Analysing the effects of COVID-19 on Crime in the United States*

A deep dive into criminal activity during the pandemic

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Abstract

The COVID-19 pandemic caused the various state-level governments in the United States to issue stay-at-home orders in early 2020. These policy measures resulted in sweeping impacts on the everyday life of people with mostly negative implications. The more negative implications of the pandemic have generally eclipsed the more positive aspects such as the reduction of crime rates by 37% worldwide (Boman and Mowen 2021), and also the noticeable drop in carbon emissions (Bauwens et al. 2020) and elevation of air quality around the world—in turn reducing pollution-related respiratory issues (Dutheil, Baker, and Navel 2020). While crime rates globally have gone down, it is also important to take a granular look at the crime data to observe which types of crimes have been most affected, and further, examine if there is a significant correlation between crime rates and COVID-19 cases — which is precisely the goal of this study. We achieve our goal of analyzing the pandemic data in conjunction with crime data obtained from the official city websites through time series modeling and also exploratory data analysis focusing on the criminal activity in key US cities such as Chicago, Los Angeles, Philadelphia, and Seattle. Each city has been chosen specifically to reflect different American aspects, geographical as well as socio-economic, to enable us to form more generalizable as well as granular conclusions.

Keywords: COVID-19 Pandemic, Criminal Behaviour, Time Series Modelling, Correlation, Dataset Creation, Criminal Psychology

1 Introduction

The COVID-19 pandemic caused the various state-level governments in the United States to issue stay-at-home orders in early 2020. These policy measures resulted in sweeping impacts on the everyday life of people with mostly negative implications. The onset of the pandemic brought with it a host of other issues like job losses, unemployment, financial crisis, and mental health issues. The pandemic also forced people to stay at home for prolonged periods, sometimes over a month, which seemed to have exasperated opioid abuse and also relapse of a host of other addictions. Furthermore, it has also been shown that the pandemic has led to increased stress and anxiety levels among individuals (Boman and Gallupe 2020). These negative implications of the pandemic have generally eclipsed the more positive aspects such as the reduction of crime rates by 37% worldwide (Boman and Mowen 2021), and also the noticeable drop in carbon emissions (Bauwens et al. 2020) and elevation of air quality around the world—in turn reducing pollution-related respiratory issues (Dutheil, Baker, and Navel 2020). While crime rates globally have gone down, it is also important to take a granular look at the crime data to observe which types of crimes have been most affected, and further, examine if there is a significant correlation between crime rates and COVID-19 cases — which is precisely the goal of this study.

The main goal of our paper is to examine the effect that the pandemic has brought in terms of specific crimes such as assault, battery, criminal theft, and much more based on state-level crime data within the United States. The main motivation behind this research is the scarcity of work examining the effect of

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*Code and data are available at: https://github.com/the-infiltrator/COVID-19-Crime

the pandemic on crime, even though there has been a lot of work done examining other aspects concerning the pandemic. News stations have consistently reported lower crime rates but have based their analyses on simply the rate of 911 calls and not actual police data. We aim to bridge this gap by focusing on the criminal activity in key US cities such as Chicago, Los Angeles, Philadelphia, and Seattle. Each city has been chosen specifically to reflect different American aspects, geographical as well as socio-economic, to enable us to form more generalizable as well as granular conclusions.

The key motivation for our work is previous work showing that certain crimes like domestic violence saw a significantly smaller drop as compared to other crimes after the onset of the pandemic [(Boman and Gallupe 2020)], indicating the importance of the nature of the actual crime committed. Our focus on individual city data is due to known data collection issues for such research (Boman and Gallupe 2020) and is motivated by preliminary studies showing that the crime rates for specific crimes are largely dependent on the city (Ashby 2020). There are also other factors such as the George Floyd protests in June 2020 that we hypothesize may have resulted in a noticeable increase in the vandalism and theft crimes in certain cities.

Overall, our paper is a small contribution building upon and motivated by several recent papers that have covered the impact of the pandemic on the human psyche and crime rates across different states and countries (Boman and Mowen 2021; Campedelli et al. 2020; Nivette et al. 2021) alongside work prompting further research in the area (Eisner, Nivette, et al. 2020). We achieve our goal of analyzing the pandemic data in conjunction with crime data obtained from the official city websites, using R statistical programming (R Core Team 2020), through time series modeling and also exploratory data analysis.

In the following section, we outline how data for this study was collected alongside an overview of the data. In Section 3 we outline, in detail our modeling approaches and in Section 4 the results are provided for each city. We conclude our study with a detailed discussion in Section 5, explaining some of our key findings and conclusions.
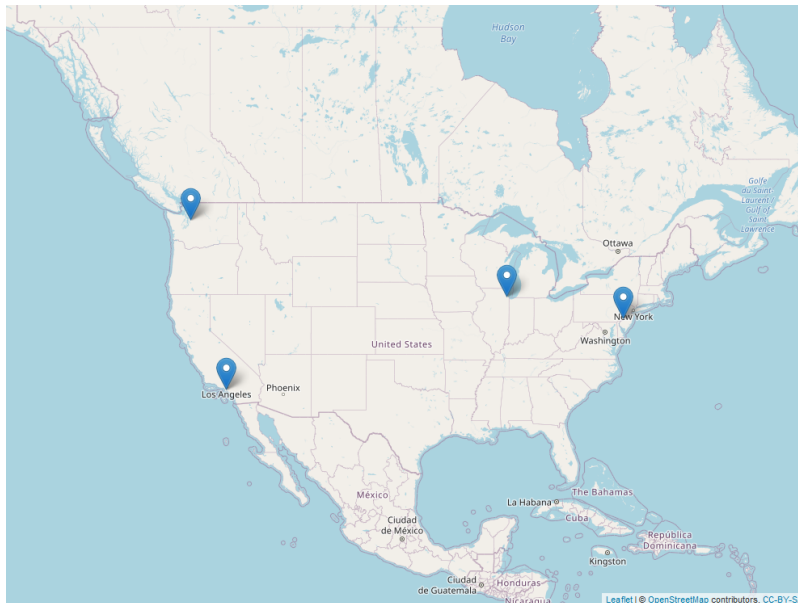

Figure 1: Geographical overview of the cities being examined under this study.

2 Data

The primary data set used is publicly available from the the R, COVID-19 Data Hub (Guidotti and Ardia 2020) containing a daily summary of COVID-19 cases, deaths, recovered, tests, vaccinations, and hospitalizations for 230+ countries, 760+ regions, and 12000+ administrative divisions of lower level including policy

measures, mobility, and geospatial data. Furthermore, we use city data for each city involved in our study to examine the crime rates across the pandemic and the city-wise data sources are outlined below alongside exploratory analyses of both COVID-19 and crime data.

2.1 Chicago

The city of Chicago was chosen for this analysis because it has the highest crime rates in America. The gang culture and gun laws have made Chicago the hub of specifically violent crimes, with higher homicide rates on average as compared to other cities. Furthermore, during the early stages of the COVID-19 pandemic, it was found that Chicago was one of the first few cities to harbor several virus strains (Anderson, n.d.), leading to a disaster proclamation by then Governor Pritzker. Chicago has since then seen roughly three waves of the virus as shown in Figure 2. The data for the city of Chicago was sourced from the Chicago police, spanning six main categories of criminal activity which are assault, battery, criminal damage, deceptive practices, vehicle theft, and general theft.
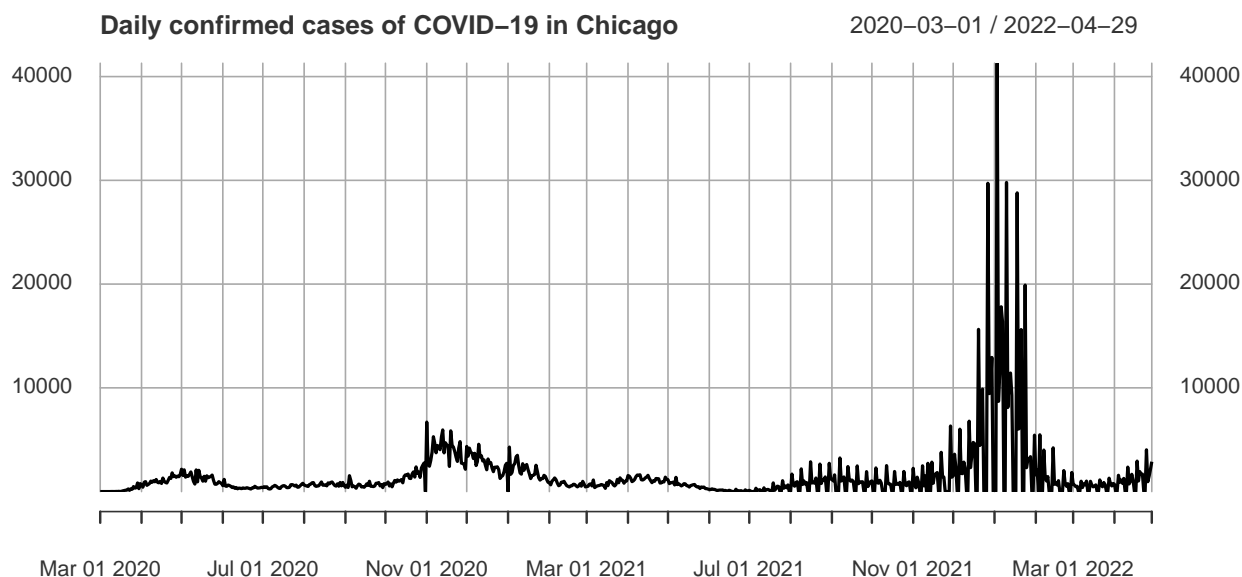

Figure 2: Daily Confirmed Cases of COVID-19 in Chicago

When closely examining yearly trends for the different crimes, Figure 3, it can be observed that theft rates and battery noticeably went down in March of 2020 while crimes like assault and Vehicle Theft remained steady. Furthermore, it can be observed throughout the pandemic, these levels remained relatively consistent throughout 2021 and 2022.
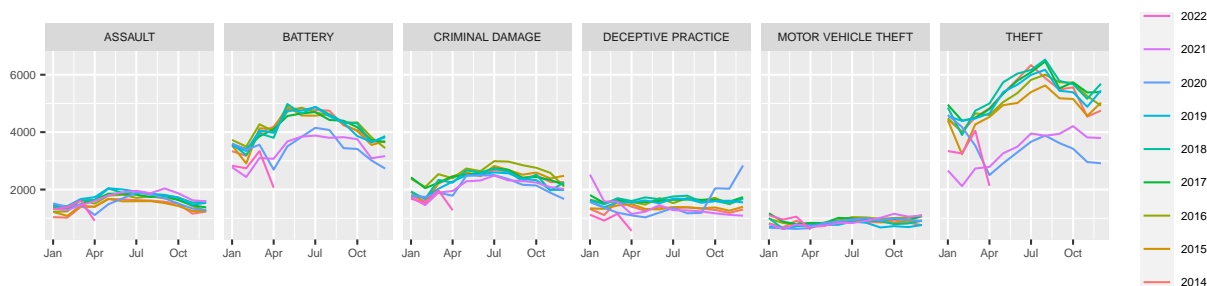

Figure 3: Yearly Trends for the top five crimes in Chicago

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In general, it is also noted that most crimes, with the exception of vehicle theft and deception, went up generally in summer and then reduced when the temperatures fell for winter, indicating a seasonal trend. Finally, a more granular look at the frequency of each crime only during the pandemic, as shown in Figure 4, shows that most crimes during the pandemic remained relatively consistent with the exception of criminal damage and theft. A sudden uptick in criminal damage and theft is noted in June 2020, which can be attributed to the violence caused by certain bad actors during the George Floyd Protests.
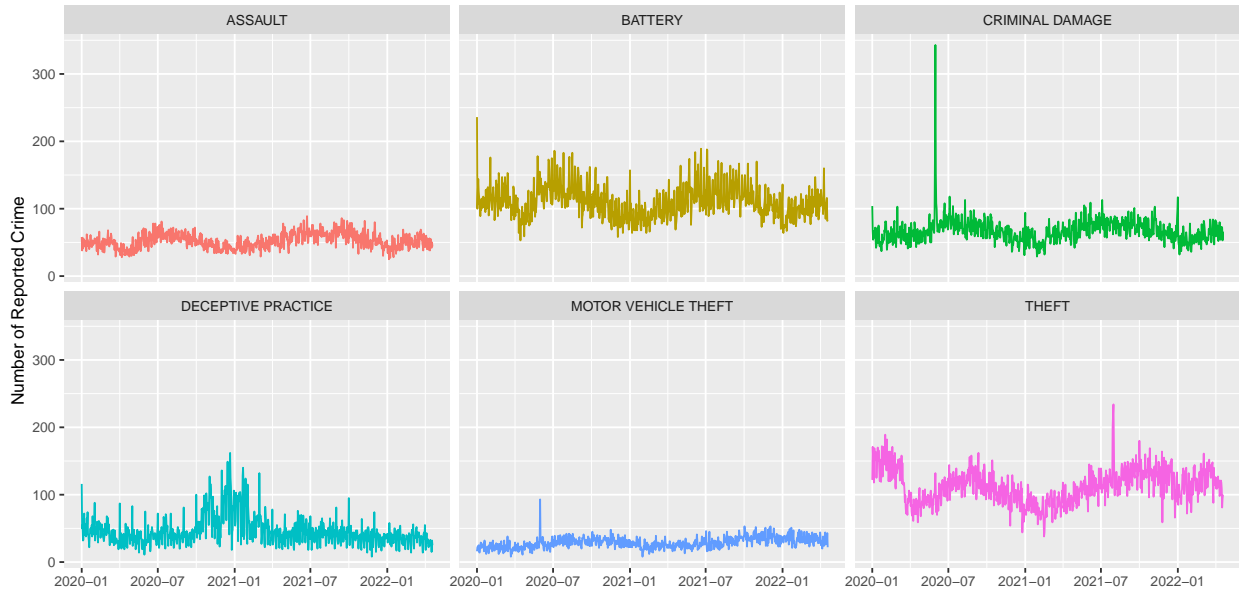

Figure 4: Frequency of each crime in Chicago during months spanning the COVID-19 pandemic.
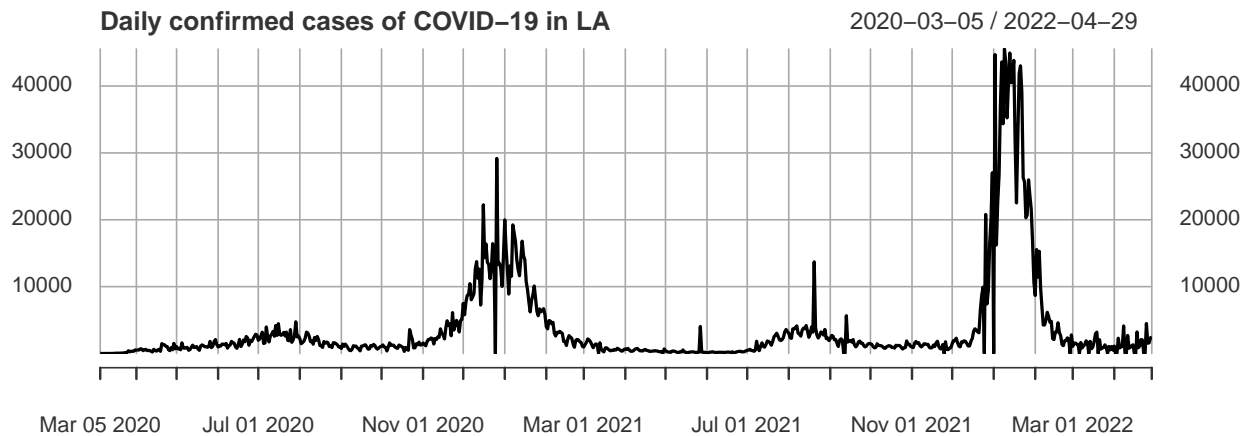
2.2 Los Angeles

Figure 5: Daily Confirmed Cases of COVID-19 in L.A

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Los Angeles, located in California, has historically been a hub of criminal activities mainly centered around narcotics due to its proximity to Tijuana and in general the US-Mexico border. Crime in Los Angeles is also prevalent due to the presence of one of the largest populations of homeless people in the United States mostly within the Skid-Row locality. Los Angeles was at the peak of criminal activity between 1970 and 1990, and more recently in 2015, it was revealed that the Los Angeles Police were under-reporting criminal activity for roughly 8 years, artificially lowering the crime rates and making it an intriguing city to examine from a data perspective (Bird et al. 2018).

To examine the crime rates within the city we source data directly from the Los Angeles Police Department Socrata API and look at the top five crimes which are mainly variants of burglary and theft crimes, alongside vehicle theft and assault. Finally, as shown in Figure 5, we note that the pandemic had a significant impact in Los Angeles with some of the first patients of COVID-19, including "patient zero", being from Los Angeles. California overall also faced a severe health crisis with cases up to ten times more than were anticipated.

Further examining yearly trends for several crimes, based on Figures 6 and 7, it was found that several crimes like battery/assault, vehicle theft, and burglary increased. The noticeable increase in these crimes remained consistent for years spanning the pandemic, although a noticeable drop in battery, burglary, and vehicle theft was observed in January 2022.
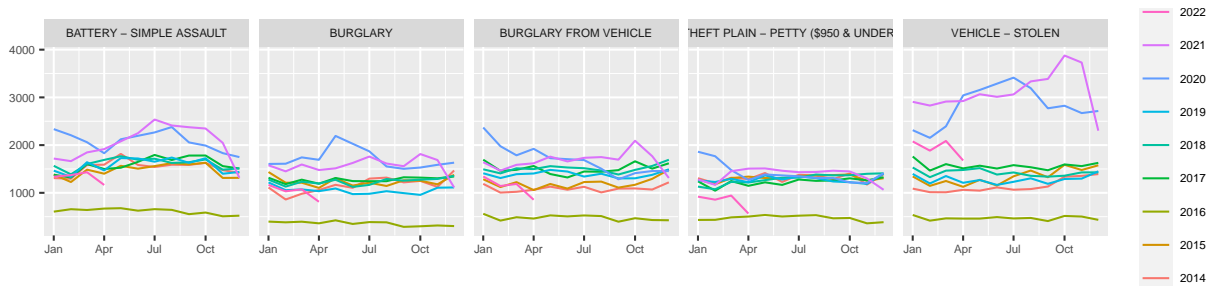

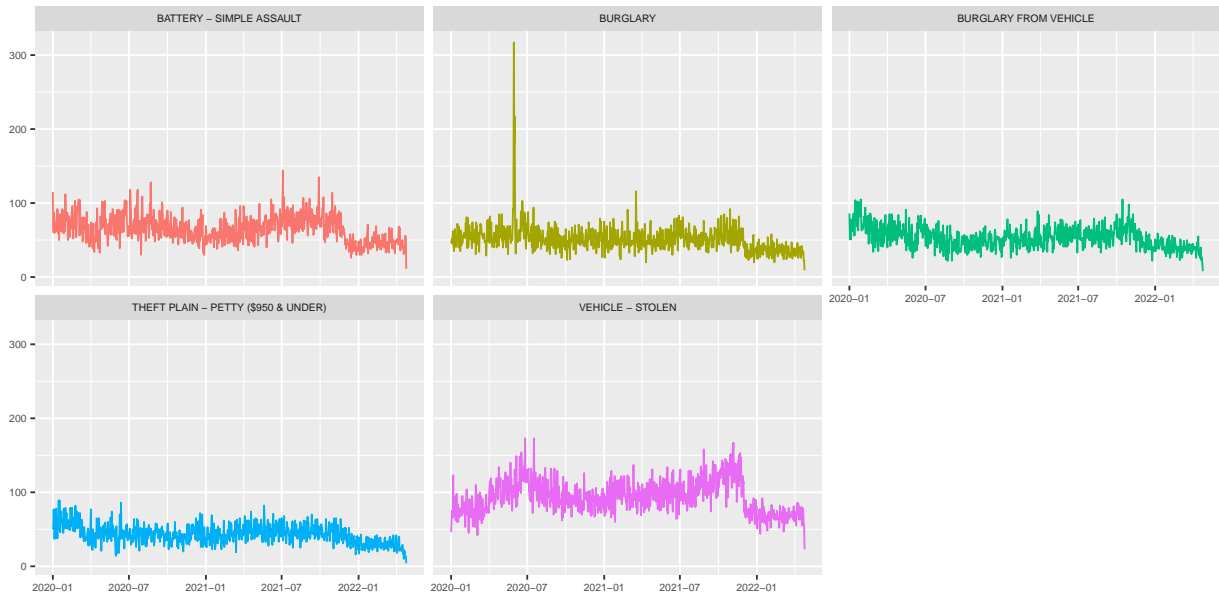Figure 6: Yearly Trends for the top crimes in Los Angeles

Figure 7: Frequency of each crime in LA during months spanning the COVID-19 pandemic.
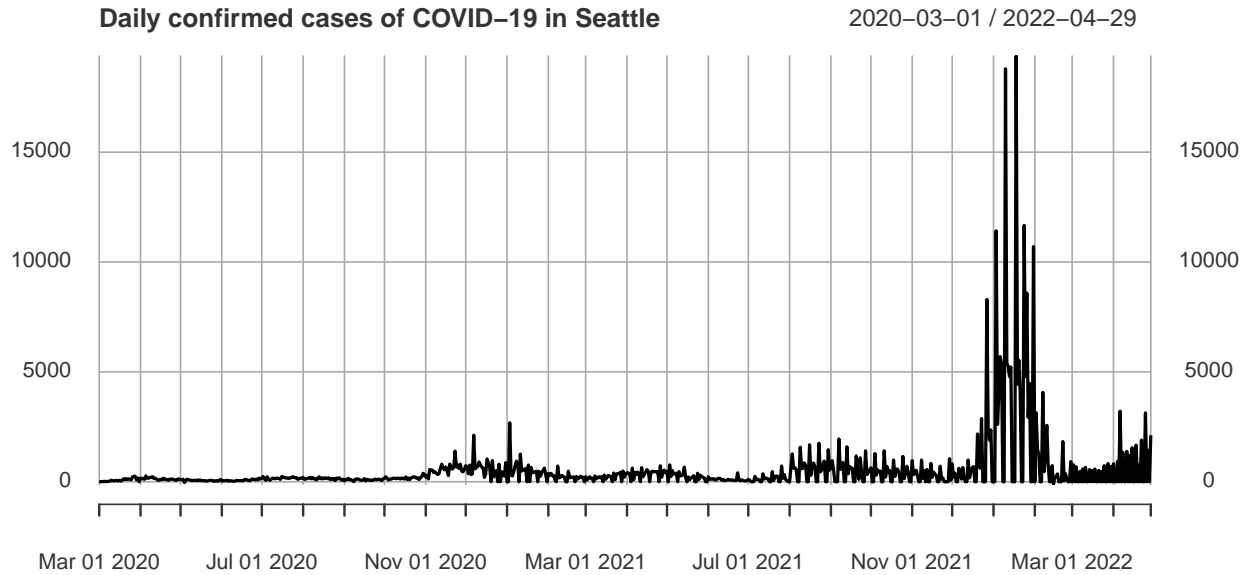
2.3 Seattle

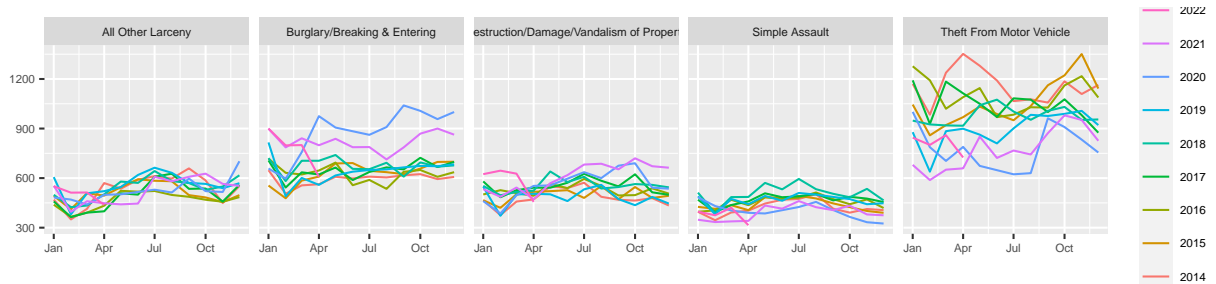Figure 8: Daily Confirmed Cases of COVID-19 in Seattle

Figure 9: Yearly Trends for the top crimes in Seattle

One of the fastest-growing cities in the United States, Seattle, was specifically chosen for this study due to its high rates of property crime while having relatively constant overall crime rates across the decades. As shown in Figure 8, the city was relatively less impacted by COVID-19, making it an interesting candidate in contrast to other cities when it comes to observing criminal behavior. Seattle is also the location of the earliest clinical trial being conducted for the Moderna COVID-19 vaccine which occurred around March 20, 2020 (Tuesday 2020), and more recently has seen a sudden increase in criminal activity alongside increased homelessness (Westneat 2022).

The crime data for Seattle was sourced from the public Seattle Police Department Records, with our focus mainly being on the top crimes comprising assault, burglary, vandalism, larceny and theft from a vehicle. Given the relatively low rate of COVID-19 in Seattle, trends across most crimes seemed to remain constant before and after the onset of the pandemic as seen in Figure 9. It was also observed that crimes such as burglary increased while theft from motor vehicles showed a decline as compared to previous trends. These relatively consistent trends during the pandemic are also visible in Figure 10, with an increase in larceny, burglary, and vandalism crimes noted in June-July 2020 due to the Goerge Floyd protests.
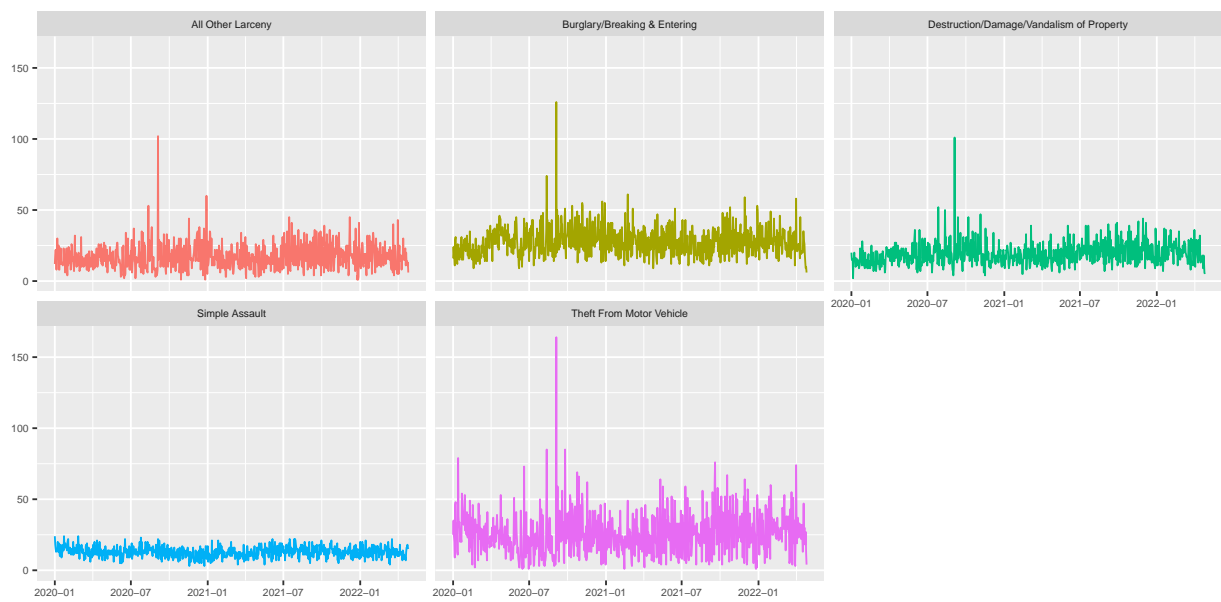
Figure 10: Frequency of each crime in Seattle during months spanning the COVID-19 pandemic.
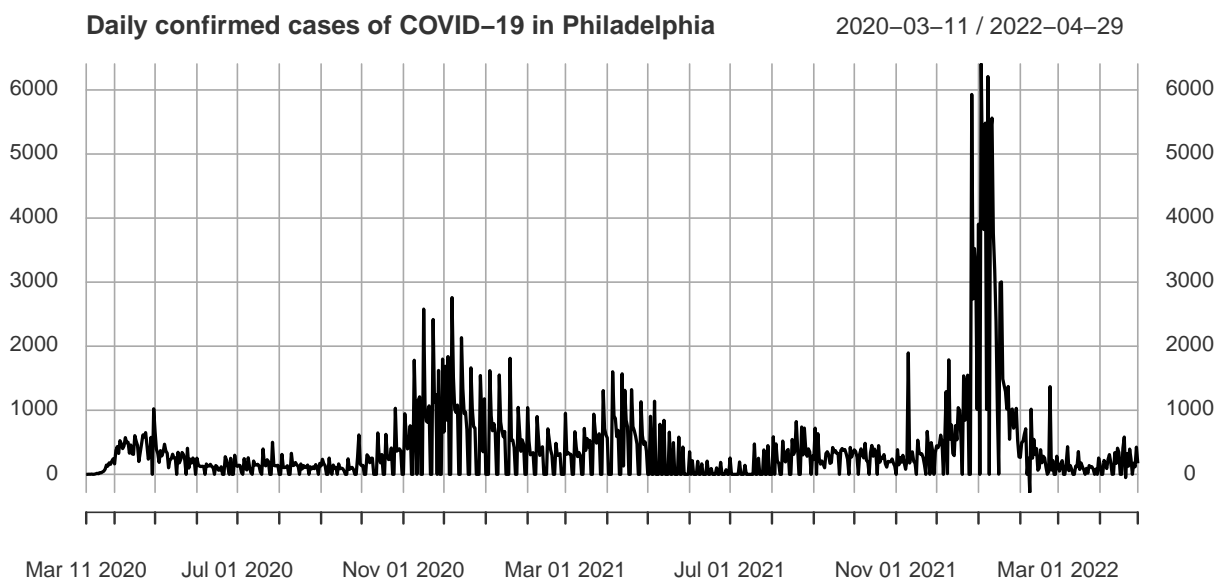
2.4 Philadelphia

Figure 11: Daily Confirmed Cases of COVID-19 in Philadelphia

The last city in our study is Philadelphia, which is one of the most violent cities in America along with the highest poverty rates. The city is the sixth most populous city in the United States with a rich cultural diversity making it ideal for our study. The city was significantly affected by the pandemic as noted by its poor economic performance and decline in the supply of workers (Haider and Eichel, n.d.). It should be noted though that when compared to the other cities in our study, Philadelphia has the lowest number of daily cases on average as shown in Figure Figure 11.

To examine the impact on crime due to the pandemic we sourced data from the Philadelphia Police Department, with an emphasis on the top crimes which were basically assaults, other offenses, thefts from vehicles, general thefts and vandalism. Overall it was found, as demonstrated in Figure 12 that petty offenses increased during the pandemic while most other crimes remained relatively consistent with patterns emerging in prior years. An immediate downtrend was also observed in crimes such as assaults and thefts right after the onset of the pandemic.
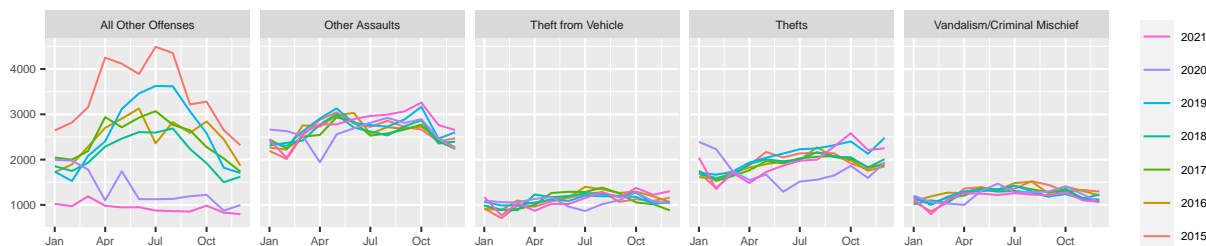

Figure 12: Yearly Trends for the top crimes in Philadelphia

Further examining the crime trends during years spanning the pandemic, as shown in Figure 13, we observe that there is a general downtrend in petty offenses while most other crimes remain consistent with some seasonal trends in assaults and thefts. Finally, as noted previously for other cities, an uptick in criminal activity is observed during the black lives matter protests of June 2020.
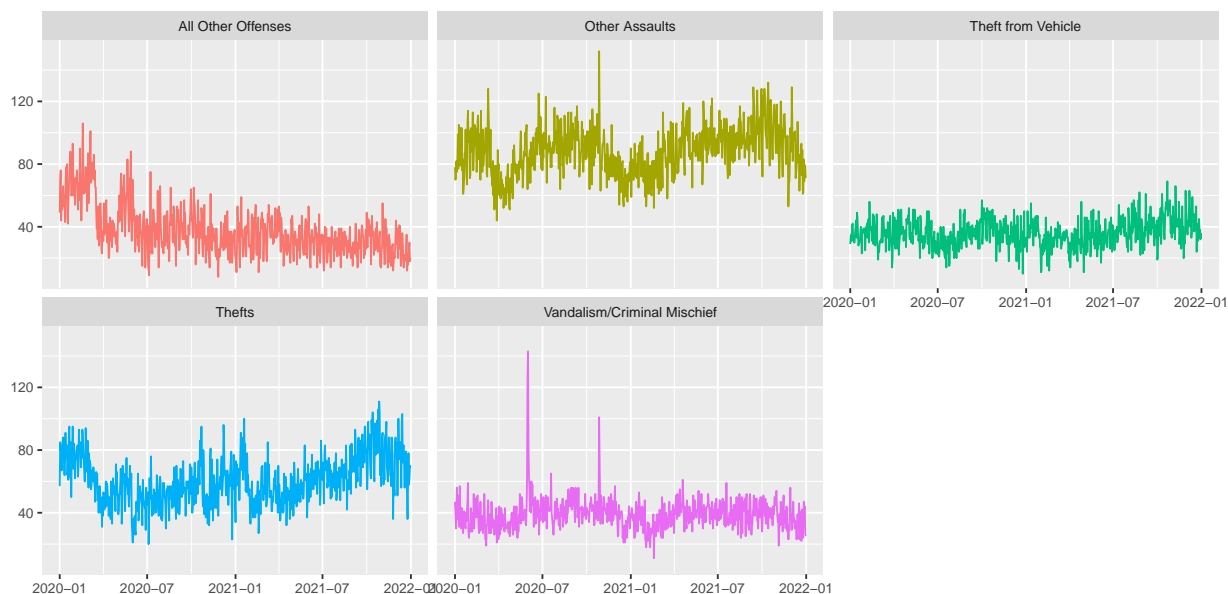

Figure 13: Frequency of each crime during months spanning the COVID-19 pandemic.

Next, we take a look at the modelling approaches employed to further verify correlations between COVID-19 and crime data.

3 Methods

In this study we employ Vector autoregressive models to model the relationship between each crime and COVID-19 cases, which are then, in turn, used for Granger causality tests and finally impulse response modelling.

3.1 Vector autoregression Model (VAR)

Vector autoregression (VAR) is a statistical model used to capture the relationship between multiple quantities as they change over a period of time. The main idea behind this model is to simply relate the present value for any variable at time t to the past values of the variable. For our study, and each city, we fit a VAR model between a given arbitrary crime denoted by CRIME and the COVID-19 cases denoted by CASES. A pth-order VAR is fitted where p is decided based on a simpler generalised additive model. The equation then takes the following form,

$$\text{CRIME}_t = c + A_{11}\text{CASES}_{t-1} + A_{12}\text{CASES}_{t-2} + \cdots + A_{1p}y_{t-p} + e_{1t},$$

$$\text{CASES}_t = c + A_{21}\text{CRIME}_{t-1} + A_{22}\text{CRIME}_{t-2} + \cdots + A_{2p}y_{t-p} + e_{2t}$$

Here $A_i 1 \ldots A_i p$ denote the coefficients for both the equations with $i \in \{1, 2\}$ and e_{it} denotes the error term. We fit these VAR models on the top five crimes for each city and then run Granger causality tests which are outlined below to establish causation.

3.2 Granger Causality Test

To determine if COVID-19 cases in a specific locality are useful in forecasting a specific crime we employ Granger causality testing. The null-hypothesis for our specific test is simply that an arbitrary crime CRIME is not caused by the the COVID-19 cases denoted by CASES. The test employs the formerly fitted VAR model to compute a p value with the test-statistic here following a F distribution. It should be noted here that this tests only for direct causality and not indirect causality which may occur due to a third unknown variable.

Furthermore, we also conduct a simultaneous test for instantaneous Granger causality which is essentially a test that checks if both x effects y and y effects x. The null hypothesis in this case is essentially that either x doesn't effect y or y doesn't effect x. More details about this test including the mathematical formulation are outlined in a much better fashion in a manuscript by Seth (2007).

3.3 Forecasting and Impulse Response

Finally, we also employ impulse response modelling that builds upon Granger tests to show us how a change of one standard deviation in CASES does to the rate of CRIME in the future. Impulse response modelling is a simple process to investigate such relationships, specifically ones which are significant on the Granger test. We employ impulse response modelling to visualise these relationships and demonstrate how due to a single new COVID-19 case, specific crimes may fluctuate in the future. Further detail on Impulse response modelling has been outlined in Koop, Pesaran, and Potter (1996).

Next we investigate the criminal activity in each city using these modelling approaches and visualise the significant crimes in the subsequent section.

4 Results

We now employ the methods outlined in the previous section to narrow down on the crimes that are the most significantly correlated with COVID-19 activity in the respective cities. For each city, the impulse response alongside the model predictions are visualized for the crimes that are most significantly associated with COVID-19.

4.1 Chicago

Based on the fitted VAR models for top crimes in Chicago, we find that COVID-19 cases do not have a significant Granger instantaneous causality, at a 95% confidence level, with crimes such as criminal damage ($p = 0.8271$), and battery ($p = 0.63$). Whereas, a statistically significant instantaneous correlation was found between COVID-19 cases impacting assault ($p = 0.036$) and a significant Granger-causality with the cases impacting vehicle theft ($p = 0.00022$). The impulse response of a new case to these crimes and the model predictions are outlined in Figures 14 & 15.
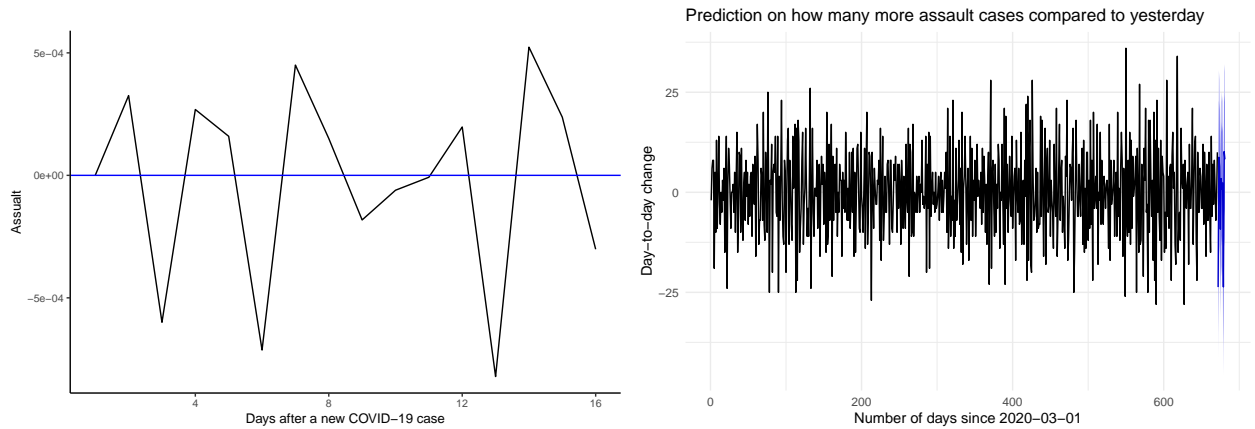

Figure 14: Impact of a new COVID-19 case on assault (left), and VAR model prediction for assault (right).
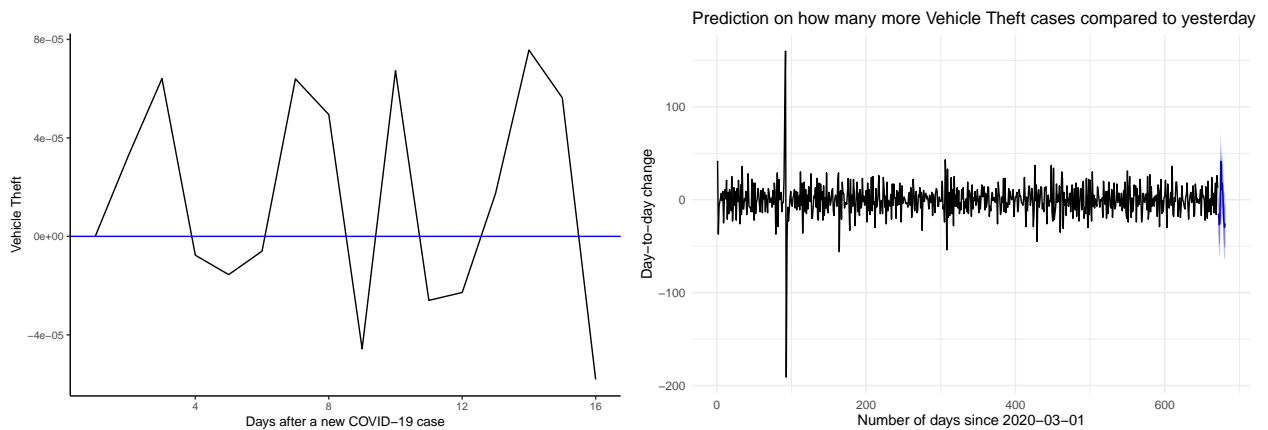

Figure 15: Impact of a new COVID-19 case on vehicle thefts (left), and VAR model prediction for vehicle thefts (right).

4.2 Los Angeles

When it comes to Los Angeles, only vandalism stood out based on the fitted VAR models. We find that COVID-19 cases do not have a significant Granger instantaneous causality, at a 95% confidence level, with crimes such as battery ($p = 0.67$), theft from vehicle ($p = 0.9$), vehicle theft ($p = 0.81$), and burglary ($p = 0.26$). Whereas, a statistically significant Granger causality was found between COVID-19 cases impacting vandalism ($p = 0.003$). The impulse response of a new case to vandalism and the model predictions are outlined in Figure 16.
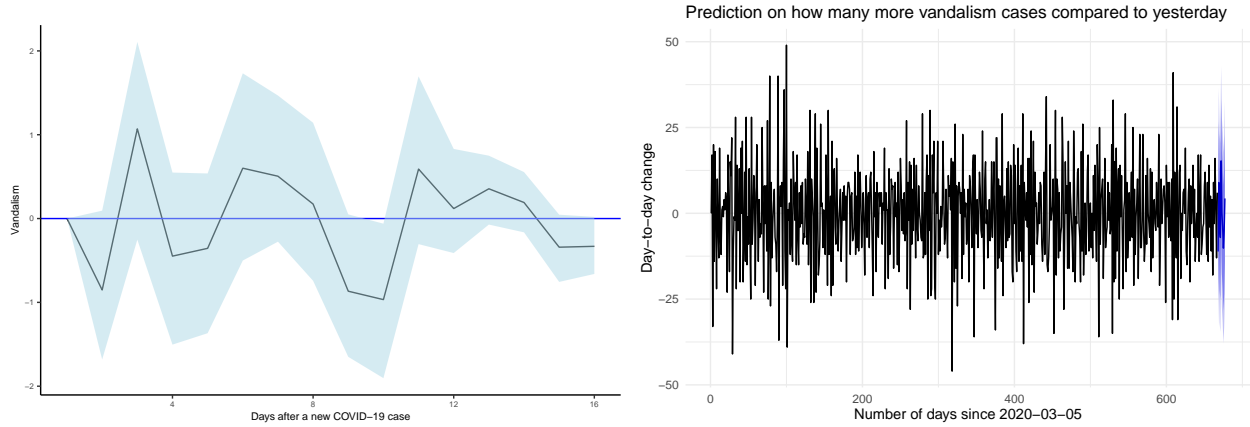

Figure 16: Impact of a new COVID-19 case on vandalism (left), and VAR model prediction for vandalism (right).

4.3 Philadelphia

Coming to Philadelphia, only vehicle and general thefts stood out based on the fitted VAR models. We find that COVID-19 cases do not have a significant Granger instantaneous causality, at a 95% confidence level, with crimes such as offense ($p = 0.42$) and assault ($p = 0.97$). On the contrary, a close statistically significant Granger causality was found between COVID-19 cases impacting vehicle theft ($p = 0.0009$) and an instantaneous causality was found with thefts (0.005). The impulse response of a new case on these crimes and the model predictions are outlined in Figures 17 and 18.
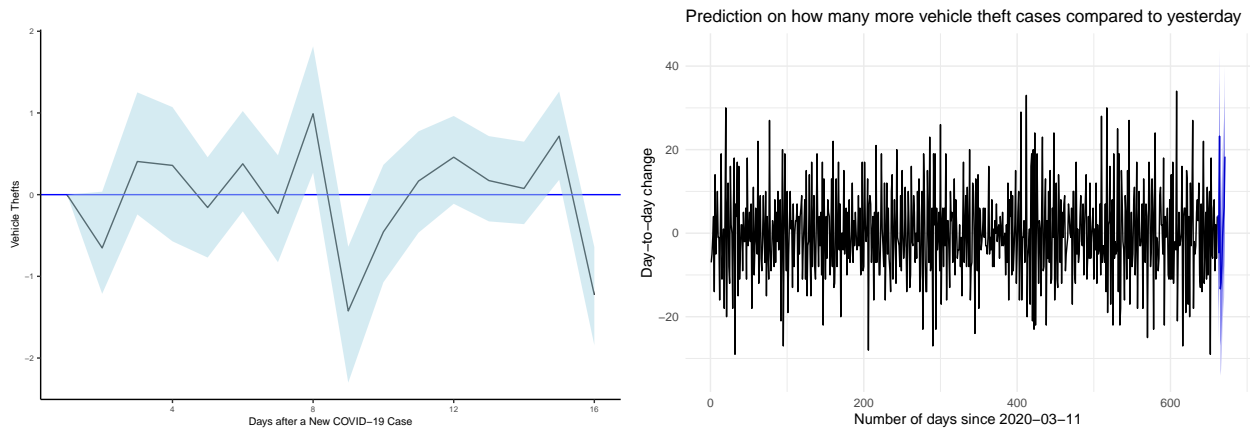

Figure 17: Impact of a new COVID-19 case on vehicle thefts (left), and VAR model prediction for vehicle thefts (right).
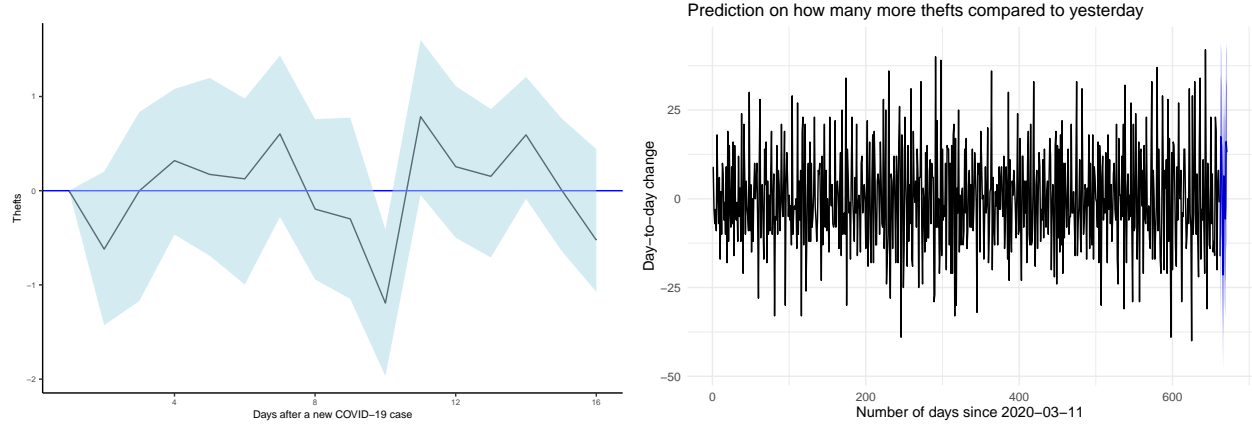
Figure 18: Impact of a new COVID-19 case on thefts (left), and VAR model prediction for thefts (right).

4.4 Seattle

Finally, for the city of Seattle, only burglaries stood out based on the fitted VAR models. We find that COVID-19 cases do not have a significant Granger instantaneous causality, at a 95% confidence level, with crimes such as larceny ($p = 0.25$), vandalism ($p = 0.79$), vehicle theft ($p = 0.31$) and theft from vehicle ($p = 0.46$). With a relaxed 90% confidence level, a statistically significant Granger causality was found between COVID-19 cases impacting burglaries ($p = 0.073$). The impulse response of a new case on burglaries and the model predictions are outlined in Figure 19.
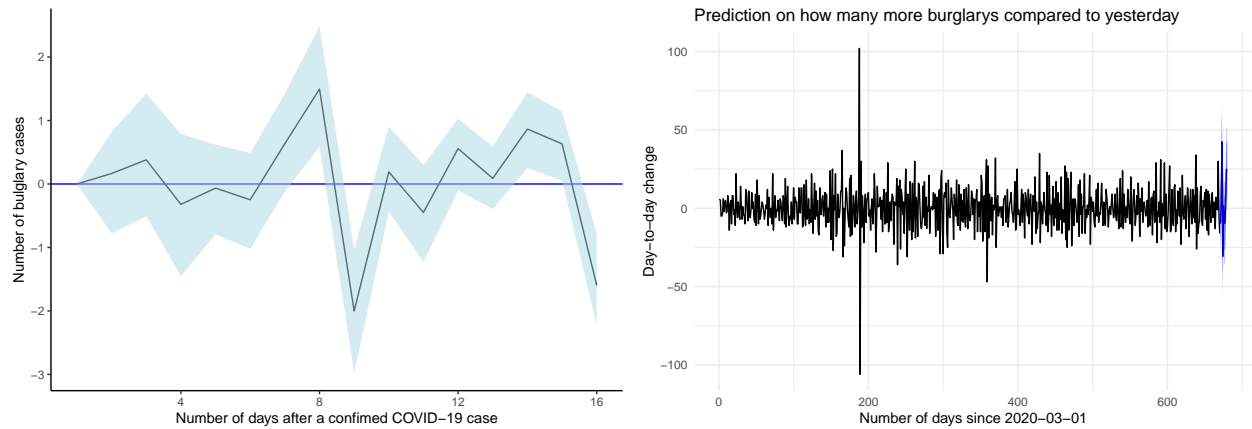
Figure 19: Impact of a new COVID-19 case on burglaries (left), and VAR model prediction for burglaries (right).

Across all of the studied cities, we found that the crimes most significantly associated with COVID-19 cases are vehicle thefts and burglaries/thefts, with vandalism and assault also emerging as significant in some sectors. In the subsequent section we now discuss various implications of these findings and also discuss limitations of the study.

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5 Discussion

5.1 Overview of Results

During the COVID-19 pandemic, the world has seen several different changes both negative and positive. With increasing stay-at-home restrictions and various other policy measures, we aim to examine the impact that the pandemic has on criminal activity across several different cities in the United States including Chicago, Los Angeles, Seattle, and Philadelphia. The main goal of this study is to take a closer look at how different crimes varied across the pandemic as well as compare them to trends prior to the pandemic.

Consistent with early research that anticipated an increase in thefts and burglaries with the onset of the pandemic (Miller and Blumstein 2020), our study found that there was a strong correlation between the rate of COVID-19 cases and crimes such as thefts and burglaries, especially in cities such as Seattle and Philadelphia, as seen in Figures 19 and 18. There was also a significant relationship between vehicle thefts and COVID-19 cases in cities such as Philadelphia and Chicago. as seen in Figures 17 and 15. Overall, our exploratory analysis also indicated similar trends, with the uptick in thefts and burglaries possibly occurring due to the lack of guardianship of assets due to people staying home. Furthermore, our study indicated that crimes such as vandalism also show some relation with COVID-19 cases when it comes to cities like L.A, as seen in Figure 16, alongside other crimes such as assault in cities like Chicago, as observed in Figure 14. Overall it is noted that crimes that are better committed individually such as assault, theft, and burglary stood out more as compared to crimes committed in groups like vandalism. This is consistent with other research on crime in the United States which arrived at similar conclusions (Boman and Gallupe 2020).

The impulse response graphs show us another perspective with respect to these crimes. These graphs show us the future effects of a new COVID-19 case on a specific criminal activity. Based on the Figures 15, 17, 18 & 19 it can be noted that on average across all of the cities examined there is a high likelihood of at least one vehicle theft or burglary occurring after a unit increase in cases. Furthermore, based on our exploratory analysis carried out in Section 2, there seems to be no significant change in the frequency of occurrence of several crimes across several cities, pointing to a more bleak reality as compared to prior studies indicating an overall crime reduction.

These results in a way bring into question the significance of the overall decline in crime as there seem to be crimes like thefts and vehicle thefts that seem to have gone up significantly when compared to historical data. Furthermore, it seems like if the pandemic worsens in the future, we might see more crimes that are simply caused due to lack of guardianship as pointed out earlier. However, before arriving at such concrete conclusions we must take into consideration some of the limitations of this study and also explore future directions.

5.2 Ethical Concerns and Limitations

Across studies that have examined crime during the COVID-19 pandemic, the lack of sufficient data has been a common limitation (Boman and Gallupe 2020; Ashby 2020; Boman and Mowen 2021; Campedelli et al. 2020; Nivette et al. 2021). In our study too, we find that unification of several datasets derived from different police units and cities is hard, and arriving at a concrete common conclusion based on them is even harder. This study looked at data collected, cleaned, and stored by different organizations across the United States impacted in different ways by both crime and criminal activity, making it important to acknowledge that the conclusions we arrive at might not be truly generalizable.

When it comes to our modeling approach, we note that the VAR models used are quite limited in their ability as the only variables involved in our models are counts of the specific crime and COVID-19 cases. These models should not be used to forecast, COVID-19 or Crime cases as there are several other factors at play that influence either of their occurrences. Another major limitation and concern are to note that the Granger causality does not determine true causality and is only one of the many metrics that can be used to determine the cause-effect relationship between variables. The Granger test fails when both the involved variables are simultaneously affected by a third unknown variable, thus giving the illusion of causality. We

only use the Granger test in our study to narrow down relevant variables but future work can certainly employ other more sophisticated Bayesian Causality metrics like GARCH (Chen and Lee 2017). Finally, there are also several biases like underreporting of certain types of crimes and racial bias that plague crime data (Hetey and Eberhardt 2018; Buil-Gil, Moretti, and Langton 2021) that have to be acknowledged as well. It should also be noted that, due to stay-at-home measures and lack of access to police stations or support, several crimes especially rape and sexual assault are even more underreported than usual limiting the scope of our research (Palermo and Peterman 2011).

5.3   Future Directions

Finally, our study opens the door for more future work exploring the impact brought upon by the COVID-19 pandemic on crime and the human psyche. With the now availability of more comprehensive datasets like the global crime data set compiled by Nivette et al. (2021), such an analysis can be further extended to other countries. With more sophisticated modelling approaches such as machine learning inspired recurrent neural networks to make more accurate predictions, our predictive approaches can be made more expressive and further improved to arrive at better informed conclusions. A more comprehensive study can also include other crimes such as domestic violence and hate crimes against racial minorities alongside cybercrime which seems to have increased over the pandemic due to increased internet use.

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