lockdown | 32.8+ | 0.1 | 25.1 | 1.0 | 51.0\* | 0.2 |
| Time since third lockdown | 1.2 | -0.0 | -2.5 | 2.3 | 6.9 | 0.9 |
| Adjusted R2 | 0.76 | 0.10 | 0.23 | 0.59 | 0.79 | 0.52 |

\*\*\*p-value<0.001, \*\*p-value<0.01, \*p-value<0.05, +p-value<0.1

# Discussion and conclusions

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