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FROM DEFUND TO REFUND THE POLICE
An Empirical Analysis of Resource Allocation in the Police
Service

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ABSTRACT

Social science disciplines have used decision theory and game theory to offer empirical understanding and analysis of individual behavior. In the wake of the Black Lives Matter movement and the demand to defund the police, this thesis develops a principal-agent model that explores whether or not reducing police budgets affects racist behavior in the police force. Also, the framework of Becker's social loss function (1968) is utilized to measure the total social loss of having racist police in the community. Finally, county crime rates in the United States are often associated with the socioeconomic resources of counties and the distribution of these resources in neighboring counties. This thesis applies spatial econometric techniques to test spatial dependence of police spending, social program expenditures and other socioeconomic characteristics. The analysis concludes that there are spatial autocorrelation and an association between crime rate and neighborhood socioeconomic disadvantage. However, police budgeting is not a decision factor to develop optimal policies that can combat racist behavior in the police force.

Keywords: BLM, Black Lives Matter, Defund the Police, game theory, spatial econometrics

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I. Introduction

Institutional racism:

- Systemic racism occurs when an institution or set of institutions working together creates or maintains racial inequity. This can be unintentional and does not necessarily mean that people within an organization are racist.
- It is often caused by hidden institutional biases in policies, practices and processes that privilege, or disadvantage people based on race. It can be the result of doing things the way they have always been done, without considering how they impact particular groups differently.

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Since the enactment of the Civil Rights Act of 1964, the United States of America has numerous public policies and programs that are established purposely to combat and reduce the racial discrimination in its society. Each U.S. President takes aggressive actions to confront structural racism in healthcare, education, employment, housing, criminal justice, and more. For instance, a recent report from the White House points out what the Biden administration is doing to address systemic racism such as Advancing Racial Equity in the Federal Government, Condemning and Combating Racism, Xenophobia, and Intolerance Against the Asian American and Pacific Islander Community, Domestic Violent Extremism, as well as a creation of Chief Diversity and Inclusion Officer at the State Department². However, the effectiveness of those anti-discriminatory policies and programs is still in question and being examined intensively since racial disparity data in America has shown little progress in social mobility and in many other critical areas³. In one particular area, law enforcement, which this thesis mainly focuses on, has been reformed and modified accordingly throughout the years to promote effective approaches to public safety as well as to the challenging racial disparity in the criminal justice system⁴. One recent policing reform proposed by the public and nationwide civil rights moments is to “defund” police departments, in other words, to reallocate police funding to social and welfare services to put an end to police brutality and racial profiling. Even though the proposal is considered too radical for mainstream politics, it has mobilized activists across the country demanding specific national policing reforms as well as caught the world by storm and continues to be a mainstream

media headline. A study using survey and experimental evidence, published in the journal *Criminology and Public Policy*, reveals that efforts to defund (or in some cases, abolish) the police receive extremely limited support and generate opposition both in terms of slogan and substance because it underestimates the role of police in public safety⁵. Despite that, this study aims to primarily assess the police budgeting aspect of the proposal by exploiting economic methodology, game theory, and spatial econometrics in analytics.

It is understandable that for a long time, racial discrimination has been studied mainly by sociologists and psychologists. However, when Professor Becker from the University of Chicago introduced an economic approach to analyze and identify reasons for racism, the public and policymakers started to see the impact and consequential losses of not only for the people who are discriminated against but also for all of the people who are engaged in it. In *The Economics of Discrimination*, Becker used utility-maximizing model in which each individual acts rationally, meaning that he or she rationalizes the outcomes to make the decision on how to proceed that maximize their benefits. Additionally, Becker illustrated the economic notion of an equilibrium which is a condition, a state, or a point at which both individuals (i.e. sellers/buyers, employers/employees, sponsors/recipients, etc.) satisfy their desire outcomes while interacting with one another. Becker first developed the concept of taste-based discrimination which reflects prejudice or preferences. Taste-based discrimination can also reflect invalid statistical inference. Therefore, someone who, contrary to a large body of evidence, believes immigrants are more likely to commit violent crimes is discriminating based on prejudice⁶. Later, Arrow and Phelps proposed statistical discrimination which are models of discrimination based on rational optimizing behavior and limited information⁷. A classic example of statistical discrimination is when an employer assessing the expected productivity of a worker she is considering hiring. Effectively, utilizing economic approach to understand and evaluate the proposal of the defund the police movement is an applicable way of generating empirical evidence for policymakers in their decision-making process.

Indeed, studies of crime and how much it would cost society that use the economic analysis have become more common nowadays. From an economic perspective, the ultimate goal of a crime-control policy is to minimize the social costs of crime which are the harms created by offenses and the costs of deterring criminals by apprehending and sanctioning them⁸. As a result, this study attempts to determine the social cost that is imposed on society when racist behavior

occurs within law enforcement by applying empirical implications of another one of Becker's famous economic approaches to crime and punishment. In essence, Becker's social loss is the sum of damages, costs of apprehension and conviction, costs of carrying out the punishments imposed, and can be minimized simultaneously with respect to (1) the probability that an offense is discovered, apprehended, and convicted, (2) the size of the punishment for those convicted, and (3) the form of punishment such as imprisonment, probation, fine, etc⁹. Undoubtedly, police officers are not entirely comparable to the offenders in Becker's social loss. Becker recognized that many people are constrained by moral and ethical considerations and did not commit crimes even if they were profitable and there was no danger of detection¹⁰. Consequently, increasing or decreasing police expenditures is not necessarily a determinant factor affecting police officer behavior. Thus, Becker's economic model answers one of the important questions of how many resources should be used to minimize the social loss from crime. Equivalently, with the same analytic apparatus, the influence of police expenditures on racist police toward racial minority groups can be evaluated to have a better sense of the outcome from shifting police budgets.

Another economic approach that this study takes advantage of is the theoretical framework of Game Theory, more specifically, the Principal-Agent model. In general, game theory is the study of decision problems which involve several parties interacting rationally. Correspondingly, the principal-agent model identifies the difficulties that arise in situations where there is asymmetric information between two parties and finds the best contract in such environments¹¹. In this case, the principal is the county who has the authority to decide the annual police budget. Even though law enforcement is funded by multiple agencies including state and federal entities, most direct spending for police is done by local governments, 87% according to the data in 2020¹². On the other hand, the agent in the Principal-Agent model is the police department who is funded directly to maintain public safety. The expectation from the county when they use taxpayer money to pay for the police department is to enable the police department to detect and arrest any illegal activities. However, they are unable to detect any racist behaviors within law enforcement unless it already happened. In the Principal-Agent model, it is called moral hazard which is behavior by the agent that the principal would not like. In other words, it refers to all environments where the ignorant party lacks information about the behavior of the other party once the agreement has been signed, in such a way that the asymmetry arises after the contract is settled¹³. It is a contractual relationship between the county and the police department and this game theory

model analyzes the optimal budgeting amount or an incentive budgeting amount that can make the police department interested in the consequences of its behavior.

Finally, a spatial autocorrelation model is utilized in order to examine the effects of police and social services program expenditures on crime rates. Again, the proposal is to reallocate police annual budgets to social service programs such as education, housing, mental health, vocational training, etc. It is assumed by the Defund of Police movement that when the government started to invest in people, in prevention, rather than spending on discovering and catching offenders, the crime rate would be reduced. And ultimately, it would limit the police brutality and excessive use of force towards minorities since police contacts, stops, arrests, tickets, and power are diminished as a direct result of budget cuts. The budget cuts that the Defund the Police demands are not only to decrease the number of new police officers hired but also reduce police power, police stops, arrests, and tickets issued to violators.

In fact, the relationship between police expenditures and crime rates has been widely investigated and analyzed statistically. Numerous studies use databases of a period of 20 years or more to evaluate the correlation between those two variables. This study argues that previous research might have led to misleading conclusions and results because spatial interaction was not included in the analysis. In the case of the Defund the Police, the crime rate in Erie County, New York might impact or be related to the crime rate of the surrounding counties such as Genesee, Orleans, and Wyoming Counties. Another explanation of such importance of including the spatial autocorrelation model in the analysis is that the police budget from Erie County might affect or be related to the crime rate of the surrounding counties. For example, logically, criminals prefer to commit a crime in a different neighborhood that has less police presence. Briefly, spatial econometrics is a subset of econometric methods that are concerned with spatial aspects present in cross-sectional and space-time observations. Variables related to location, distance and arrangement are treated explicitly in model specification, estimation, diagnostic checking and prediction¹⁴. Furthermore, the spatial analysis model in this paper also examines the effects of social services programs' expenditures on crime rates which is the primary objective of the Defund the Police proposal.

Police brutality and excessive use of force in the United States not only damage its own society and citizens but also ruin its international reputation. Research has repeatedly shown that people of color are most affected by police use of force¹⁵. Despite many efforts and policy reforms,

the issue is still the most controversial and divided debate on both sides of the political aisle and within public opinion. Policies to stop police brutality or corruption are difficult because police officers put their lives on the line in their job and violators can be violent or deadly ¹⁶. As a result, the most basic definition of excessive use of force can also be challenged for interpretation and conceptualization. The law is clear but, in some cases, it very much depends on situational factors such as individual suspect behavior or the officer's perception of whether there is an immediate threat to themselves or the public. Nonetheless, this study does not aim to find out why the police tend to use excessive force toward the minority or if there is clear systematic racism in law enforcement or what policies should be effective to reduce the issue. Instead, the focus of this study is to provide empirical evidence and theoretical knowledge regarding the demand for defunding the police. Particularly, it desires to answer the following research questions:

- What is the effect of reallocating police budgets to social programs on crime rates?
- To which extent does shifting police expenditures minimize the social loss for having racist police officers in the community?
- Is the crime rate of a certain county influenced by one or more other factors existing in neighboring counties?

By strictly using economic approaches and statistical tests to clarify those research questions, the remainder of this paper is divided into seven sections. Following the introduction, a background of the Defund the Police movement as well as data on crime and police use of force are presented. The next section is literature review where previous research and studies about the topic will be discussed. Each economic model (Becker's social loss, the Principal-Agent, and the spatial autocorrelation) and its analysis will be presented in the following three sections. Finally, the study ends with the discussion and conclusion to highlight the main points of the study's result as well as explain the study's limitation.

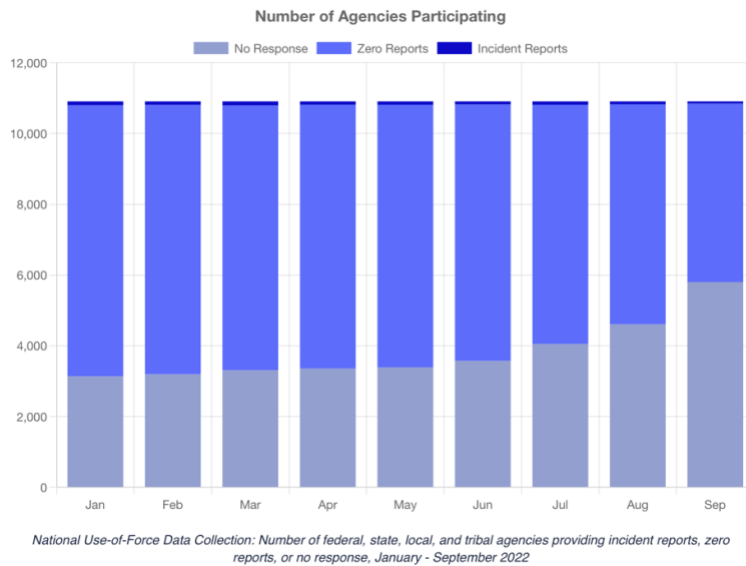
II. Background of the Defund the Police Proposal and Police Use of Force

“I can’t breathe, I can’t breathe.” Those are the last words from George Floyd, an unarmed man who was killed in police custody in Minnesota in 2020. George Floyd’s death has triggered major protests and sparked rage across the United States and around the world. These demonstrations dispute the fundamental role and purpose of law enforcement in a democratic and free society. Tracing back to the days of slavery in colonial America in the 1700s, the history of law enforcement in the United States generates a broader picture of how one incident of police excessive use of force has shaken the entire country to its lowest point in terms of civil rights movements. According to Senior, the first police department in the United States was established in New York City in 1845 after large numbers of immigrants from Germany and Ireland. At the time, New York City’s elite, political, economic, and social dominance were English and Dutch. With large immigrant populations in a crowded city struggling for a place in American society, serious trouble began in the 1820s including crimes, riots, and other disturbances. As a result, the mayor and common council established a professional police force to quash labor strikes and riots against the rich with George W. Matsell as the first New York City Police Commissioner¹⁷.

On the other hand, the South and the West of the United States remained lawless after the Civil War¹⁸. The history of the United States cannot be separated from slavery. Criminals were usually brought to vigilance courts and applied lynch law. Slave patrols were tasked to catch and return runaway slaves¹⁹. Furthermore, the Civil War did nothing to discourage the practice of lynching or raise the standard of internal policing²⁰. Throughout the years, a number of policing legislations were passed intensifying the segregation between the black and white population such as Jim Crow laws. In addition, police have adopted discriminatory practices such as the “stop and frisk” policy which empowers police to stop and search someone without a warrant if they have a reason to believe that individuals are doing something wrong, or the practice of racial profiling individuals to fit the description of a suspect the police can then target²¹. Consequently, it is not surprising that modern-day policing is constantly on the edge of racially discriminated exposure. As a matter of fact, the police’s excessive use of force in the case of George Floyd is not the only incident of note.

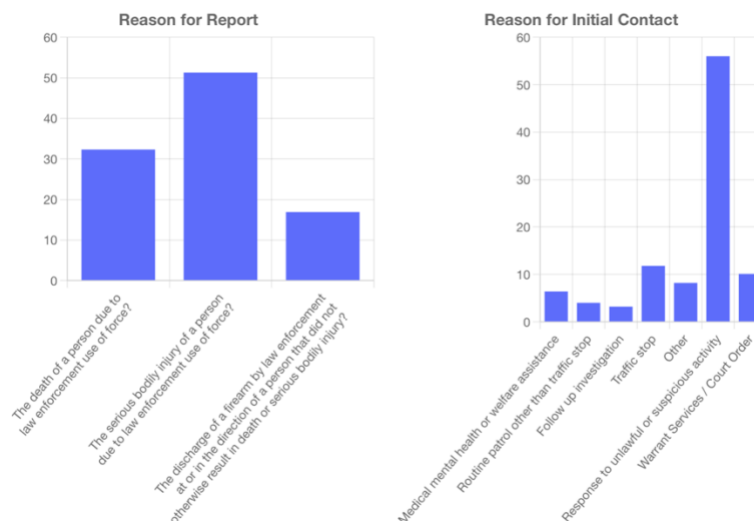
Police use of force data is very limited and little available for the public and for researchers. In 2019, The Federal Bureau of Investigation (FBI) launched the very first National Use-of-Force

data collection and encouraged all law enforcement to participate. For instance, data from January to September 2022 indicates that there were 840 use-of-force incidents reported to the FBI database. However, the number might lead to inaccurate conclusions because there were only 8,484 out of 18,514 federal, state, local, and tribal law enforcement agencies throughout the nation participating and providing use-of-force data. The officers employed by these agencies represent only 66% of federal, state, local, and tribal sworn officers in the nation²².



Source: FBI Crime Date Explorer – Use of Force Data from 2022

More specifically, the 2022 report also reveals top reasons for initial contact between law enforcement and civilians, the type of force used, and resistance encountered.



Source: FBI Crime Date Explorer – Use of Force Data from 2022

Rank	Type of Force Used	Rank	Resistance Encountered
#1	Firearm	#1	Failing To Comply To Verbal Commands Or Other Types Of Passive Resistance
#2	Hands-Fists-Feet	#2	Attempted To Escape Or Flee From Custody
#3	Electronic Control Weapon (Taser®)	#3	Displaying A Weapon At An Officer Or Another
#4	Canine	#4	Using A Firearm Against An Officer Or Another
#5	Other	#5	Resisted Being Handcuffed Or Arrested

Source: FBI Crime Date Explorer – Use of Force Data from 2022

The Centers for Disease Control and Prevention (CDC) also collects national data pertaining to lethal and nonlethal injuries inflicted through legal intervention. According to CDC, a death from legal intervention is a death in which a person is killed or died as a result of injuries inflicted by a law enforcement officer or other peace officers, including military police, while acting in the line of duty²³. Data from 2017 to 2020 shows that there was a total of 2,666 deaths through legal intervention regardless of race, sex, and ethnicity.

All Intent All Injury Deaths and Rates per 100,000

Data Years: 2017 to 2020, United States, All Ages, Both Sexes, All Races, All Ethnicities

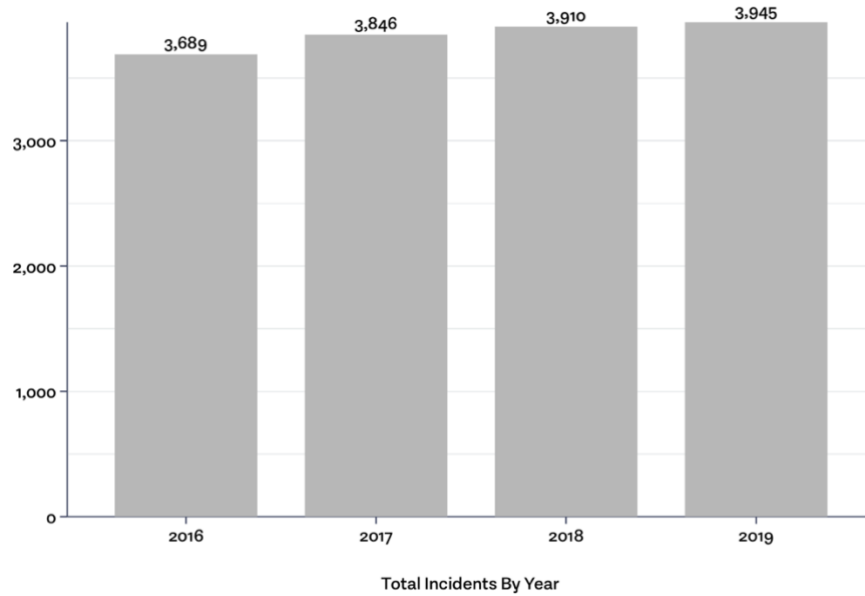
ICD-10 Codes: V01-Y36,Y85-Y87,Y89,*U01-*U03

Intent	Deaths	Population	Crude Rate	Age-Adjusted Rate	Years of Potential Life Lost
Unintentional	711,058	1,309,774,403	54.29	51.05	11,713,861
Homicide	82,057	1,309,774,403	6.27	6.45	2,543,834
Legal Intervention	2,666	1,309,774,403	0.20	0.21	73,808
Suicide	189,007	1,309,774,403	14.43	13.92	3,809,554
Undetermined	23,177	1,309,774,403	1.77	1.75	515,675
Total	1,008,008	1,309,774,403	76.96	--	18,657,054

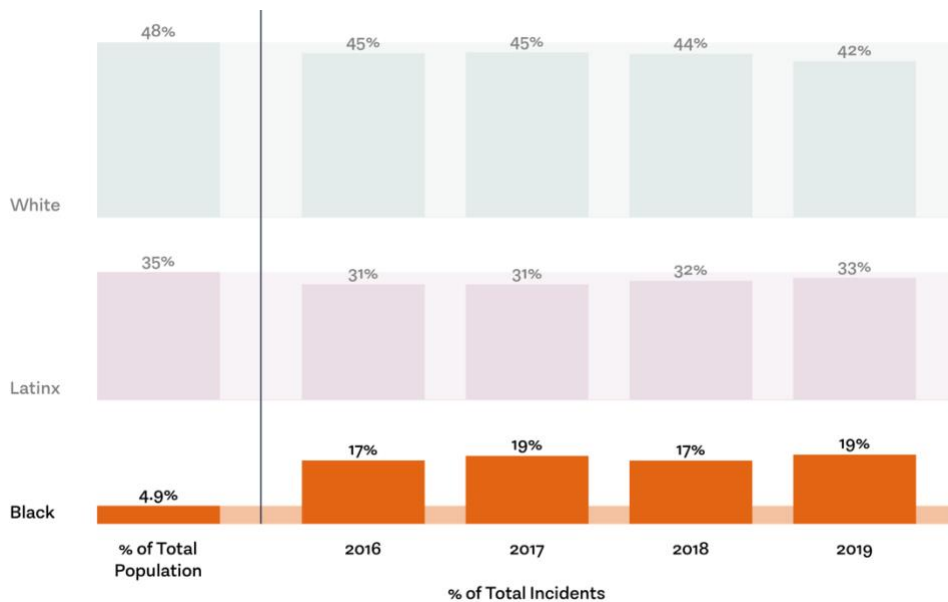
Source: CDC Web-based injury statistics Query and Reporting System (WISQARS) Fatal and Nonfatal Injury Reports

Indeed, there is no accurately comprehensive nationwide-level data on police use of force. As a result, this makes it harder for searchers and policymakers to issue conclusions about whether or not it is just a few bad apples or the entire modern law enforcement systematic racism inherited. On the other hand, a number of major cities and counties have started to keep track of their own Police department use of force in order to enhance equity in public safety. One example is San Diego County, California in which the total population is 3,185,270 consisting of 48% White, 35% Latino, 12% Asian, 4.9% Black, 0.4% Native Hawaiian or Pacific Islander. The number of use-of-

force incidents recorded each year with complete data varied from a low of 3,689 in 2016 to a high of 3,945 in 2019 (notice that that number is much higher than the number reported in the FBI National Use of Force data)



Source: Center for Policing Equity – the Justice Navigator. San Diego County – Use of Force Incidents per Year



Source: Center for Policing Equity – the Justice Navigator. San Diego – Use of Force Incidents per Year, Separated by Racial Group, and Compared to Population

Data analysis shows that in San Diego, Black people were subjected to force four times as often as white people. Furthermore, once stopped by law enforcement, Latino people were searched for contraband 1.4 times as often as white people²⁴. Emphatically, local-level data provides more insight into police use of force. However, local-level data is unable to identify national trends associated with use-of-force incidents and other outlying factors.

There are some national-level records that can point out the prominence of racial disparities in the criminal justice system. For instance, a report on interaction between police and the public, established by the U.S. Department of Justice – The Bureau of Justice Statistics, found that Black residents were more likely to be stopped by police than white or Hispanic residents, that Black and Hispanic residents were more likely to have multiple contacts with police than white residents, and that when police initiated an interaction, they were twice as likely to threaten or use force against Black and Hispanic residents than against white residents²⁵. Another report submitted to the United Nations on racial disparities in the U.S. criminal justice system shows that in 2016, Black Americans comprised 27% of all individuals arrested in America, about twice their proportion of the total population in which the authors of the report argue that main drivers of the disparity include disproportionate levels of police contact with Black Americans²⁶. Police excessive use of force towards civilians, especially towards the racial and ethnic minorities, can be deadly and extremely costly. There is the human cost which is when civilians are killed by police officers and the social cost which can be seen as the trust between law enforcement and the community. Those costs are inhumane and incalculable as well as are the determinant factor for the establishment of the Black Lives Matter movement.

After the death of George Floyd in 2020, about 15 million to 26 million people solidified across the country to protest the disproportionate interactions with the criminal justice system and the carceral state experienced by Black and African Americans²⁷. Nonetheless, the Black Lives Matter movement was born long in advance. In fact, Black Lives Matter was indirectly created in 2013 out of decades of frustration within the African-American community over the legal system's continual exoneration of those who had taken black lives²⁸. In context, the Black Lives Matter movement seeks to fight the country's old and hidden wound regarding spatial segregation which the black and the minority are deliberately kept away from the white neighborhood. There is a number of cases when Black people who "accidentally" transgress the boundary between black and white communities are killed by white people who are later found not guilty by the legal

system. For example, the Chicago race riot of 1919 that left 38 dead began when Eugene Williams, a 17-year-old black man, drowned in Lake Michigan after being stoned to death because he accidentally swam near white people even though the beach was not a segregated beach. The man who threw rocks that caused Eugene Williams' death was identified but the police denied arresting him²⁹. Similarly, Trayvon Martin, a 17-year-old Black teenager on his way coming back from buying snacks in Florida, was shot and killed in 2012 by George Zimmerman. Zimmerman, is white and was a crime-watch volunteer, called 911 to report suspicious criminal activity when he encountered Martin in his neighborhood. Ignoring the 911's instructions not to pursue, Zimmerman confronted Martin and shot Martin to death, claiming self-defense. He was found not guilty and was acquitted of his charges, a decision that sparked national outrage and fueled the birth of the Black Lives Matter movement³⁰.

There is another type of cost, the economic cost of police use of force and misconduct. Every year, taxpayers in cities and counties across the country pay hundreds of millions of dollars to settle lawsuits filed in response to police misconduct and excessive use of force causing unlawful and unnecessary injuries and deaths³¹. Breonna Taylor, Tony McDade, Michael Brown, Philando Castile, and Freddie Gray are among high-profile killings by police excessive use of force, and George Floyd's violent death was a breaking point. As a result, the Black Lives Matter calls for a national defunding of police. They demand investment in Black communities and the resources to ensure Black people not only survive but thrive³². Particularly, Defund the Police is a demand to cut funding and resources from police departments and other law enforcement and invest in things that the movement claims will make communities safer such as quality, affordable and accessible housing, universal quality health care, including community-based mental health services, living wage employment, education, youth programming and employment³³. The demand argues that the police spend most of their resources going after minor incidents that could be solved by other non-lethal means. For instance, in the US, only 5 percent out of 10.3 million arrests made per year are for the most serious offenses, including murder, rape, and aggravated assault. The remaining 95 percent are for social conditions related to poverty and precarity. For instance, despite having no other place to go, homeless people are regularly subjected to harassment from police while living in public space³⁴. Thus, instead of criminalizing citizens for their poverty, counties and cities can reinvest in social programs that support and meet community needs. The

ultimate objective of the defund the police is to reduce crime in the community, and consequently, minimize adverse police contacts with black and minority communities.



Source: #DefundThePolice – The Demand is Still

The five-month nationwide demonstrations after George Floyd's death have put an inescapable pressure on government entities to react to the Black Lives Matter's demand. In fact, the *Defund the Police* proposal was widely supported by the public at the time. After six months of the movement, the BREATHE Act was introduced to Congress by legislators, and organizers across the country have won significant victories in campaigns to reallocate funds from police department budgets to meet community needs³⁵. More than 20 major cities (New York, Chicago, San Francisco, Los Angeles, etc.) have reduced over 840 million dollars from police departments and secured investments of at least 160 million dollars in communities. Officials from over 25 cities such as Denver and Oakland removed cops from schools, saving an additional \$34 million for investment in meeting student needs³⁶. Nevertheless, there were also 26 major cities where lawmakers continued to increase police budgets and the \$840 million dollars reduction is a significantly small portion compared with the U.S. collectively spending \$100 billion annually on policing and another 80 billion on incarceration across all levels of government³⁷. As crimes increase after the pandemic, many cities that have defunded police budgets during the 2020 demonstrations were asked to restore their police budget by state governments' legislation³⁸. The country again increases or "refunds" police departments to maintain public safety. Recently, the proposal Defund the Police is brought up one more time since five Memphis, Tennessee police officers violently beat Tyre Nichols, an unarmed black man, to death during a simple traffic stop. The images of another Black man dying at the hands of police in the video footage released by authorities shocks the world and again mobilizes protestors in multiple cities.

III. Literature Review

In the book *The Logic of Collective Action*, Olson (1965) states that the market mechanisms do not bring fair results to the different groups in the economy. This unfairness will not be removed by collective action promoted by the government unless pressure groups force through the necessary reforms³⁹. Indeed, the Black Lives Matter movement is considered to be representing an organized pressure group seeking to influence governmental policies to combat forms of structural racism directed towards Black and African Americans. Their fight reflects what they have been experiencing despite the Civil Rights Act having been enacted more than 50 years ago. However, a good cause does not guarantee a successful outcome for the whole movement. Professor Truman recognizes that most pressure groups would be weak and divided in those circumstances in which they asked for too much from society since their members also had overlapping memberships in other groups with different interests and would thus tend to oppose excessive demands. Moreover, there were potential groups that would arise and organize to do battle with the special interests if the special interests got far out of line⁴⁰. The police can be seen as “the other group” in this case. If a cut in the police budget was advanced, it could cause an increase in crimes and would undermine the safety of the police. Therefore, the police and other groups that support the police would organize a lobby to oppose it. It is resisting to wonder if the *Defund the Police* proposal asks too much from society since data has shown again and again the substantial racial inequality in the U.S. society, especially in the criminal justice system.

There is no concrete and incredibly limited data pertaining to police brutality and racial bias. Academic researchers and media outlets often rest on statistics such as the number of arrests, and the number of Black men killed during police confrontations compared with the white population to investigate law-enforcement practices. Similarly, DeAngelo, Vitaliano, & Lang⁴¹ use violent and property crime rates to compare with policing costs of 50 municipal police departments in New York State such as new hiring of police officers, number of vehicles, etc. The purpose of the paper is to investigate the potential for each police force to reduce crime while holding constant budgeted resources by using the Data Envelopment Analysis model. In other words, the authors want to investigate if local police departments reduce their policing budgets but are still able to maintain their efficiency as in the case of New York State in 2014, Governor Cuomo proposed a US\$60 million budget cut to the New York State Police, while other upstate

New York cities such as Rochester unveiled a spending plan that includes laying off 51 full-time positions. The study concludes that “of the 50 municipal police departments examined in this paper, 30 are operating at maximum efficiency: crime could not be reduced further with the resources available, based on observed best practice policing of peer departments. The remaining departments show considerable room for improvement if they were to adopt the policies and procedures of their best peers: violent crime could be reduced by about 173 percent and property crime by 64 percent, on average”⁴². For example, the per capita violent crime rate in Wellsville, NY is 0.004975 in 2003. An output-oriented Data Envelopment Analysis shows that this city could reduce its crime rate to 0.002123 if it operated as effectively as the four peer departments against which it is evaluated a 133 percent reduction. Even though the study does not reflect on police brutality and racial bias, it edges one aspect that the influence of budget on crime is not as strong as the influence of policing policies, procedures, and practices.

Comparably, Simes (2017) analyzes disaggregated prison admissions and investigates the spatial concentrations and levels of admissions for the entire state of Massachusetts by using a spatial regression model. Simes bases his analysis on two perspectives (1) urban inequality perspective and (2) social control perspective to hypothesize that even in a statewide analysis, the overwhelming majority of places marked by extreme levels of prison admissions should be not only in major cities but be significantly limited to poor, segregated neighborhoods within them⁴³. It is understandable and statistically proven that poverty, race (socio-economic disadvantage), crime, and incarceration are highly correlated. As a result, a high crime rate has been seen in the neighborhoods where residents live with constant socio-economic constraints. Therefore, Simes explores how local conditions shape prison admission rates in the wake of a broadening spatial distribution of social and economic disadvantage. Regression analysis yields three findings. “First, incarceration is highly spatially concentrated: census tracts covering 15% of the state’s population account for half of all prison admissions. Second, across urban and non-urban areas, incarceration is strongly related to concentrated disadvantage and the share of the black population, even after controlling for arrest and crime rates. Third, the analysis shows admission rates in small urban satellite cities and suburbs comprise the highest rates in the sample and far exceed model predictions”⁴⁴. Indeed, spatial autocorrelation is a well-fitting and proper method to analyze spatial patterns of crime in the community and how budget influences that issue.

Another research focuses on how increasing social programs' budgets affect racial bias in the police force and the frequency of police interactions and how they handles towards Black and other minority populations. Lum, Koper, & Wu (2021)⁴⁵ analyze millions of 911 calls for service across nine U.S. cities to understand why people call the police and how the police handle the calls. Police respond to a wide range of concerns such as traffic-related problems, everyday disputes, worries about suspicious behaviors, disorders, disturbances, and general requests for help and assurance. They find that a large proportion of calls that police agencies are receiving from citizens do not seem to be for serious crimes or obvious emergencies; mental distress events only contribute to a small fraction of calls to the police; and only a small share of calls for service result in citations or arrests⁴⁶. This does not support the common view that police agencies are handling large amounts of calls for people in mental distress, and therefore provides the first indication that significant defunding of the police would likely not be achieved even if another agency handled these calls⁴⁷. Many argue that police are not professionally trained in crisis intervention which is emergency interactions between persons with mental illness and police officers. It is reasonable to transfer a part of police budget to specialized social services agencies. However, the statistics above reveal that the number of mental distress events reported to 911 is insignificant. Thus, the fund that transfers from the police to social service agencies is just another waste of public resources. The *Defund the Police* movement demands more resources for social programs not only to eliminate unnecessary interactions between the police and the Black community which probably result in reducing police brutality but also to improve socio-economic conditions within Black communities in order to decrease the arrest and crime rates. This thesis using the spatial autocorrelation method will contribute one analytical evidence with a broader perspective to test that claim from the proposal.

Budgetary allocation to police agencies involves various factors. Zhao, Ren, & Lovrich (2010)⁴⁸ examine the utility of the three competing approaches (local political culture, socioeconomic characteristics, and the incremental nature of change in public sector decision-making) in predicting annual municipal budgetary allocations made to police agencies in U.S. cities. A regression model was used in their analyses in which the dependent variable is the annual percentage of budgetary allocation that a police department received from the city government in 1993, 1996, 2000, and 2003. The independent variables are mayor-council, district-council, partisan elections, crime rates, unemployment rates, percentage of minority residents, per capita

incomes, the annual percentage of fire department expenditures, and annual percentage of park/recreation expenditures. The findings for 188 U.S. municipal governments clearly indicated that the municipal budgetary process is primarily incremental in nature, the utility of the incremental approach is somewhat greater when applied to essential services than when applied to nonessential services, and the size of the minority population was statistically significant in increasing police budgets⁴⁹. The incremental approach is when budget decisions are made based solely on the previous year's allocation. The finding shows that essential services such as public safety get more benefits than non-essential services such as parks and recreation expenditures when applying the incremental approach. In fact, these findings align with Aaron Wildavsky's theory of budgetary incrementalism which dominated the mainstream of American budgeting for decades. Wildavsky sets out a theory of budgetary incrementalism based on the assumption of bounded rationality in which budgetary actors tend to satisfice rather than maximize⁵⁰. Particularly,

“Budgeting is incremental, not comprehensive. The beginning of wisdom about an agency budget is that it is almost never actively reviewed every year in the sense of reconsidering the value of all existing programs as compared to all possible alternatives. Instead, it is based on last year's budget with special attention given to a narrow range of increases or decreases. Thus, the men who make the budget are concerned with relatively small increments to an existing base.”⁵¹

Wildavsky further discusses budgetary strategies in which the budgetary process involves a group of individuals: line agencies, the Bureau of the Budget, and the Appropriations Committee. The fate of budgetary allocation depends on what strategies each party plays in the process. However, most of the time the decision of who gets what and how much is based on the previous year's allocation because decision-makers use previous activities, programs, and policies as the basis for their decision to deal with uncertain risks which can be explained by Wildavsky's theory of budgetary incrementalism.

Nevertheless, Wildavsky's perspective of governmental budgeting as an annually repeated process with a clear bargaining game is recently re-examined by many other scholars since governments have made numerous reforms in budgeting. As a result, Wildavsky published a revised edition of his book “The new politics of the budgetary process” in 1988 in which “the book

mixed substantial chunks of incrementalist theory with a more incisive, analytic, and contemporary theory”⁵². For example, Professor Sieberg and Professor Khan modernize Wildavasky’s budget game model by developing a game-theoretic approach and adding one more party in the budgetary process: the clientele vis-à-vis the public, who do not directly participate in the budget game but whose interests all three groups claim to serve or represent⁵³. It is the case of the *Defund the Police* proposal which is a collective pressure group represented by all three parties in the budgeting process. The movement cannot express their opinions or be able to directly change the course of the decisions, but their voice could rationalize and influence how each party uses strategies during the budgeting process. Why is it important and even a substantial constituent of the process? Incrementalism is when policymakers exhaust precious knowledge to make decisions. Therefore, Wildavsky’s model assumes it is symmetric information (open information/knowledge) and each party knows what the other would do in every phase of the process which creates only one equilibrium. In the meantime, with the presence of a new party, Sieberg and Khan point out that a broader range of possible outcomes can occur besides the pure equilibrium, i.e. the incremental outcome as Wildavasky demonstrated⁵⁴. Specifically, there is a mixed-strategy equilibrium where all players use mixed strategies if the potential gains exceed the potential losses and a partially mixed-strategy equilibrium where some players play pure and some play mixed-strategy⁵⁵. In fact, Rubin (2015) in the book *Public Budgeting: Policy, Process, and Politics* validates that “the result is a pattern of incremental decision making that insulates the city from needs and demands. However, this pattern may vanish if a coalition forms to resolve severe municipal problems”⁵⁶.

Police budgets play a vital role in not only community safety but also the effectiveness and quality of law enforcement. It can either encourage police officers to faithfully do their job or at the same time circumstantially corrupt them. Becker and Stigler (1974) used an economic approach to explain what influences police officers from not fulfilling their job duties as monetarily contracted with the police department. Given to any rational individuals, police officers would violate or abuse their power, bribery for example, if the expected utility gained from such activities exceeds the monetary equivalent of the punishment and the expected utility (salary) gained from the job. Becker and Stigler further made two suggestions for improving the quality of police officers. The first proposal is to raise the salaries of officers above what they could get elsewhere, by an amount that is inversely related to the probability of detection, and directly related to the size of bribes or any other benefits from malfeasance⁵⁷. The author argued that instead of

spending resources on detection, the department should find the minimum salary and pension that would discourage police officers from malfeasance. This proposal makes sense because paying for monitoring police officers is proven to be extraordinarily expensive. Most police work, especially police field operations is unsupervised. Therefore, police officers could engage in illegal activities such as intimidating and taking bribes from potential suspects, or underperforming tasks. However, when raising police salaries, the social loss from offenses will also rise because police salaries fall into the category of the cost of apprehending. Another question could be asked when policymakers decided to raise police salaries is that what is the best measure to evaluate the effectiveness of those high-paid police officers.

The second Becker and Stigler's proposal is to pay private law enforcement for performance or on a piece-rate basis. The authors admitted that public police officers are ideal to achieve an optimal combination of punishments and probabilities of apprehending and conviction, yet "the temptation of malfeasance by public enforcers and the cost of policing them would rise as the punishment rose, and therefore an appropriate tax on private enforcement could lower its equilibrium probability of conviction to any desired level"⁵⁸. In 1991, a pilot program in California was adopted to contract out with private firms to provide nonessential police services such as parking enforcement, burglary alarm response, investigation and reporting of non-injury traffic accidents, etc. The program was examined to see how it might benefit California law enforcement in the future. They concluded that local police departments could save up to 51 percent salary and could use it to address violent crime, drug-related problems, and other equally important community concerns. Moreover, contracting out nonessential services would benefit local law enforcement from the perspective of reducing the problems and the associated costs of recruiting, training, and disciplining in-house employees involved in the performance of nonessential tasks⁵⁹. The concept of government privatization is not new to the American public such as privatized prisons and healthcare. However, with a weak checks and balances system and an incomprehensively regulated market, privatization could create a new principal-agent problem in which private security firms intentionally create more demand to maximize their profits. Furthermore, the potential legal implications of private policies operating in public spaces could spark controversial debates among the public.

IV. Gary Becker Social Loss Model

The fact is that humanity has not been able to create a crime-free society because governments cannot eliminate or prevent completely individuals from committing illegal activities. Therefore, the purpose of public law enforcement is to maximize social welfare and minimize the social cost of crime. Nobel Prize winner Gary Becker started to think about an economic approach toward criminal behavior while he was searching for parking in New York City. He calculated the likelihood of being ticketed and how much he would have to pay in fines and the cost of putting the car in a lot if his illegal parking is detected⁶⁰. What Becker did is he made a cost-benefit analysis in order to decide whether to pay for parking or not. As rational choice theory suggests, the potential criminal will engage in a crime if the expected benefit is less than the expected punishment including the consideration of the probability of detection. However, not all of us would commit a crime even if we met these conditions because there are more external reasons to be considered. In the case of police officers, it can be assumed that people voluntarily join the police force because they believe in justice. They protect people and property from any violations. Nevertheless, people could have different perceptions of justice as efficiency. Some police officers with a particular prejudice would target a certain group of the population while doing their police work. Even with that prejudice and limited chances of being detected, it does not guarantee that they would act on it because of the constraints set by the law. Becker's studies of crime analyze these constraints and further develop a model to measure the social loss from crime. Becker's theoretical and empirical implications will be utilized to explore in what conditions police officers with prejudice start to abuse their power and the loss the county suffers when they accidentally hire prejudiced police officers.

Again, defunding the police department does not necessarily decrease the number of offenses. The question is what makes a person commit a crime? With the assumption criminals are utility maximizers, the criminal commits a crime to acquire a wealth (w). He or she is caught and punished with probability (p), and the punishment (f).

Becker's function of an expected utility maximizing criminal⁶¹:

$$EU = pU(w - f) + (1 - p)U(w)$$

$U(w - f)$ is the utility function if he is punished with the probability p ($0 < p < 1$)

$U(w)$ is the utility function if he is not caught with the probability $1 - p$

The expected value would be:

$$\begin{aligned} EV &= p(w - f) + (1 - p)w \\ &= w - pf \end{aligned}$$

As the potential criminal needs to make decisions under uncertainty, each decision will lead to different possible outcomes, in other words different expected utilities. If he decides to:

- Commit a crime and get caught: $EV = w - f$ (Note: in some cases, the criminal will not gain anything from his offenses ($w = 0$) and only pay punishment from his offenses)
- Commit a crime and get away with it: $EV = w$
- Commit a crime, get caught but the punishment is insignificant compared with the expected income from offenses: $EV = w$
- Not to commit a crime because he can find a legally alternative income w' ($w' > w$)

Generally, potential criminals need to weigh on the probability of getting caught and the size of the punishment they have to pay before making the decision to commit a crime. It needs to be addressed that the supply of offenses is determined not only by the individual's rationality but also the legal income availability. If he could find a sufficiently alternative income, he would rather invest his time and resources in that activity than facing uncertainty. Consequently, the probability of detection/conviction and the severity of the punishment play a vital role in the crime-control scheme. Either an increase in the probability or the severity of punishment will decrease the expected utility gained from offenses and theoretically could deter potential criminals from committing offenses. The probability of detection depends on funding for technology, the police force, the court, prosecutors, etc. In contrast, the severity of punishment includes the length of prison term, fines, probation, or a combination of fines and probation. Practically, there are four possible scenarios regarding those two decisive variables:

- Low probability and Low severity: it is the case when policymakers decide to invest in the community and the people instead of spending money to control them. People could see it as a way to achieve the optimal incapacitation when people would not commit any crimes

since they have enough alternative monetary and/or nonmonetary income to supplement the gain from the crime. However, reality teaches us that we are not living in a utopian world because it is just “fundamentally against human nature”. From the criminal perspective, the expected value of the crime ($EV = w - pf$) will increase significantly because p and f are approaching zero.

- Low probability and high severity: the reason we do not touch a hot pan is that we know that the consequence/the punishment which is our hands will burn. With that logic, it can be understood that spending less on police and imposing higher sentences or fines would be a practical approach to deter criminals. Now, according to Becker’s criminal economic model, the optimal deterrence will depend on the type of punishment in order to achieve the lowest possible cost for society. It is important because if misdemeanors were punished at the same level as felonies, it could incentivize criminals to commit more serious crimes.
- High probability and low severity: similar to low probability and high severity, it will play a role in deterring potential criminals from committing a crime. However, the difference here is that high probability would lead to an increase in incarceration and higher cost to society. Additionally, policymakers should consider the likelihood of catching innocent people when increasing spending on police and courts.
- High probability and high severity: it does not take much imagination to conclude that even if the damages/losses from crimes are not counted in this equation, the high probability and high severity approach will increase the social loss to the maximum. Yes, the effects of criminal deterrence would reach the optimality, but the question is at what cost policymakers are willing to suffer to pursue that goal?

Indeed, the probability of apprehension and conviction, and the severity of punishment have significant effects on criminal behaviors. However, it is moderately different in the case of police officers who possess a racial prejudice because for them the marginal benefits and the marginal costs vary and depend on personal risk preferences. For instance, the New York state speed limit on highways is 65 mph. Yet, every driver knows that there is a 5-mile “gray area” that they could drive beyond 65 with a very low probability of getting ticketed. Police officers, on the other hand, legally can stop and issue speeding tickets to any drivers who violate even with just 2 or 3 miles over the speed limit. This 5-mile gray area is an example of the dilemma that the county

faces when they want to determine if the police officer has a racial prejudice or not after observing the result. Even though the county can base assessed investigations on index crime rates that are categorized by race, these index crime rates cannot identify predictive factors such as racial bias (i.e. a large number of black residents arrested by white officers does not mean those white officers have a racial prejudice). Hence, there is a need to understand the expected utility of racial-prejudiced police officers in order to distinguish any decision variables.

Police officers cannot be treated as regular potential criminals. They will not gain monetary utility from using race or ethnicity as a criterion in conducting stops, searches, and other law enforcement procedures, but they will receive guaranteed wages from the county for their efforts of doing police work, then the expected utility of racially prejudiced police officers is given by:

$$EU = pU(w + tl - f) + (1 - p)U(w + tl)$$

Where:

p: the probability of getting caught

w: base police salary

f: punishment

t: the intensity of racial bias and

l: level of force allowed

The term tl is the extra utility gained by the police officers from carrying out implicit racial bias. If t increases, the extra utility increases and vice versa. On the other hand, if the level of force allowed increases and the police officer still decide to act biasedly, the extra utility will also increase (the higher risk the greater reward). Divergent from regular potential criminals, if the police officer decides to not carry out racial bias (it means $t = 0$ and result in the extra utility = 0), he will still legally receive his salary paid by the county just like any other regular police officer. It is an important factor because now the police officer has the upper hand in the situation and depending on his risk preferences he could risk earning extra intrinsic benefits for racist behaviors. Remember that the county pays the police an hourly wage rather than a commission for each valid arrest or action; thus, the police who knows the law is able to collectively and proactively choose

the appropriate situation (or even fabricate the situation) so that he can execute racial bias and at the same time eliminate as much as possible the probability of being exposed.

Given that police officers can influence the interaction with potential criminals, detecting racial bias in policing is extremely difficult. In Becker's function of an expected utility maximizing criminal, the government invests in the police force and court personnel to increase the probability of conviction which is a practical strategy to deter criminal behavior. On the other hand, to increase the probability of convicting any racial-prejudiced police officers for wrongdoings, the county must invest in body-worn cameras, implicit-bias training (prevention to reduce the supply of offenses), reports, and other officers' testimonies. It raises another issue "The Blue Wall of Silence" as Jean-Pierre Benoit describes in his essay *Why do Good Cops Defend Bad Cops*. Using the tools of game theory and Bayesian modeling, Benoit investigates a criminal procedure court that involves three parties: the court, the police union and the police officer to determine the validity of the accusation about police officer's malpractice. Briefly, the police officer is self-interested and seeks to minimize the probability that he is convicted. The police union represents the desire of the majority. Lastly, the court will receive evidence provided by the police union and the officer to determine if the police officer is bad or good; that is, to declare the police officer guilty or innocent. The study infers that the blue wall of silence is not just to protect the bad apples but to defend all police. Police officers can make honest mistakes and it can be interpreted improperly as malevolent acts, especially by outsiders and even by other officers. Therefore, it can be understood why even the good cops try to protect the bad cops because there is a possibility that can happen to them at some point. On the other hand, the court will receive mixed signals from the union and the police officer so that the court will have to rely on prior beliefs, specifically the overall perception of police, to make decisions⁶². In a nutshell, as reality has shown, the probability of convicting and detecting bad police officers before he or she can act is close to 0 because the common knowledge is that they want to uphold the rule of law rather than break it when they join the police force.

Comparably, punishment is another puzzle that policymakers have trouble imposing in order to deter some police officers from committing racial bias. Criminal sanctions can be monetary or nonmonetary. For infractions, the expected penalty is fines which are the lowest method of punishment, and then sanctions will increase to imprisonment or capital punishment in accordance with the severity of the crime. However, punishment choices for malfeasant police

officers are limited. First, they will face being fired after the authority such as disciplinary committees evaluate their behaviors and conducts in given incidents or complaints filed against them. Yet, firing a police officer is not an easy process like in regular businesses. Many states have the Law Enforcement Officers Bill of Rights that gives police officers the ultimate protection from accountability for police misconduct. For instance, a Howard County police chief abandoned his call for public disciplinary hearings, citing the Bill, and a court ruled that an officer who was fired after using excessive force had to be reinstated and given back pay⁶³. Former officer Chauvin, prior to the death of George Floyd, had 18 complaints against him on official record and was involved in three other police shootings, one of which was fatal, but he was still able to maintain his job⁶⁴. Additionally, even if an officer is fired for misconduct, he or she can be rehired by other police departments. The New York Times reports that the police officer in Cleveland, Ohio, who fatally shot 12-year-old Tamir Rice in 2014 had previously resigned from another police department after it had deemed him unfit to serve. The Cleveland police did not review the officer's personnel file before hiring him⁶⁵. When the allegations of misconduct and malfeasance reach beyond the protection of the police union, police officers now will be scrutinized by the public and trialed by the criminal court. As a result, police officers will face prison time (it is rare and only a small group of law enforcement has been convicted on charges related to on-duty killings), but they often receive less prison time than other civilian counterparts. Given the history of not holding officers to the same standard as criminals under similar circumstances, the punishment variable is hard to be considered as a decisive factor.

Recall that the demand is to defund the police. In this case, not only the county reduces the probability of detection and prevention but also discourages civilians from joining police force because the salary does not match the reservation wage (this wage is the legal work available for civilians outside of the police force). Furthermore, the consequences of reducing the number of police can lead to an increase of racial bias to compensate for the loss in the salary. The term *tl* explains the quantity of extra "income" police officers receive if he or she decides to use racial bias practices. While the intensity of racial bias *t* decides the willingness and commitment of the police officer, the level of legal force allowed plays a role as a constraint and a signal that racist police officers will face consequences if excessive and unreasonable force is used. The intensity can be positive when racist officers unnecessarily punish racial minorities and gain utility for that action. It also can be negative if they decide not to and produce disutility. Meanwhile, it is

recognized that the police department who is the direct supervisor of police officers trusts each officer in their judgement of determining the appropriate use of force in each interaction with potential criminals. The level of force allowed is to educate the police officer about the limitation of his or her authority. If the level of force allowed is low and the intensity is high, it will incentivize prejudiced police officers' racist behavior because they can justify their actions as appropriate. In contrast, if the level of force allowed is high and the intensity is low, racist police officers will be discouraged because of the probability of being exposed (racial bias becomes less desirable). Therefore, they can only earn a legitimate salary from legal police work.

In the analysis above, it is observed that prejudiced police officers respond to the rate of change in the level of force allowed and the intensity regarding the extra utility gained from racial bias. Particularly, if the intensity increases, there will be an increase in the extra utility. Otherwise, with the intensity unchanged, if the level of force allowed decreases, there will be a decrease in the extra utility. Assuming that the two factors detection probability (p) and punishment (f) are insignificant in the equation (as explained above), the supply of prejudiced police officers now is influenced by the level of intensity and the level of force allowed. Increasing police budget (w) only increases the police expected utility. It aligns with Becker's 1974 proposal in increasing police salaries to discourage them from malfeasance such as monetary bribery. However, prejudiced police officers do not gain monetary utilities but instead enhance their intrinsic rewards. Consequently, the optimal solution would be to discourage the intensity of racial bias, and the county needs to find an optimal level of force allowed. It is, however, not an easy task. Racial bias is a social construct and people are not born racist. The environment, society, and culture people grow up in play a vital role in this matter.

What if the county decided to accept the presence of prejudiced police officers as a risk they have to take in order to maintain justice, what would the cost be? Becker (1968) introduced a social loss model that measures the social loss of offenses and finds those expenditures of resources and punishments that minimize this loss. Becker's crime model is described as follows⁶⁶:

$$L = D(O) + C(p, O) + bpfO$$

Where:

- L: the total social loss
- O: the illegal activity level (or the supply of offenders)
- $D(O)$: The net cost or damage to society is defined simply by the difference between the harm from illegal activities and the amount of gain to offenders.
- $C(p,O)$: the cost of apprehension and conviction
- p: the overall probability that an offense is cleared by conviction (the probability of conviction)
- $bpfO$: the cost of punishment in which b is types of punishment, f is the cost of punishment.

Becker observes that the coefficient b is a given constant greater than zero (b could be fines or imprisonment); thus, only p (the probability of conviction) and f (the cost of punishment) are decision variables. In Becker's crime model, he takes the gains to criminals from crimes into consideration of the optimal level of deterrence. Becker suggests that if policymakers aimed for deterrence policies, they could raise the probability of conviction close to 1 and punishments could be made to exceed the gain. As a result, the supply of offenders could be reduced almost at will. Deterrence would not work if a total of the gains to criminals plus the cost of punishment and the probability of conviction (expenditures on police, courts, etc.) was greater than the harm to victims caused by crimes. According to Becker, if potential criminals are risk neutral, the social loss could be minimized by lowering the probability of apprehension and conviction close to zero and raising the punishment sufficiently high so that the supply of offenders could reach optimality. In other words, because risk-neutral potential criminals do not have constraints on the gains he could earn from crimes, any combination of b and f will produce the same effect for deterrence. When policymakers increase the cost of punishment such as increasing fines, it will not cost any resources from society (even generate additional income for society). Therefore, the combination of a low b and a high f is the optimal deterrence for policymaker's consideration because most of potential criminals are assumed risk neutral as has been analyzed in previous discussion. On the other hand, if the aim was "an eye for an eye", policymakers could raise the probability of conviction close to one and the punishment could be equated to the harm imposed on the rest of society.

However, if potential criminals are risk-averse or risk-seeking, the combination of a low b and a high f might not be an ideal. According to Becker, if potential criminals are risk avoiders, the optimal social policy would be to select the probability of apprehension and the punishment in ranges that convicted criminals only pay the minimum for whatever crimes they commit. If risk-averse potential criminals face sentences for their crimes, they will grow disutility for the imprisonment and this disutility will increase in accordance with increases in prison times. Therefore, risk-averse criminals prefer to know in advance what penalty he would get than any uncertain penalties. Consequently, a high sentence and a low probability of conviction would be undeniably optimal deterrence. On the other hand, if punishment is fines, according to Becker, the only cost of a fine is the cost of collecting it. Thus, a low probability of collecting fines will reduce the additional income for society (since the fine is not paid). And if the additional income is greater than the savings in the cost of punishment (choosing fines over imprisonment in the first place to save costs), the combination of a low probability and a high f could be more expensive for society. In contrast, if potential criminals are risk preferers, the loss in income from offenses could be minimized if policymakers select positive and finite values of p and f . In the opposite way with risk-averse criminals, risk-seeking criminals prefer uncertain penalties to certain penalties. Therefore, when f increases and b reduces, deterrence could be optimal if risk-seeking criminals have high expected penalties. Becker also implies criminals tend to be risk seekers, which means that a given increase in f compensated by a decrease in p would leave the expected gains the same but would make criminals better off. Therefore, when criminals are risk seekers, the elasticity of supply of offenses with respect to p is greater than the elasticity of supply of offenses with respect to f ⁶⁷.

Applying the framework of Becker's social loss function, unintended consequences imposed on counties that accidentally hire prejudiced police officers would be:

$$L = H(S) + w(S) + E(p, S, t, m) + C(p, S) + bfpS$$

L : Total social loss from having convicted prejudiced police officers.

$H(S)$: the loss from racial bias behaviors

$w(S)$ = The wage that is wasted on hiring the wrong type of police officers.

S = the number of prejudiced police officers in the force (or the number of racist behavior that is exposed and convicted)

$E(p, S, t, m)$ = the cost that the county pays for innocent victims due to error punishments

t = the intensity of racial bias

m = the cost from erroneous punishment

C(p,S) = cost of conviction

p: the probability of catching racist police officers

f: the cost of punishing racist police officers with a parameter b (b=0 for fired, while b>1 for imprisonment)

Since only convicted prejudiced police officers can provide proof of damage to the county, the loss from racist behaviors (H) would tend to increase with the number of prejudiced police officers in the force. Unlike what Becker claimed in his criminal model, there is no evidence to support that the county or society would receive any positive values upon the utility derived from racial bias behaviors in the police force. The loss can include the county's reputation, the trust between the police and the community, and overall, the perception of the public towards governmental institutions. Similarly, the wasted wage $w(S)$ that the county spends directly on police salary and any motoring mechanisms depends on the number of prejudiced police officers in the force. Furthermore, when racist behaviors are implemented and convicted, it mostly results in monetary settlement agreements or monetary court orders between the county and the innocent or the people who are harmed by police brutality. One approximation to an empirical measure of the total cost that the county pays for innocent victims due to error punishment is a multiplication of the number of prejudiced police officers, the intensity of racial bias, and the monetary cost of erroneous punishment. The parameter t – the intensity of racial bias – is defined as greater than zero and lower than 1. If t is 1, the consequence of the racist behavior could be the death of the innocent and as a result, the county must pay more for the victim. The total cost fluctuation again responds to the number of prejudiced police officers in the force. At last, when racist behaviors are publicly exposed and out of the protection from the police union as well as the immunity within the police department, alleged police officers will face trials and the county suffers the cost of court personnel and imprisonment (only for a brief period in county local jails while waiting for their sentence). The more police officers being convicted, the more cost the county has to pay. The term $bf pS$ is the cost of punishing racist police officers in which pS is the number of racist police officers convicted and bf is the cost per racist police officer punished. Hence, the total social loss for counties from having convicted prejudiced police officers can be written as:

$$L = H(S) + w(S) + pStm + C(p,S) + bfpS$$

Based on the loss function above, a decrease in the budget as the movement demands will lead to a decrease in the loss of paying for racist police officers. However, the budget variable plays an inconsequential role in minimizing the total loss. Instead, the variables p , f , and t carry more weight to achieve the goal of minimizing the total loss. When these variables are chosen, it will determine the values of H , w , E , C , S , and finally the loss L . Recall the previous analysis regarding the expected utility of racially prejudiced police officers, potential prejudiced police officers self-select into law enforcement because it provides the opportunity to punish biasedly a certain population group. They would even accept a lower pay compared with the pay in the best available alternative occupation because the opportunity of punishing biasedly could give them an extra utility which would compensate for the base salary (*Note that it is a possibility but it is not always the case*). Again, they are fully aware of the punishment they will get if they get caught: (1) fired but they can find another police job at a different location; (2) imprisonment but it is hard to convict and prove their misconduct unless the evidence is overwhelming. Simultaneously, the probability of detecting prejudiced police officers is also problematic. One isolated incident cannot justify police misconduct. Instead, the law requires proof beyond a reasonable doubt of engagements in a pattern or practice of conduct involving local law enforcement officers⁶⁸. Therefore, the term t_l can also be seen as the temptation of racial bias and a deciding factor of the supply of offenders as in the case of prejudiced police officers. Again, policymakers can adjust the level of the probability of catching racist police officers (p), the cost of punishment (f), and the level of force allowed (l), but they cannot proactively adjust the level of individual intensity of racial bias.

V. Game Theory Principal-Agent Problem

The term “moral hazard” is used in many discussions such as health care, insurance, and the financial sector. It can be explained that when a person has health insurance that covers all their health care expenses, they might not avoid health risks such as getting too much sun can cause skin cancer. Also, he or she will go to see the doctor and utilize other medical services more frequently and even unnecessarily. Consequently, it potentially increases health care costs which will be paid by the insurance company. Another example of moral hazard can be seen in the recent banking crisis when the government decided to bail out, or partially bail out, Silvergate Bank, Signature Bank (U.S.), and Credit Suisse (Switzerland) to avoid catastrophic consequences for the entire world economy. The bailout means that bankers have the government’s guarantee against any losses. It will set a precedent and incentive for bankers to take more risks when they invest their customers’ deposited money. In both cases, the principal (the insurance company and the government) needs to choose an incentive scheme that not only maximizes its payoff but also minimizes the cost of having the agent choose to behave in a way that does not fit the principal’s agenda. It might sound straightforward but in reality, principal-agent models are far more complicated, especially in the case of law enforcement.

In the principal-agent framework, the county (the principal) writes the contract that constrains the police department (the agent) by including in the contract not only the county’s goal and budget to accomplish this goal, but also procedures, policies, and regulations that ensure police officers will not be able to act upon whatever their desire and deviate from achieving the county’s agenda. In fact, to answer the question “who polices the police”, law enforcement agencies monitor their own police officials by establishing laws, regulations, code of conduct or any internal affairs divisions to deal with issues such as the use of excessive force by police officers, police misconduct, giving suspects their Miranda rights, corruption, interrogation practices, and police brutality. Furthermore, potential police candidates must go through mandated selection mechanisms such as written, physical, and psychological examinations as well as 12-14 weeks of training in police academies⁶⁹. However, even when all these mechanisms are put in place, the county still cannot ensure that all of the police officers hired, in other words accepted the contract, doing their job equitably and justly. This is when principal-agent problems arise. The problem is

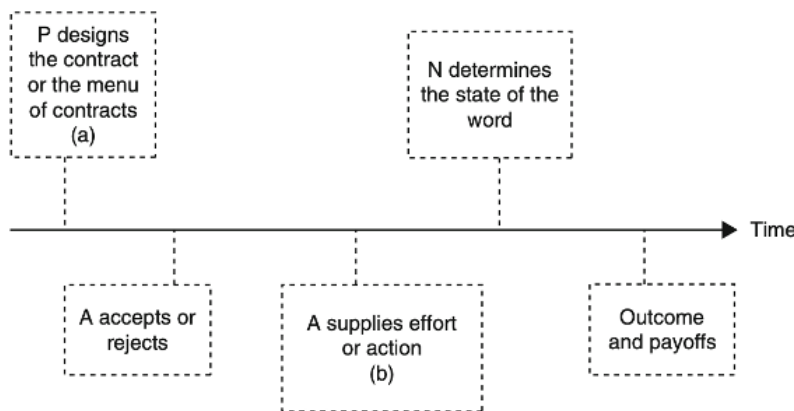
that the agent has much knowledge about the work and takes action to perform the work but the principal is usually unaware of this knowledge and actions, which are referred to as the agent's private information⁷⁰. To return to the principal-agent problem in police forces, it is never an easy and simple solution.

The fundamental assumption of the theory of rational choice is that people are rational and utility maximizers in which they have to have something to maximize⁷¹. The county, as a rational party with a limited budget, will attempt to maximize its own profit which in this case one can assume the county's profit is to preserve social order. To accomplish that, the county recruits civilians as police officers to enforce criminal laws, reduce civil disorder, and last but not least to protect people and property. Police officers are legitimately given the authority and unique power that other civilians do not have to do just that. Comparatively, rational police officers will maximize their own utility including the salary given by the county, and at the same time, minimize their cost of doing police work. The principal-agent model requires the county to design a contract that creates incentives that are attractive enough to persuade civilians to join the police force or otherwise they will reject the contract because they can find work elsewhere that gains more utility than the police work. Moreover, the incentive also needs to be sufficient enough to make sure police officers do the job at the level the county wants.

The incentive is extremely important and plays a vital role in creating an optimal contract. If the incentives were too weak, police officers could seek monetary payments from criminals and violators, or even innocent people, to compensate for the under gain from enforcing laws. In fact, it is logical to think that criminals would do anything to get away from being punished for their crimes. They could bribe law enforcement, court officials, and intimidate witnesses to avoid being arrested and convicted. Another consequence of weak incentives is shirking in which police officers would reduce the cost of doing the work in order to maximize their utility. As basic economic principle indicates, police officers cannot manipulate the wage they receive from the county, so they will turn in what they could influence which is their own efforts of doing the job. Police, in some cases, have to risk their lives in dangerous situations to protect civilians. It is a part of the duties established in the contract with the county. However, the county lacks efficient tools that do not increase the cost for the county to watch over police daily work. They could either honor the contract and work hard to align with the county's interest or they could just do the minimum effort and collect their guaranteed paychecks. Keep in mind that the relationship

between the county and the police is different than the relationship between the manufacturing industry employers and employees where employees can get paid based on how many products they produce. Police officers are salary-based employees. And if the county paid them by how many violators they bring in, not only police officers could misuse their legitimately unique power to catch criminals for any minor or major offenses but also the county would create an unintentional incentive that innocent civilians or people unfamiliar with the law could be framed by police officers for crimes they did not commit.

The dilemma in the relationship between the county and the police is that the county desires to hire “good” cops who are willing to make maximum efforts to do the police work, but they are unable to know in advance what type the agent is and level of effort/ability the agent will execute after the contract is signed. In fact, operating under asymmetric information makes it harder for the county to obtain the private information possessed by the agent and send out the right signal as well as an incentive to reach an equilibrium outcome for both the agent and the principal. Since the principal-agent model is a sequential game where each player’s choice of action influences what the next move can be made in the game, the base principal-agent game can start with the principal who has the authority to design a contract and establish a set of rules that cannot be negotiated by the agent. The principal then offers the contract to the agent. The agent has the option of accepting or rejecting the contract. If the agent accepts the contract, the expected utility gain from executing the contract has to be greater than any outside expected utility available to the agent. If the agent rejects the contract, the game will end there. Otherwise, the agent will make efforts (let’s consider there are two types of efforts: High and Low) to fulfill the contract. Finally, the principal will evaluate the outcome and make payments to the agent.



Source: Charalambos Aliprantis & Subir Chakrabarti – Game and Decision Making⁷²

From an economic perspective and rational choice theory, in order to maximize the outcome and minimize the cost, the principal will want to employ the first order condition, and in some cases the second order condition on their utility function subject to any constraint functions on the agent such as individual rationally constraint (guaranteeing the agent accepts the contract) and incentive constraint (ensuring the agent makes the right level of effort/ability)⁷³. In other words, the first-order condition allows the principal to make predictions and the second-order condition allows the principal to evaluate the nature of stationary points (maximum or minimum)⁷⁴. Mathematically, the first and second-order condition are the use of differentiation which is to compute the rate change of functions of multiple variables. In game theory, it is important to find an equilibrium of the game which is the set of optimal actions that the players of the game have no incentive to change their actions. These techniques along with comparative statics produce a measure of the rate of change of the equilibrium actions with a change in some parameters of the game⁷⁵. To solve the principal-agent problem, Grossman and Hart (1983) use a three-step procedure. The first step is to characterize the set of incentive-compatible contracts that implement a given level of effort. In order words, Grossman and Hart suggest that the first step is to identify which wage level would cause the agent to provide high efforts and which wage level would cause the agent to provide low efforts. Next, find the element of this set that implements the desired distribution at the least cost to the principal. This step will identify what is the cheapest way for the principal to get high efforts from the agent and what is the cheapest way for the principal to get low efforts from the agent. Finally, choose the distribution over the effort that maximizes the difference between the principal's expected revenue and the cost of the agent's compensation⁷⁵. More specifically, to design the optimal contract with moral hazard problems, the county needs to set up a budget structure that is correlated to the outcome and can induce “good” police officers to provide higher efforts which is costly to them. Mathematically, the county needs to calculate what is the set of budget contracts that would guarantee getting “bad” and “good” police officers separately, and then apply the first order condition to find out the cheapest way to get “bad” and “good” police officers, again separately. However, it is not easy for the county to do that because they lack a number of necessary information such as the distribution of police types, the respective probabilities that each of these types will encounter “good” and “bad” luck on the job, and the respective payoffs to the county and all agent types for all scenarios⁷⁶.

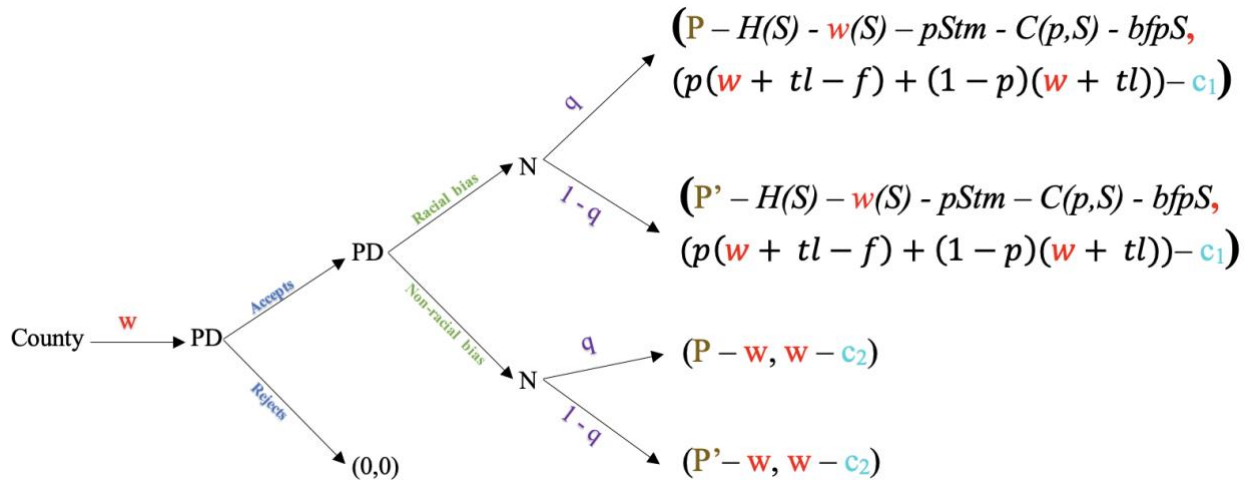
The difficulty here is how does the contract define the payoff for the county and evaluate the police's performance? If the payoff for the county is public safety, it cannot depend on crime rates because crime rates are affected by various variables such as education, housing, unemployment, homelessness, the economy, and the nature of demography. If the county takes crime rates as a measurement for performance, when crime rates rise, it could prove that the police have done a good job of catching criminals. Or the police department could manipulate the data so that it could look better from the outside. Furthermore, if the county considers justice as their payoff when they pursue the policy of an eye for an eye on criminals, the police department with uncertain probabilities of bad and good police officers could accidentally encourage and motivate racist behaviors from the racist and extreme use of force type of police officers. This is the puzzle that the Defund the Police movement is trying to solve. The movement considers reducing police budgets is a way to use monetary incentives to undermine intrinsic motivation. A study from Benabou and Tirole (2003) concludes that the crowding out of intrinsic motivation arises because setting strong monetary incentives provides a negative signal on the agent's perceived ability level which, in turn, may lead the agent to exert low effort⁷⁷. Briefly, in their study, the principal first sends a signal to the agent by selecting a reward (extrinsic motivation) to encourage the agent. That signal impacts the willingness of the agent to perform the task. The idea is that by offering low-powered incentives, the principal signals that she trusts the agent. Adopting a cognitive approach, they show that rewards may be only weak reinforcement in the short term and come with hidden costs, in that they become negative reinforcers once they are withdrawn and reduce the agent's motivation to undertake similar tasks in the future. However, the study was set in a condition that the principal holds private information about the agent's ability level which cannot apply to the relationship between the county and the police department.

Another factor that affects the payoff for both the principal and the agent is the level of tolerance for risk. As established, the principal and the agent are rational individuals and utility maximizers. Risk references will shape the utility functions of both. For example, if they are risk neutral, their utility functions will be linear. If it is strictly concave, it will be risk averse, and lastly, if they are risk-seeking, the utility functions will be strictly convex⁷⁸. It is important and needs to take into consideration the principal-agent relationship between the county and the police. Assuming the county is risk neutral, they send a signal to the police by establishing a level of force allowed in apprehending suspects. The "bad" police officers with intrinsic motivations for racist

behavior will decide how to react based on the signal they receive which is the level of force allowed. If he or she is risk averse, he or she will not receive extra utility from facilitating racist behaviors, instead, he or she only receives the payment paid by the county which must be greater than the reservation utility. Oppositely, if the county is risk averse and the police are risk neutral, the county's expected utility now depends on the outcome of police performance and productivity. In addition, the intensity of racial bias is correlated to the level of force allowed and helps to determine the extra utility gained from facilitating racial bias.

Generally, police officers are permitted to use force to apprehend potential criminals who pose threats to the police and to other civilians. During their time at the Police Academy, they will be trained and given guidelines on how to use force to control situations. However, the level of force allowed depends on the very moment of the situation and the police officer's choices of action. Because of that dilemma, it is plausible to assume that each police officer has a use of force preference. For example, when responding to an active domestic violence call with an implication that the abuser is acting hysterically, police officers who have a low preference (anti-use of force) could use dialogue to approach the abuser. On the other hand, police officers who have a high preference (pro-use of force) also could use the dialogue approach, but any sudden or suspicious movement could easily trigger the use of force which is already an approved choice of the high preference police officer. Similarly, racially biased police who already have intrinsic motivation will abuse their right to use force if the suspect is Black. When the intensity of racial bias is also high, he can use maximum force to gain optimal extra utility without facing consequences because his action is legally justified.

With the scope and complexity of the principal-agent problem in law enforcement described above, the study will simplify the matters by analyzing a simple game model depicted as follows:



The game consists of two players: the county and the police and operates under informational asymmetry. Each player's payoff is calculated as utility (U) as they are utility maximizers and strategically look to maximize their payoff. The game starts with the county providing the police a wage (**w**) to maintain public order and safety, enforce the law and prevent, detect, and investigate any illegal activities. The police have a choice of either accepting or rejecting the budget. If rejecting, both players' payoff will be 0 and the game will end there. If accepting, for simplification purposes, the police can choose to do the work with either racist behavior or non-racist behavior.

- When the police choose racist behavior, the game will move to the upper branch of the game tree. From there:

(1) With the probability (**q**), the county will reach their optimal desire justice (**P**) established when they provide the budget to the police. However, the county incurs a social loss $H(S) + w(S) + pStm + C(p,S) + bfpS$ for having prejudiced police officers in the community (including the wage that is wasted on hiring the wrong type of police officers). The expected utility of the county is:

$$P - H(S) - w(S) - pStm - C(p,S) - bfpS$$

(2) In contrast, with the probability (**1 - q**), the county will only reach their minimum desire justice **P'** established when they provide the budget to the police. But again, they incur a social loss $H(S) + w(S) + pStm + C(p,S) + bfpS$ for having prejudiced

police officers in the community (including the wage that is wasted on hiring the wrong type of police officers). The expected utility of the county under this probability is: $P' - H(S) - w(S) - pStm - C(p,S) - bfpS$

A simple comparison will suggest the following:

$$(P - H(S) - w(S) - pStm - C(p,S) - bfpS) > (P' - H(S) - w(S) - pStm - C(p,S) - bfpS)$$

(3) On the other hand, the expected utility of the police will be the same in both cases which includes the expected value of facilitating racial bias budget

$$p(w + tl - f) + (1 - p)(w + tl) \text{ but minus the cost of doing police work } (c_1).$$

- When the police choose non-racist behavior, the game will move to the lower branch of the game tree. From there:

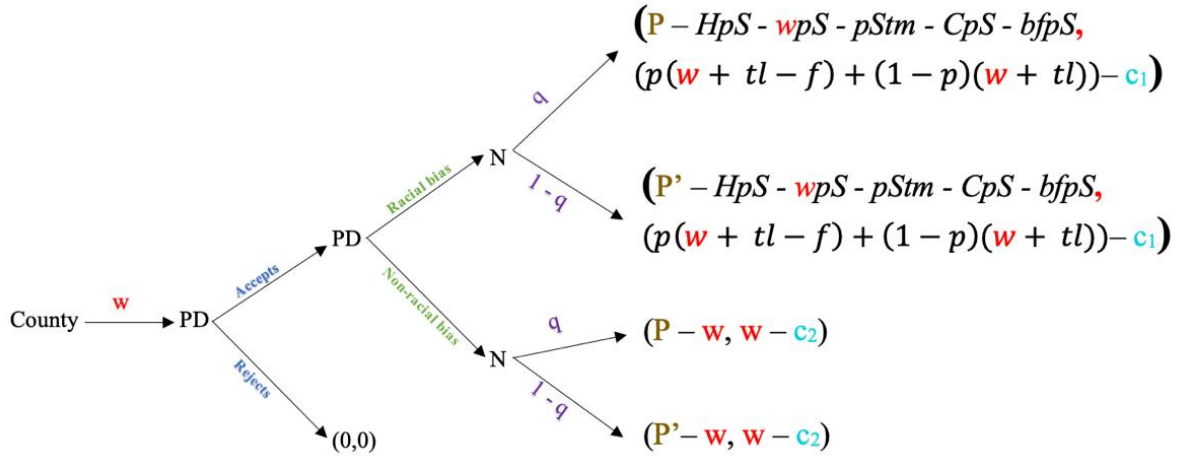
(1) Similar to the upper branch of the game tree, the county will reach their optimally desire justice (P) with the probability (q) and will reach only minimum desire justice (P') with the probability ($1 - q$). However, they only incur the wage cost w . Thus, the county expected utility under this condition is: $P - w$ and $P' - w$ with a condition $(P - w) > (P' - w)$

(2) On the other hand, the expected utility of the police includes the wage w minus to the cost of doing police work (c_2). Since racist police officers will make extra effort to earn the extra utility and cover his behavior, c_1 will be greater than c_2 - ($c_1 > c_2$).

* The extra payoff for the taste of racist behavior (tl), the expected value of prejudiced police officers $p(w + tl - f) + (1 - p)(w + tl)$, and the social loss of having prejudiced police officers in the community (L) has been explained in Part IV.

The social loss $L = H(S) + w(S) + pStm + C(p,S) + bfpS$ can be written as

$L = HpS + wpS + pStm + CpS + bfpS$ in which pS is the number of convicted prejudiced police officers.



In this game of a strategy, the expected payoffs of players need to be counted in all possible strategies.

For instance, the expected payoff for the county is:

$$U_{\text{county}} = \begin{cases} q(P - HpS - wpS - pStm - CpS - bfpS) + (1 - q)(P' - HpS - wpS - pStm - CpS - bfpS) & \text{for racist behavior} \\ q(P - w) + (1 - q)(P' - w) & \text{for the case of Non racist behavior} \\ 0 & \text{for the case of the police rejects the budget} \end{cases}$$

The expected payoff for the police is:

$$U_{\text{police}} = \begin{cases} q(p(w + tl - f) + (1 - p)(w + tl)) - c_1 + (1 - q)(p(w + tl - f) + (1 - p)(w + tl)) - c_1 & \text{for racist behavior} \\ q(w - c_2) + (1 - q)(w - c_2) & \text{for the case of Non racist behavior} \\ 0 & \text{for the case of the police rejects the budget} \end{cases}$$

In order for the police to accept the budget, the county needs to make sure the expected utility of the police is greater than their reservation wage which is the wage they can find outside of the police force (the participant constraint). Let's denote by X the police reservation wage. The optimal budget under moral hazard is the solution to the maximization problem:

$$\mathbf{Max} \quad \{q(P - HpS - wpS - pStm - CpS - bfpS) + (1 - q)(P' - HpS - wpS - pStm - CpS - bfpS), q(P - w) + (1 - q)(P' - w), \mathbf{0}\}$$

$$\mathbf{Subject \ to} \quad \{q(p(w + tl - f) + (1 - p)(w + tl) - c_1) + (1 - q)(p(w + tl - f) + (1 - p)(w + tl) - c_1), q(w - c_2) + (1 - q)(w - c_2)\} \geq \mathbf{X}$$

As the county seeks to induce the police to Not have racist behavior, the solution is to solve the following maximization problem:

$$\mathbf{Max} \quad (q(P - w) + (1 - q)(P' - w))$$

In the Principal-Agent model, wage is severed as an incentive for the agent to do the level of effort that the principal desires. Grossman and Hart propose to solve those maximization problems above by identifying the optimal payment mechanism for any effort and then the optimal effort. The incentive condition depends on the result as a measure of how informative they are as to the effort of the agent. If the principal agrees to increase the wage, the principal expects the agent to increase their effort (from low to high, for example). Nevertheless, in the case of the county and the police, it is hard for the budget variable to have much influence on the police effort because the county cannot know how many (or an estimation of the probability) prejudiced police officers they have in the force. Or even after observing the result, the county will have a hard time categorizing the behavior of the police as racist. In the game tree, if q is assumed $\frac{1}{2}$, the equilibrium of the game is Accept/Non-racist bias with the payoff $(P - w, w - c_2)$. Certainly, the equilibrium does not solve the dilemma between the county and the police, along with giving a reasonable explanation for the influence of the budget aspect on police behavior.

VI. Spatial Econometrics

VI.1 Introduction of Spatial Econometric

County crime rates in the United States are often associated with the socioeconomic resources of counties and the distribution of these resources in neighboring counties. Spatial clusters can be found in poorer communities, where economic opportunities are limited, with higher crime rates and higher unequal distributions of resources. One argument is that the presence of police force makes the crime rate increase meaning the bad guys are caught and punished but it does not solve the root problem of deterring potential criminals. Reducing the police budget, hence, is a more suitable and appropriate approach for an ultimate crime-control scheme. However, as Tobler's First Law of Geography declares "Everything is related to everything else, but near things are more related than distant things"⁷⁹, the argument might not have been fully supported since the mechanisms that influence the pattern do not consider the potential spatial distribution of other factors such as demography and police budgets of nearby areas. Tobler's First Law introduces the concept that an explanatory or a response variable in one county could depend on other variables established from neighboring counties. For instance, as utility maximizers, potential criminals from a poor county could drive to the next county, which is richer, to commit crimes there. As a result, the richer county needs to increase their police budgets and cut back funding social programs to combat crimes, even the criminals that do not originate from the county. As mentioned in the introduction, the Defund Police movement suggests cuts in police department budgets with the intention of reducing police power, the size of the force, and the scope of operation (police contacts, stops, arrests, and tickets). They assume the cut would eventually eliminate racial behaviors toward the minority, especially the black population, in the police force. This thesis will use spatial statistical modeling techniques to assess that assumption as well as the role of space in influencing the outcomes and in this case is the crime rate since there is no solid and reliable data on racial behavior on police use of force. Before getting into the analysis, there are several technical terms that need to be introduced.

Spatial dependence is a functional relationship between what happens at one point in space and what happens elsewhere⁸⁰. The potential interinfluence of social and demographic characteristics among counties can be understood as spatial dependence, and spatial analysis will

help to examine the impact that one characteristic has on other. More specifically, the analysis focuses on if there is a spatial correlation among social and demographic characteristics that are geographically near one another such as income inequality, social program spending, police spending, poverty rate, etc. To examine that possible clustering as well as spatial patterns, Moran's I statistic will be utilized. In fact, Moran's I is the most common measure to examine the variables in datasets for global autocorrelation. The global version of Moran's I is given as:

$$I = \frac{n}{\sum_{i=1}^n \sum_{j=1}^n w_{ij}} \frac{\sum_{i=1}^n \sum_{j=1}^n w_{ij} (y_i - \bar{y})(y_j - \bar{y})}{\sum_{i=1}^n (y_i - \bar{y})^2}$$

where the y_i denote n observations with mean \bar{y} that are spatially connected via weights w_{ij} .

with the expected value of Moran's I under hypothesis of no spatial autocorrelation:

$$E(I) = -\frac{1}{n-1}$$

If the observed value of I is greater than its expected value $E[I]$, then an observation tends to be surrounded by neighbors with similar values. While if I is less than the expected value $E[I]$, the observation tends to be surrounded by dissimilar values⁸¹. Similarly, a local version of Moran's I , referred to as Local Indicator of Spatial Autocorrelation (LISA) will also be considered in this analysis. According to Anselin a local Moran statistic for an observation I can be defined as⁸²:

$$I_i = z_i \sum_{j=1}^n w_{ij} z_j$$

where z_i is a standardized variable

$$z_i = (x_i - \bar{x}) / SD_x$$

With the same principle, the interpretation of Anselin’s LISA statistic is similar to the global Moran in which if the observed value of I is greater than the expected value $E[I]$, there is local possible autocorrelation at the location I and a large (or small) value at that location tend to be surrounded by large (or small) neighboring values. Otherwise, there is local negative autocorrelation if the observed value of I is less than the expected value $E[I]$ ⁸³. For example, if a county has a high crime rate and neighboring counties also have a high crime rate, there will be a high local autocorrelation in that county. Using Moran’s I and LISA statistics allows us to illustrate the distribution of counties that have significant high-high and low-low clusters.

Both the global Moran’s I and LISA require the calculation of neighbor weights w_{ij} . Formally, the spatial weights matrix is a n by n positive matrix (W) which specifies neighborhood sets for each observation in which $w_{ij} = 1$ when i and j are neighbors and $w_{ij} = 0$ otherwise.

$$W = \begin{bmatrix} w_{11} & w_{12} & \dots & w_{1n} \\ w_{21} & w_{22} & \dots & w_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ w_{n1} & w_{n2} & \dots & w_{nn} \end{bmatrix}$$

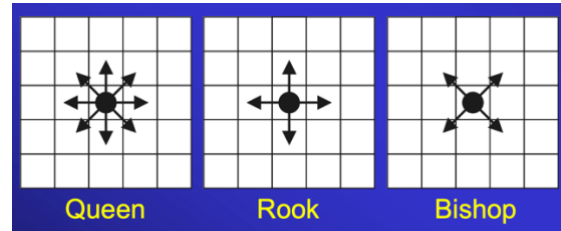
The weights matrix is often standardized such that the elements of a row sum to one. Hence, the elements of a row-standardized weights matrix equal⁸⁴:

$$w_{ij(s)} = \frac{w_{ij}}{\sum_j w_{ij}}$$

$$0 \leq w_{ij} \leq 1$$

Additionally, when using spatial analysis software to facilitate spatial analysis, there are few varieties of contiguity weights which indicates two spatial units share a common border of non-zero length. For example, consider the map matrix and three types of contiguity below:

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16



Source: Eric Sieberg - Spatial Econometric Analysis Class Lecture

The difference between the three types of contiguity is the number of neighbors. More specifically:

- Under a queen criterion of contiguity, the county number #6 will have the counties number #1, 2, 3, 7, 11, 10, 9, and 5 as its neighbors.
- Under a rock criterion of contiguity, the county number #6 will have the counties #2, 7, 10, and 5 as its neighbors.
- Under a bishop criterion of contiguity, the county number #6 will have the counties #1, 3, 11, and 9 as its neighbors.

Although the specification of W is an important step in spatial econometric models, Anselin (2002) has suggested that there is little formal guidance on choosing the correct spatial weights for the given application⁸⁵.

Furthermore, a standard ordinary least squares (OLS) will be used and compared to estimate the effects of county-level characteristics on crime rates in order to point out the need of spatial analysis utilization, i.e. crime rates can be influenced by factors in neighboring counties. OLS model is given as:

$$y_i = \mathbf{X}_i\beta + \varepsilon_i$$

where:

u_i is the error term for observation i because it contains all factors affecting y_i other than x_i . This OLS model would make the prediction that the change in local characteristics in one county affects only crime rates of this county, with no allowance for spatial spillover impacts. Consequently, the OLS model needs to add a spatially lagged dependent variable on the right hand side of the

equation. This new spatial regression model is called Spatially Lagged Model (or Spatial Autoregressive Model).

$$y_i = \mathbf{x}_i\beta + \rho\mathbf{W}_i.y_i + \epsilon_i$$

where a positive or negative value for the parameter associated with the spatial lag (ρ) would indicate that counties are expected to have higher crime rates or police budgets if, on average, their neighbors have also high crime rates or police budgets. Spatially Lagged Model assumes that the dependent variable y (e.g. crime rates, police budgets, or social program spending) in one county is directly influenced by the dependent variable y found in its neighboring counties. On the other hand, if the dependent variable y is not directly influenced by the dependent variable y as such among neighbors, but rather there is some spatially clustered feature that influences the dependent variable y in a certain county and its neighbors but is removed from the specification, an alternative spatial model will be considered and it is called Spatially Error Model.

$$y_i = \mathbf{x}_i\beta + \epsilon_i + \lambda\mathbf{W}_i\xi_i$$

where ξ is a term indicating the spatial component of error term and the parameter λ indicates the extent to which the spatial component of the error ξ are correlated with one another for nearby observations, as given by the weight connectivities w .

To demonstrate the alternative spatial analysis is more appropriate, Robust Lagrange Multiplier statistics is used to test both Spatially Lagged Model and Spatially Error Model. The Robust Lagrange Multiplier statistics are corrected for the covariance between ρ and λ .

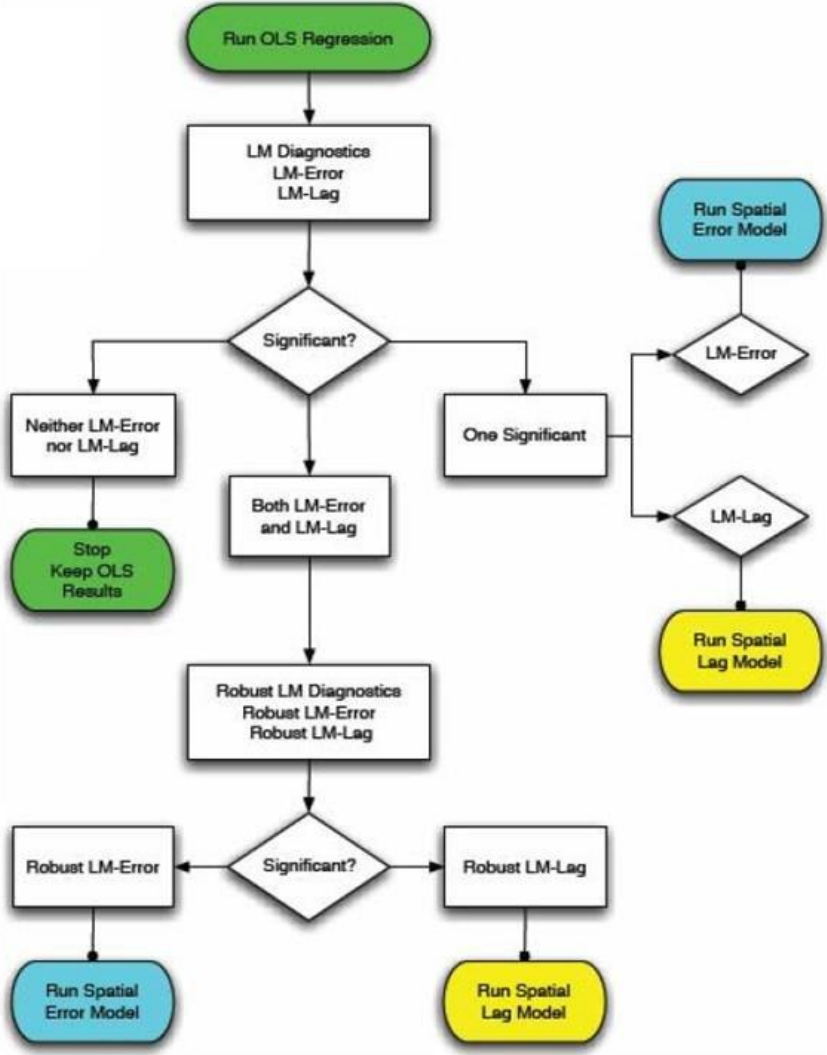
The Robust Lagrange Multiplier statistics for the Spatially Lagged Model is given as:

$$LM_\rho^* = \frac{(d_\rho - d_\lambda)^2}{(D - T)} \sim \chi^2(1)$$

And the Robust Lagrange Multiplier statistics for the Spatially Error Model is given as:

$$LM_\lambda^* = \frac{(d_\lambda - TD^{-1}d_\rho)^2}{[T(1 - TD)]} \sim \chi^2(1)$$

In addition to the Robust Lagrange Multiplier statistics, there are straightforward decision rules that help to identify the next steps if there is as well as is no evidence of spatial autocorrelation. The decision rule is depicted as follow:



Source: Modern Spatial Econometrics in Practice: A Guide to GeoDa, GeoDaSpace and PySAL by Anselin, Luc, Rey, Sergio J.

VI.2 Data gathering and Spatial Analysis Software

The scope of this spatial analysis does not cover all 50 states of the United States. Instead, this analysis includes only data from 48 states (excluding Alaska and Hawaii), specifically including data from a total of 3,038 counties, because spatial analysis requires a geographical connection. Data are taken from the National Association of Counties, The United States Census Bureau, and The United States Federal Bureau of Investigation – Uniform Crime Reporting Program. The National Association of Counties provides data on expenditures on police departments and social programs such as spending on higher education, health, human services, libraries, housing and community, park and recreation. Meanwhile, the United States Census Bureau provides demographic data including the white population, minority population, poverty, unemployment, income inequality ratio, and counties' cartographic boundary. Lastly, the FBI Uniform Crime Reporting Program provides the number of violent crimes and property crimes recorded in 2017. Given the unavailability of the most recent data, only data for the year 2017 will be used for the analysis. Due to the magnitude of the database and the data quality, any missing county data from the three main sources above was filled by manual searches and recorded into the dataset. All the collected data were coded to fit the Spatial Analysis Software GeoDa format which is the main tool in this thesis to conduct analysis.

GeoDa is a software program that has been developed since 2003 by Dr. Luc Anselin and his team to explore spatial econometrics and carry out mapping and geo-visualization. Since its release, GeoDa has been downloaded by more than 520,000 users around the world and it is quickly becoming a standard to teach introductory spatial analysis. The software supports spatial statistical tests such as exploratory spatial autocorrelation, and spatial regression analysis including the spatial lagged model and spatial error model. In fact, GeoDa is similar to a number of other modern spatial data analysis software tools, although it is quite distinct in its combination of user-friendliness with an extensive range of incorporated methods⁸⁶. With more than 3,000 counties of data, GeoDa will help readers to effortlessly visualize the result and examine any spatial patterns regarding the relationship between police and social program expenditures and crime rates.

VI.3 Variables

Since there is no county-level data on police excessive use of force or any data on police brutality and racism, this paper uses county-level crime rates as a dependent variable and explanatory variables include police expenditures, social program spending, unemployment, poverty, and population characteristics. It is important in this analysis to consider beyond the scope of the Defund the Police’s demand. In fact, crime rates are affected by not just police budgets and social program spending but also by socioeconomic characteristics. Below are the details of the variables.

- Observations = 3,038
- Year = 2017
- Variables = 11

Variable	GeoDa Code	Description
Violent Crimes	VC	Including rape, robbery, aggravated assault, murder and nonnegligent manslaughter
Property Crimes	PR	Including burglary, larceny-theft, motor vehicle theft, arson
Total Crimes	TC	The number of offenses reported by the sheriff’s office or county police department
Police Spending	PP	Expenditures for general police, sheriff, and other government departments that preserve law and order, protect persons and property from illegal acts, and work to prevent, control, investigate, and reduce crime (excluding expenditures on correctional facilities, judicial and legal services, fire protection)
Social Program Spending	TSPE	Expenditures for education, health, human services, housing and community development, libraries, park and recreation.
Income inequality Ratio	IIR	Ratio of household income at the 80 th percentile to income at the 20 th percentile

Unemployment Rate	UR	Number of persons unemployed as a percent of the labor force
Poverty Rate	PV	The percentage of people in a county living in poverty
Population	Population	The number of people living in both the incorporated and unincorporated areas of the county
White Population	WP	County residents (not Hispanic) identifying with origins in any of the original peoples of Europe
Minority Population	MP	County residents identifying with a race or ethnic group other than white

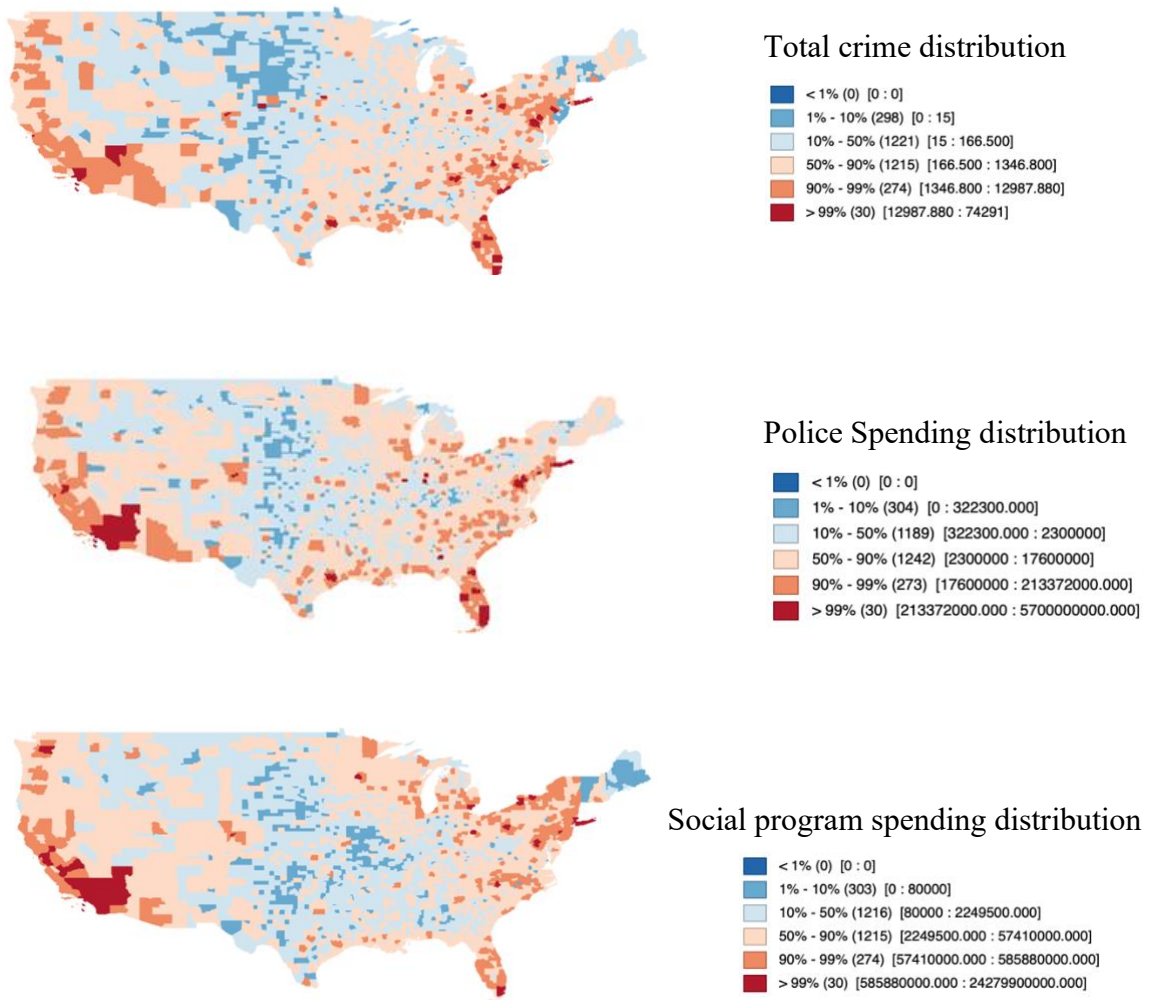


Figure 1: Distributions of total crime, police spending, and social program expenditures.

The baseline OLS model:

$$y_i = \mathbf{x}_i\boldsymbol{\beta} + \varepsilon_i$$

where \mathbf{y} is the vector of total crimes (or violent crimes or property crimes), \mathbf{x} is the matrix of independent variables, $\boldsymbol{\beta}$ is the vector of regression parameters to be estimated from the data, $\boldsymbol{\varepsilon}$ are the model residuals which are assumed as constant $\boldsymbol{\varepsilon} \sim (\mathbf{0}, \boldsymbol{\Sigma})$

The regression model can be outlined as follows:

$$TC = \alpha + \beta_1PP + \beta_2TSPE + \beta_3IIR + \beta_4UR + \beta_5PV + \beta_6Population + \beta_7WP + \beta_8MP + \varepsilon$$

VI.4 Results and Analysis

Table 1 gives the observed and expected value of Moran's I for each of the variables in the analysis. It can be seen that the socioeconomic indicators (poverty rate and unemployment rate) are the highest degree of spatial correlation, followed by the income inequality ratio and the population that identifies as white. Meanwhile, the number of crimes both violent crimes and property crimes, police spending, and social program expenditures are the lowest degree of spatial autocorrelation among the independent variables in the analysis. Nevertheless, if using spatial rate, which is each county crime rate computed in combination with their reference neighboring counties, to calculate the crime rate per 100,000 of the population, it shows strong positive spatial correlation.

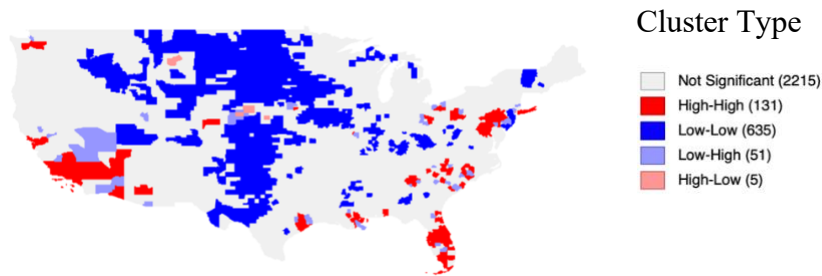
Table 1. Global Moran's I values for variables in the analysis.

Variable	Observed I	E [I]	Z [I]
Total Crime Count	0.153	-0.0003	14.81
Total Crime Spatial Rate per 100,000 of the population)	0.555	-0.0003	56.20
Violent Crime Count	0.123	-0.0003	12.04
Violent Crime Spatial Rate per 100,000 of the population	0.547	-0.0003	54.86
Property Crime Count	0.157	-0.0003	15.26
Property Crime Spatial Rate per 100,000 of the population	0.556	-0.0003	56.39
Police Spending	0.078	-0.0003	11.09
Social Program Spending	0.067	-0.0003	10.20
Income Inequality Ratio	0.375	-0.0003	34.37
Unemployment rate	0.603	-0.0003	56.89
Poverty rate	0.593	-0.0003	54.43
White population	0.390	-0.0003	35.48
Minority population	0.289	-0.0003	29.51
Population	0.343	-0.0003	32.61

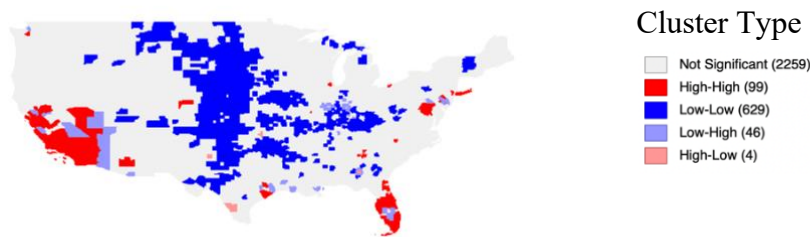
E[I]: Expected value of Moran's I

Z[I]: The observed I value's standard deviate under the Null hypothesis of no association.

Generally, the statistics behind the Global Moran's I spatial autocorrelation are designed to test the null hypothesis of spatial randomness. On the other hand, the concept of a local indicator of spatial association, or LISA, is to give the location of the clusters and an assessment of the significance of each county. The results of the analysis of local autocorrelation analysis are presented in Figure 2.



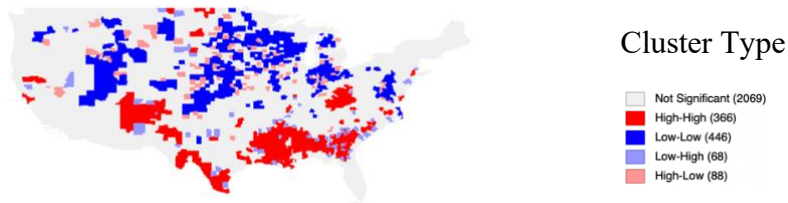
(a) Local Autocorrelation Cluster Total Crime



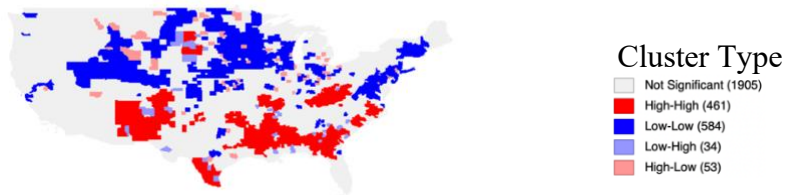
(b) Local Autocorrelation Cluster Police Spending



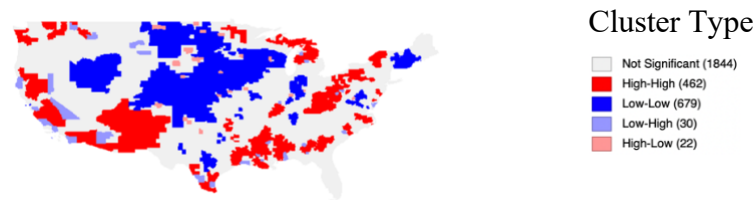
(c) Local Autocorrelation Cluster Social Program Spending



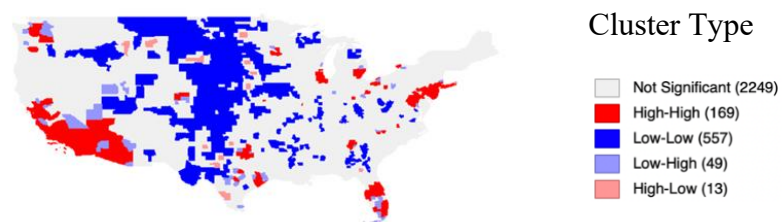
(d) Local Autocorrelation Cluster Income Inequality Ratio



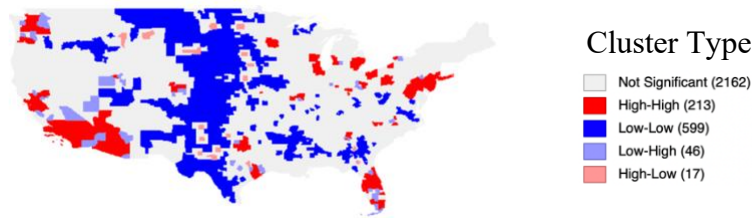
(e) Local Autocorrelation Cluster Poverty Rate



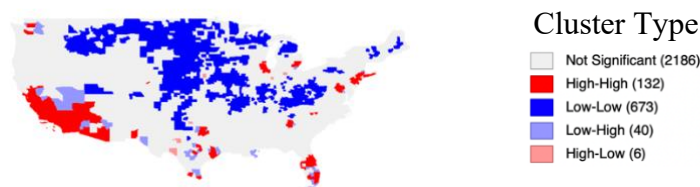
(f) Local Autocorrelation Cluster Unemployment Rate



(g) Local Autocorrelation Cluster Population



(h) Local Autocorrelation Cluster Minority Population



(j) Local Autocorrelation Cluster White Population

Figure 2. Local Autocorrelation cluster map for (a) Total Crime; (b) Police Spending; (c) Social Program; (d) Income Inequality Ratio; (e) Poverty rate; (f) Unemployment Rate; (g) Population; (h) White Population

LISA statistics allow to show what counties that have high values of each variable surrounded by neighbors that likewise have high average values for the same variable. It is defined as positive autocorrelation High-High clusters. Positive local spatial autocorrelation also can have Low-Low clusters where a county with a low value is surrounded by neighbors with a low average value. In contrast, negative local spatial autocorrelation is locations with High-Low and Low-High clusters where counties that have a high value for a variable but are surrounded by low average values for that variable, and vice versa.

Total crime exhibits high-high clusters mostly in urban areas such as Los Angeles, New York City, Orlando, Miami, New Orleans, Dallas, Philadelphia, Seattle, and Washington DC. Low-low clusters are observed mostly in the Midwest starting from the south of New Mexico up to the north of Montana. The high-high clusters indicate that counties in these clusters are observed to have high crimes and share boundaries with counties that also have high crimes. As the same

with low-low clusters, it indicates that counties with low crimes share borders with counties that also have low crimes. Correspondingly, as three distribution maps in Figure 1 indicates, high-high cluster counties tend to spend more on police and social programs to reduce crimes in the community. Additionally, counties that spend more on police and social programs have several areas of high-high clustering such as the state of Florida, Southern California, Northeast Maryland, New York City and Long Island. Again, the low-low clusters for police spending and social programs are represented in the Midwest of the country.

Socioeconomic variables including income inequality, poverty, and unemployment exhibit high-high clusters in the Deep South, New Mexico, Colorado, Arizona, and Utah. While low-low clusters are located in the counties of Wyoming, Nebraska, Iowa, Indiana, Ohio, Michigan, North and South Dakota. Despite having a high crime value and spending more on police and social programs, the state of Florida alone is an unclustered neighborhood. Population values show high-high clusters in the urban areas which focus on megacities such as Chicago, New York City, Miami, Orlando, Seattle, and cities in the southern part of California, while low-low clusters are generally observed in the central of the country. The county population that is white and minority exhibits high-high clusters again in urban areas, and low-low clusters are in the central – Midwest. The county population that is minority also shows low-low clusters in the Deep South which is consistent with settlement patterns in the United States.

Based on these results, the standard OLS model and weighted OLS regression model will be proceeded. After that, the analysis will continue to conduct based on the decision rule mentioned in the Variable subsection.

- Standard OLS model result:

Variable	Coefficient	Std.Error	t-Statistic	Probability
CONSTANT	-26480.2306547	2365.9126436	-11.1923958	0.0000000
IIR	2513.3190395	636.7676449	3.9469955	0.000809
MP	-0.0390625	98256.2164239	-0.0000004	0.9999997
PP	0.0000386	0.0000088	4.3935337	0.0000115
PV	38.5103600	85.7336852	0.4491859	0.6533297
Population	0.0468750	98256.2164239	0.0000005	0.9999996
TSPE	-0.0000043	0.0000021	-2.0161473	0.0438727
UR	-1018.1999933	273.1131134	-3.7281256	0.0001964
WP	-0.0390625	98256.2164239	-0.0000004	0.9999997

REGRESSION DIAGNOSTICS
 MULTICOLLINEARITY CONDITION NUMBER 250809741.006

TEST ON NORMALITY OF ERRORS
 TEST DF VALUE PROB
 Jarque-Bera 2 886.741 0.0000

DIAGNOSTICS FOR HETEROSKEDASTICITY
 RANDOM COEFFICIENTS
 TEST DF VALUE PROB
 Breusch-Pagan test 8 201.125 0.0000
 Koenker-Bassett test 8 1463.234 0.0000

- Weighted OLS model result:

Variable	Coefficient	Std.Error	t-Statistic	Probability
CONSTANT	-26480.2306547	2365.9126436	-11.1923958	0.0000000
IIR	2513.3190395	636.7676449	3.9469955	0.0000809
MP	-0.0390625	98256.2164239	-0.0000004	0.9999997
PP	0.0000386	0.0000088	4.3935337	0.0000115
PV	38.5103600	85.7336852	0.4491859	0.6533297
Population	0.0468750	98256.2164239	0.0000005	0.9999996
TSPE	-0.0000043	0.0000021	-2.0161473	0.0438727
UR	-1018.1999933	273.1131134	-3.7281256	0.0001964
WP	-0.0390625	98256.2164239	-0.0000004	0.9999997

REGRESSION DIAGNOSTICS				
MULTICOLLINEARITY CONDITION NUMBER		250809741.006		
TEST ON NORMALITY OF ERRORS				
TEST	DF	VALUE	PROB	
Jarque-Bera	2	886.741	0.0000	
DIAGNOSTICS FOR HETEROSKEDASTICITY				
RANDOM COEFFICIENTS				
TEST	DF	VALUE	PROB	
Breusch-Pagan test	8	201.125	0.0000	
Koenker-Bassett test	8	1463.234	0.0000	
DIAGNOSTICS FOR SPATIAL DEPENDENCE				
TEST	MI/DF	VALUE	PROB	
Lagrange Multiplier (lag)	1	2.530	0.1117	
Robust LM (lag)	1	1397.124	0.0000	
Lagrange Multiplier (error)	1	7886.474	0.0000	
Robust LM (error)	1	9281.068	0.0000	
Lagrange Multiplier (SARMA)	2	9283.598	0.0000	

The OLS model indicates that the population variable (either white or minority population) has no association with the changes in total crime. In other words, there is insufficient evidence to conclude that there is an effect at the population level. Similar to the poverty rate variable, its p-value is greater than the significance level; therefore, the poverty rate variable has no correlation with the total crime variable since it favors the null hypothesis. On the other hand, total crime will see the advantage in counties that have higher police spending, that have an increase in income equality ratio, and that have a decrease in employment rates. In contrast, total crime decreases when social program expenditures increase. The resulting value of Moran's I for the weighted least square model is -0.5958 with $p\text{-value} = 0.55132$, indicating no significant degree of global autocorrelation. The weighted OLS model also shows the Lagrange Multiplier test for error is statistically significant and the Lagrange Multiplier test for lag is statistically insignificant. Therefore, based on the decision rule, the analysis will skip the spatial lag model and proceed with the spatial error model.

Spatial Error Model result as follows:

Variable	Coefficient	Std.Error	z-Statistic	Probability
CONSTANT	21516.0754562	680.8642145	31.6011254	0.0000000
IIR	-3055.8278174	175.4949640	-17.4126240	0.0000000
MP	0.0019531	8420.0981226	0.0000002	0.9999998
PP	0.0000137	0.0000024	5.6554201	0.0000000
PV	347.2002760	24.6692788	14.0741964	0.0000000
Population	0.0014648	8420.0981226	0.0000002	0.9999999
TSPE	-0.0000012	0.0000006	-2.1195834	0.0340412
UR	-2009.0776871	81.2527905	-24.7262608	0.0000000
WP	0.0053711	8420.0981226	0.0000006	0.9999995
lambda	0.2220317	0.0276516	8.0296274	0.0000000

As suggested by $\hat{\lambda}$ ($\hat{\lambda} = 0.22 \neq 0$), there is strong evidence of positive spatial correlation. When comparing the results between the standard OLS model and the spatial error model, it is recognized that OLS does not take into account the spatial clustering in total crime, police spending, social program expenditures and other socioeconomic characteristics among neighboring counties. Now, total crime increases in counties that have higher police spending and poverty rate, and also in counties that reduce social program expenditures. The estimated coefficient for the impact of poverty rate, unemployment rate, and income equality are considerably larger compared with OLS model.

VII. Discussion and Conclusion

The utilization of the Becker's social loss model in this thesis gives a clear analysis of the impact of the probability of detection and the punishment of potential criminals. However, the case of prejudiced police officers is more complicated than combatting regular criminals. It has been proven that it is not easy to detect or convict police officers for wrongdoings. The county has already invested in body and police vehicle cameras as well as required police reports for every encounter between the police and the civilian. Police can lie on their reports, but high-quality videos and audio cannot. By doing that, the county even cannot defund but must increase its budget to pay for monitoring police work. Additionally, in big cities like New York City or Chicago, their police departments have a specific committee that handles all of the complaints of misconduct against police officers. This independent party is created as another constraint to make sure police officers understand the consequences of their behavior. And again, it will cost the county another part of its budget. Meanwhile, the county does not have much power to influence the punishment aspect because when a police officer is caught or convicted, he or she will be treated like any other alleged criminal. In theory, these checks and balances ensure the public that police officers will do their job justly and unbiasedly. In reality, the Defund the Police movement demands reductions in police force, power, weaponry/equipment, and further a cutback on police contacts, stops, arrests, and tickets. Based on Becker's crime model, that demand does not fall into any decision factors of the crime-control scheme which are the probability of conviction, the cost of punishment, and the level of intensity of racial bias. Rather the demand appears as an impulsive retaliation for the misconduct of some police officers in the force and does not serve as a deterrence mechanism.

One can argue that policymakers can make policy reform on the probability of detecting and convicting police officers who have actions that show a prejudice against a certain group of the population. But the question is what more policymakers can impose on policing? This thesis introduces a factor that could trigger or discourage racist behavior. The level of force allowed and the intensity of racist bias determine the extra utility that prejudiced police officers could gain besides the base salary. From a prejudiced police officer's perspective, the intensity will decide how much more extra utility they can gain, and the level of force allowed decides if it is worth it for him to take the risk. For instance, when the level of force allowed is sufficiently high but the

police officer still decides to proceed with racial bias because he also has a high-intensity level of racial bias, he will acquire a high or even maximum extra utility despite a greater probability of being convicted (the bigger the risk the bigger the reward). The same principle, if the level of force allowed is high but the intensity is low, the police officer will hesitate to have a racial bias. In contrast, when the level of force allowed is low, whatever the level of intensity is, the prejudiced police officer will always choose to practice racial bias in his work because the probability of being convicted is small. Policymakers cannot control the level of intensity because it depends on externalities such as cultural values, needs, beliefs, experiences, or expectations, but policymakers can set the level of force allowed. Although there are disadvantages in that approach. If the level of force allowed is too low, as the Defund of Police demands, it will give potential criminals incentives to use maximum force in order to avoid being caught. And if the level of force allowed is set too high, it will accidentally provide prejudiced police officers strong incentives to commit racial bias. The United States is known as the country that has the highest incarceration rate in the world. Therefore, policymakers have enough data on different types of encounters between the police and civilians to arrange an optimal level of force allowed that can play as a deterrence method.

In addition, the level of force allowed and the intensity are determinant elements in the social loss model of this thesis. As these variables indirectly determine the supply of offenders, policymakers can reduce the loss caused by prejudiced police officers. For instance, the smaller the intensity, restrained by the level of force allowed, the smaller the cost of paying for erroneous punishments. As this thesis focuses on the budget aspect of the demand, the budget wasted on hiring the wrong type of police officer contributes only a small amount to the total social loss from having convicted prejudiced police officers. Also, defunding the police might cause a decrease in the probability of detecting racist police officers. According to The Justice Department survey in 2016, there are more than 12,200 local police departments nationwide but nearly half of all local police departments have fewer than 10 officers. Three in 4 of the departments have no more than two dozen officers, and 9 in 10 employ fewer than 50 sworn officers⁸⁷. The majority of small police departments have already acted as community/neighborhood policing officers. Most of the police officers live in the community and have close relationships with the residents. Even if those police departments want to provide training such as use of force, diversity, or tactical response to mental health emergencies, it could be a little problematic because they cannot just shut down

entire the department for days or just send fewer officers on the streets. Thus, the demand could make an argument that instead of seeking nationwide restructuring and improving policing, the defund the police movement should be selective; specifically big cities with large police budget allocations such as New York City, Chicago, Philadelphia, San Jose, Los Angeles, Phoenix, Houston, Dallas, San Diego, or San Antonio. One thing that needs to be kept in mind is that a sudden cut in the police force/manpower could cause a surge in crimes, as a result, increasing the total loss for the community.

On the other hand, using the budget as an incentive to discourage racist behavior in the police force seems to be not a good approach. The principal-agent model presented in this thesis demonstrates that decreasing the budget might not only does not reduce racist behavior but also risks losing potential police candidates for other outside occupations. For example, even with low wages (not too low because it becomes unrealistic), prejudiced police officers still can get attracted to the police force if (1) they have a strong intensity of racial bias and (2) the job gives them opportunities to practice racial bias. In comparison with offering high wages, prejudiced police officers even gain more utilities if the county fails to monitor their interactions with civilians. Let's consider the reservation wage of a prejudiced police officer is \$100,000. He encounters 100 Black suspects and decides to catch them all due to his racial bias attitude. He earns a utility of \$50,000, so the best strategy for the county to hire prejudiced police officers is to offer a wage of \$50,000 that matches the reservation wage (the county successfully saves \$50,000). However, if 20 out of 100 Black suspects are not guilty, the county suffers disutility which will determine how much the county can save from wage costs. If the disutility is greater than \$50,000, the county fails to save its budget because they end up paying for innocent victims. Currently, modern policing procedure involves a third party such as judges, District Attorney Officers, or courts. They play a role of reducing the extra utility that prejudiced police officers earn when they practice racial bias. Except for traffic stops or responding to crimes and complaints from 911 calls, a judge has to observe evidence (the probability of guilt) before he or she can issue a warrant for the seizure of the suspect. Therefore, even if the prejudiced police officer wishes to make an arrest for his extra utility, he will be unable to do so given the warrant requirement. The point is that the budget aspect is unable to affect police behavior. Therefore, the county should rather focus on improving police policies, procedures and regulations as stronger constraints, at the same time, reasonable incentives to induce good civilians into the force.

Another aspect of the demand is to allocate the police budget into the community through social programs such as homelessness, education, after-school programs, job assistance, etc. The spatial econometric analysis in the last part of this thesis tests the relationship between those socioeconomic characteristics and crime rates. Applying regression analysis, the result gives strong evidence that the income inequality ratio, poverty rate, and unemployment rate have a statistically significant effect on the crime rate. While the non-spatial regression analysis rules out the poverty rate's impact on the crime rate, the spatial analysis confirms that the crime rate of a certain county can be explained by all of the socioeconomic characteristics and police spending in neighboring counties. Meanwhile, the variables population, white and minority population do not have a statistically significant effect on the crime rate. It opposes the biased social perception that crime rates are often higher in minority communities. There is one unexpected result from the analysis that social program expenditures have a negative correlation with the crime rate. It can be interpreted that the crime rate will increase when social program expenditures reduce and vice versa.

Beyond the patterns of crime and socioeconomic disadvantage, the results also show that the crime rate is spatially clustered, along with police spending and social program expenditures. However, the level of spatial clusters of these two main characteristics is not much (0.078 and 0.067 respectively). Places with high crime rates both violent and property crimes report significantly higher police spending which is understandable. Moreover, the spatial analysis results align with the Justice Department 2016 report in which most police spending concentrates in megacities such as New York, Chicago, Los Angeles, Miami, etc. In this analysis, rural communities do not experience very high crime rates, police spending, and social program expenditures.

While the results demonstrate an association between crime rate and neighborhood socioeconomic disadvantage, future research could include variables that are set over time if available. Anselin states that most socioeconomic phenomena coincidence in values-location is not only an instant coincidence but also a final effect of some cause that happened in the past, one which has spread through geographic space during a certain period of time⁸⁸. The purpose of space-time autocorrelation statistics in the regression analysis is to examine the effects caused by spatial interaction between certain space-time variables. Moreover, as mentioned in the Background section, the data from the Federal agency used in the analysis might not be entirely accurate and

sufficient since it depends on voluntary reports from local authorities. This limitation might cause potential misspecifications regarding the spatial effects of all related variables.

The aim of this thesis is to analyze the demand of the Defund the Police movement which rose in the mid of the national protest regarding civilians who died in police custody, especially Black people. The movement requests shifting the police annual budget to social service programs that can help improve the lives of minority groups. Using three economic models to evaluate the effect of the budget on crime rate and police behavior, it provides empirical evidence to answer three main research questions of this thesis. It can conclude that police budgeting is not a decisive factor to develop optimal policies that can combat racist behavior in the police force. Police is dangerous work because they have to face much potential violence from criminals. Plus, the United States has a gun culture where guns can be legally and easily bought by civilians. It explains why police officers often take more caution when they encounter civilians. Reducing the number of police officers or police power and weaponry might cause a negative effect of discouraging future police candidates to join the force due to safety concerns. Given this particular circumstance, policymakers might still have a long and rough path to determine if there is systematic racism in the police force, but they could focus on reinforcing policing procedures, regulations, and intensive training. Additionally, policymakers could reconstruct the independent party (such as the Complaint Committees) that monitors the police work so that it could reduce the extra utility generated by practicing racial bias.

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